Dictionary of Oil, Gas, and Petrochemical Processing





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This book is dedicated to all oil, gas, and petrochemical engineering professionals and enthusiasts, as well as those who have lost their lives and properties as regards, because without them there would not be any need for this book.

Preface

The aim of this comprehensive dictionary is to help oil, gas, and petrochemical engineering professionals, academic staff members, and science and engineering students gain a clearer understanding of the definitions and descriptions of the processes and equipment that they use every single day as well as to grasp the concepts related to the field.

When communication problems arise in the industry, the results can prove costly. This is where this dictionary can help eliminate frustration, reduce cost, cut downtime, and prevent equipment failure. It explains scientific and engineering terms in every area of the oil and gas industry, specifically for those with no technical background, and deals principally with three areas.

Engineers, students, academic staff, vendors, contract employees, and consultants can now quickly refer to key technical terms and definitions in this handy new volume. Providing a common ground for more effective communication, this dictionary is an essential reference for anyone working in the oil, gas, and petrochemical engineering industry, and it is a useful reference for students as well.

The entries are arranged alphabetically and range from a few descriptive words to lengthy descriptions of a page or more, covering key terms used in daily communication and in research and industrial activities. The definitions have been written in nontechnical jargon and clearly demonstrate the core principles and concepts.

Many terms found in this dictionary have standard definitions and can be found across a wide array of sources. The purpose of this work is to offer these definitions in a single, easily accessible format. We have carefully compiled terms from various sources, including Stream LNG, Schlumberger, US Energy Information Administration, the Society of Petroleum Engineers, British Petroleum, BHP Billiton, Santos, Woodside Petroleum, Todd Energy, Origin Energy, Anadarko Petroleum Corporation, Apache Corporation, Chevron Corporation, ConocoPhillips, Continental Resources, Devon Energy, ExxonMobil, Greka Energy, Hess Corporation, HKN, Inc. Koch Industries, Linn Energy, Marathon Oil, Murphy Oil, Occidental Petroleum, Plains Exploration & Production, SandRidge Energy, Shell Oil Company, Vaalco Energy, Venoco, XTO Energy, Seasol, Gas Strategies, InfoBiotech resources, George E. King Engineering, BG Group, Cairn Energy, Centrica/Perenco, Premier Oil, Salamander Energy, Stone Enterprises, Tullow Oil, Eni, Bayerngas, DNO International, Det Norske Oljeselskap, InterOil, Noreco, Norse Energy, Rocksource, Statoil, Canadian Natural Resources Limited, Encana, Husky Energy, Imperial Oil, Laricina Energy, Nalcor Energy, Nexen, Pacific Rubiales Energy, Penn West Exploration, PetroKazakhstan, Suncor

Energy, Syncrude, Talisman Energy, ShaMaran Petroleum Corp, PetroChina, Inpex, JAPEX, Nippon Oil, Petronas, Kuwait Oil Co, and IranOilGas Network.

Last but not least, we would like to thank the editorial team at CRC Press, Allison Shatkin, and Kathryn Everett for their editorial assistance, advice, and support during the production of this book.

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Dr. Bahadori is the author of over 200 articles and 6 books. His books have been published by prestigious publishers such as John Wiley & Sons, Springer, Taylor & Francis Group, and Elsevier. He also serves as a member of the editorial boards of a number of journals such as the *Journal of Sustainable Energy Engineering*, which is published by Wiley-Scrivener.

Chikezie Nwaoha is an independent researcher and petroleum/natural gas engineer. He graduated in petroleum engineering from the Federal University of Technology, Owerri, Nigeria. He has coedited two books, *Dictionary of Industrial Terms* and *Process Plant Equipment: Operation, Control, and Reliability*. He has also coauthored several scientific articles in leading international peer-reviewed journals. He is the downstream correspondent to *Petroleum Africa* magazine and a contributing editor to *Control Engineering Asia*, *Oil Review Africa*, *Oil & Gas Eurasia Magazine*, and *PetroMin*. He is also a member of the Society of Petroleum Engineers (SPE), Institution of Mechanical Engineers (IMechE), Occupational Safety and Health Association Nigeria (OSHAN), and the Pipeline Professionals' Association of Nigeria (PLAN). Nwaoha is a guest member of Subsea Integrity Research Group, University of Aberdeen, Aberdeen, United Kingdom, and is currently a graduate student at the Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand.

Malcolm William Clark, PhD, is a senior lecturer in the School of Environment, Science, and Engineering, Southern Cross University, Australia. He initially studied architecture and graduated with a BSc in geology and chemistry from Canterbury University, New Zealand, where he also completed his MSc (Hons) in geology, specializing in sedimentary geochemistry. He then moved to Lismore, Australia, in 1991 and undertook his PhD in environmental and engineering geochemistry at Southern Cross University, where he taught earth science and geochemistry in 1996. Between 2000 and 2008, Dr. Clark was a full-time researcher investigating the geochemistry and environmental application of waste materials, particularly the geochemistry and reuse of

bauxite refinery residues. He has industrial experience commercializing this research and has undertaken many research projects and consultancies for the mining and mineral processing industry. He has also published widely and has written over 200 scholarly works, including 6 books and book chapters, 19 patents, and 85 refereed journal and conference proceedings.

A

AACQ: See *Actual annual contract quantity.*
AB: See *Able-bodied seaman.*
Abandon: (1) The proper plugging and abandoning of a well in compliance with all applicable regulations and the cleaning up of the wellsite to the satisfaction of any governmental body having jurisdiction with respect thereto and to the reasonable satisfaction of the operator. (2) To cease efforts to find or produce from a well or field. (3) To plug a well completion and salvage material and equipment.
Abandoned Well: A well (oil, natural gas, or water injection) not in use because it was a dry hole originally or because it has ceased to produce economical quantities of oil and/or natural gas or has become unusable. Regulations require the plugging of abandoned wells to prevent the seepage of oil, gas, or water from one stratum of underlying rock to another.
Abandonment Cost: Costs associated with the abandonment of facilities or services, including costs for the removal of facilities and restoration of the land.
Abandonment/Decommissioning: Process of dismantling wellhead, production, and transportation facilities and restoration of depleted producing areas in accordance with license requirements and/or legislation.
Abandonment Pressure: The minimum pressure of the reservoir when the wells are abandoned.
Abatement: (1) The act or process of reducing the intensity of pollution. (2) The use of some method of abating pollution. (3) Putting an end to an undesirable or unlawful condition affecting the wastewater collection system. A property owner found to have inflow sources connected to the collection system may be issued a "notice of abatement." Such notices will usually describe the violation, suggest corrective measures, and grant a period of time for compliance.
Abiogenic Theory: A theory of petroleum generation in which petroleum is thought to have formed from hydrocarbons trapped inside the earth's crust when the earth was forming. See also *Biogenic theory* and *Organic theory.*
Abject Failure (Risk): A failure mode that can cause the cancellation of or immediate halt to a project or event. Generally expressed as a percent probability.
Able-Bodied Seaman: A member of an LNG crew, with three years of sea service, certified by examination to perform all the duties of an experienced seaman. A typical LNG ship carries five able-bodied seamen (ABs) in her crew complement. See *Crew.*

A

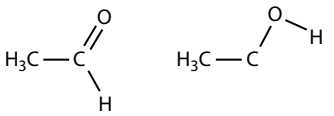
Abnormally Pressured: A pore pressure higher than a column of seawater for that true vertical depth.
Abnormal Pressure: Pressure outside the normal or expected range.
Abrasion (Geologic): A form of mechanical weathering where loose fragments are transported with water or wind.
Abrasion (Mechanical): Wearing away by friction.
Abrasive: Particles propelled at a velocity sufficient to cause cleaning or wearing away of a surface.
Abrasive Jetting: A perforating process involving pumping a slurry of liquid and size particles through a nozzle to cut through steel and rock.
ABS: American Bureau of Shipping.
Absolute Ages: Estimation/measurement of age of a formation, fossil, etc., in years before the present.
Absolute Filter Level: A filter rating that purports to set the maximum size of an opening in a filter or the maximum size of the particle that can pass through the filter. The definition varies with use and company.
Absolute Open Flow: The maximum rate that a well can produce at the lowest possible bottom-hole pressure (usually figured with a gas gradient).
Absolute Open Flow Potential: The theoretical maximum flow that a well could deliver with a zero back pressure at the middle of the perforations.
Absolute Permeability: Permeability to a single-phase fluid in a cleaned core.
Absolute Porosity: The percentage of the total bulk volume, that is, pore spaces, voids, or fractures.
Absolute Pressure: (1) The reading of gage pressure plus the atmospheric pressure. (2) Gage pressure plus barometric or atmospheric pressure. Absolute pressure can be zero only in a perfect vacuum. See *Pressure, absolute (psia)*.
Absolute Temperature: Temperature measurement starting at absolute zero (total absence of heat).
Absolute Viscosity: The measure of a fluid's ability to resist flow without regard to its density. It is defined as a fluid's kinematic viscosity multiplied by its density.
Absolute Volume: The volume a solid occupies when added to a fluid divided by its weight. m^3/kg or gal/lb.
Absolute Zero: Zero point on the absolute temperature scale; equal to −273.16°C, or 0 K, or −459.69°F, or 0°R.
Absorb: To fill part or all of the pore spaces.
Absorber or Contactor: (1) Equipment in acid gas removal units where neutralization reactions of acid gases is achieved using amines or carbonates. (2) A vertical, cylindrical vessel that recovers heavier (longer carbon chain) hydrocarbons from a mixture of lighter hydrocarbons.
Absorptance (Seismic): The ratio of the energy absorbed by a formation in relationship to the total energy passing through it.

Absorption: (1) The penetration of atoms, ions, or molecules into the bulk mass of a substance. (2) A physicochemical process in which a substance associates with another to form a homogeneous mixture presenting the characteristics of a solution. (3) Not to be confused with adsorption; absorption is one substance that is taken up into the interior of another—adsorption with a "d" is entirely a surface effect. Examples are the swelling of a poly(acrylamide) polymer with aqueous solution (in a disposable nappy) or the dissolution of carbon dioxide in seawater (one of the possible antidotes to global warming that crops up in models of world climate. (4) The disappearance of one substance into another so that the absorbed substance loses its identifying characteristics, while the absorbing substance retains most of its original physical aspects. Used in refining to selectively remove specific components from process streams.
Absorption Gasoline: Gasoline extracted from wet natural gas by putting the gas in contact with oil.
Absorption Oil (Facilities): The wash oil used to remove heavier hydrocarbons from the gas stream.
Absorption (Processing): The ability of one material to absorb another.
ABS (Plastic): Acrylonitrile–butadiene–styrene.
Abyssal: Depositional environment of the deepest areas of the oceans.
Abyssal Plain: Large, flat ocean floor, usually near a continent and usually over 4 km (13,100 ft) ss.
AC: See *Alternating current*.
AC: See *Asphalt cement*.
ACA: See *After closure analysis*.
Accelerator (Chemical): A chemical that speeds up the rate of a chemical reaction. Most common are the accelerators used in cementing.
Accelerator (Drilling): An energy-increasing device, with sudden energy release, used in a jarring string while fishing.
Access: A stipulation in contracts allowing market players to charge for the use of capacity in a pipeline or gas facility.
Accommodation: Place where personnel spend their off-duty time on a rig.
Accommodation Platform/Rig: An offshore platform, or semisubmersible rig, built or adapted to provide living quarters for drilling and production personnel.
Accounting Depreciation: The expense that reflects the use of a capital asset during a period. This is both a cost in the income statement (representing the cost of using the asset during the year) and a reduction in the value of the asset on the balance sheet. The depreciation is generally charged on a unit of production basis.
Accounting Discount Rate: The discount rate used for the calculation of decommissioning provisions.
Accounts Receivable: The value of money due from customers at the balance sheet date relating to oil sales and tariff income.
Accretion: The action of particles forming adhering clumps on pipe.
Accumulated Depreciation: The total depreciation attributable to an asset that has built up over the lifetime of the asset.

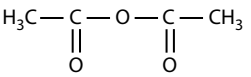
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Accumulation (Reservoir): An economic quantity of hydrocarbon trapped in a permeable rock stratum.
Accumulator: The storage device for nitrogen-pressurized hydraulic fluid, which is used in operating the blowout preventers.
Accumulator Precharge: The initial nitrogen charge on a BOP accumulator that is placed before the fluid is pumped in to charge the accumulator.
Accumulator (Pressure Control Device): Canisters of hydraulic fluid, pressurized with a nitrogen gas cap of sufficient pressure and volume to operate all the rams on a BOP in case of power failure to the BOP.
Accumulator (Processing Plant): A vessel that receives and temporarily stores a liquid used in the feedstock or the processing of a feed stream in a gas plant or other processing facility.
Accuracy: The closeness of agreement between the measured value and the exact value.
Acetaldehyde: This is a good example of a case where the IUPAC system may be logical, but can easily engender no end of confusion.

Ethanol and ethanal are very different:



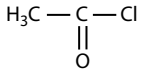
Acetic Acid: (1) A very weak organic acid used for minor and shallow damage removal. Also used as a moderately effective iron precipitation preventer. Vinegar is 4% acetic acid. (2) An organic acid compound sometimes used to acidize oil wells.
ACFM: Actual cubic feet per minute.
Acid: (1) There are three definitions: Those of Arrhenius, Bronsted, and Lewis acids. In the Lewis conception, which is the most general and useful, an acid is essentially any compound that needs electrons, and a base is basically any compound that wants to give them away. (2) A reactive material with a low pH. Common oil field mineral acids are HCl and HCl/HF.
Acid Anhydride: Take two carboxylic acid molecules—for example, salicylic acid—and remove water to give a molecule containing a –(C=O)–O–(C=O)– link—this molecule will be an acid anhydride. For example, ethanoic anhydride:



Ethanoic anhydride (aka acetic anhydride)

Acid Brittleness: Low ductility of a metal due to its adsorption of hydrogen. More commonly called hydrogen embrittlement.

Acid Chloride: Take a carboxylic acid and replace the OH group with a chlorine atom. What you now have is an acid chloride. Acid chlorides react readily with water to regenerate carboxylic acid + HCl. For example, ethanoyl chloride:



Acid Effect: The change in pulsed neutron capture created by acidizing a carbonate. Acidizing increases interconnected porosity and strands chlorides and other ions in the rock.
Acid Flowback Analysis: Chemical analysis of the acid concentration and other chemical and physical measurements in the returning acid.
Acid Fracture: (1) To fracture stimulate a formation by injecting the acid over the parting pressure of the rock and using the acid to etch channels in the fracture face. (2) To part or open fractures in limestone formations by using fluid under hydraulic pressure.
Acid Gas: (1) A gas that contains compounds such as CO_2, H_2S, or mercaptans that can form an acid in solution with water. (2) Group of gases that are found in raw natural gas and are usually considered pollutants. Among them are CO_2, H_2S, and mercaptans. (3) Any produced gas, primarily H_2S and CO_2, that forms an acid when produced in water.
Acid Inhibitor: Acid corrosion inhibitor. Slows the acid attack on metal.
Acidity: The capacity of water or wastewater to neutralize bases. Acidity is expressed in milligrams per liter of equivalent calcium carbonate. Acidity is not the same as pH because water does not have to be strongly acidic (low pH) to have a high acidity. Acidity is a measure of how much base must be added to a liquid to raise the pH to 8.2.
Acidization: Also referred to as acid treatment. A process whereby acid is squeezed into tight and/or damaged (usually limestone/chalk) reservoirs to improve the flow of hydrocarbons to the well. The acid dissolves a portion of the rock, thereby improving the porosity and permeability characteristics of the reservoir.
Acidize: To treat formations with acid for the purpose of increasing production.
Acidizing a Well: A technique for increasing the flow of oil from a well. Hydrochloric acid is pumped into the well under high pressure to reopen and enlarge the pores in the oil-bearing limestone formations.
Acid Number: A measure of the amount of potassium hydroxide (KOH) needed to neutralize all or part of the acidity of a petroleum product. Also specified as neutralization number (NN) or value (NV) and total acid number (TAN).
Acid Solubility: The percent by weight loss of exposing a sample of material to an excess of acid.

A

Acid Stick: A solid stick of chloroacetic or sulfamic acid for small-scale removal of acid-soluble deposits.

Acid Stimulation: (1) Form of hydrochloric acid is pumped down well hole to enlarge pore space in oil-bearing rocks to increase flow and recovery. (2) A well stimulation method using acid. See *Acidize*.

Acid Treating: Process in which unfinished petroleum products, such as gasoline, naphthas, kerosene, diesel fuel, and lubricating oil stocks, are contacted with sulfuric acid to improved their color, odor, and other properties.

Acid Treatment: A refining process in which unfinished petroleum products such as gasoline, naphthas kerosene, diesel fuels, and lubricating stocks are treated with sulfuric acid to improve color, odor, and other properties.

Acoustic Basement: Formations below the deepest zones that can be imaged by an acoustic process.

Acoustic Impedance: The velocity of an imposed sound wave (acoustic velocity) through a rock times the density of the rock.

Acoustic Log: (1) Record of time taken by a sound wave to travel over a certain distance through geologic formations. (2) A generic term for a well log that displays any of several measurements of acoustic waves in rocks exposed in a borehole, for example, compressional-wave transmit time over an interval (sonic log) or relative amplitude (cement bond log).

Acoustic Logging: A sonic travel time record of a formation using a tool with an emitter and a detector. Measures porosity and is useful to compare to other porosity logs to estimate pore filling. Also used to generate rock strength evaluations.

Acoustic Travel Time: The total time required for an acoustic wave to travel through a substance.

Acoustic Velocity: Velocity of an imposed sound wave through a rock.

ACQ: See *Annual Contract Quantity.*

Acquiring Shipper: In the context of capacity release, a shipper who acquires firm capacity rights from a releasing shipper. Also known as "replacement shipper." See *Capacity (gas).*

Acquisition Log: The raw, real-time recording of data, later formed into a digital or playback log.

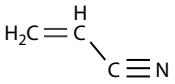
Acreage: (1) An area covered by a lease granted for oil and gas exploration. (2) Land leased for drilling exploration. (3) Land leased for oil and gas exploration and development; usually descriptive of more than one lease.

Acre-Feet: One acre (43,560 ft^2) to a depth of 1 ft.

Acrylamide Polymer: A nonionic polymer (polyacrylamide) used in flocculation, clarifying, and even gelling acids and other brines. Very stable, but difficult to effectively break.

Acrylic: A resin polymerized from one of several sources: acrylonitrile, acrylic acid, methacrylic acid, etc.

Acrylonitrile: A common monomer used in free-radical polymerization. Here is a picture:



Acrylonitrile is one of the more toxic monomers and is a proven carcinogen; one of its main applications is in the production of carbon fibers.

ACS: American Chemical Society.

AC Test Dust™: A precision-sized micron particle material used for testing the solid stopping capability of filters.

Activated Carbon: (1) Adsorptive particles or granules of carbon usually obtained by heating carbon (such as wood). These particles or granules have a high capacity to selectively remove certain trace and soluble materials from water. (2) A highly porous solid, usually a charcoal. Used for adsorption of unwanted materials.

Activated Sludge: Sludge particles produced in raw or settled wastewater (primary effluent) by the growth of organisms (including zoogleal bacteria) in aeration tanks in the presence of dissolved oxygen. The term "activated" comes from the fact that the particles are teeming with bacteria, fungi, and protozoa. Activated sludge is different from primary sludge in that the sludge particles contain many living organisms that can feed on the incoming wastewater.

Activated Sludge Process: A biological wastewater treatment process that speeds up the decomposition of wastes in the wastewater being treated. Activated sludge is added to wastewater and the mixture (mixed liquid) is aerated and agitated. After some time in the aeration tank, the activated sludge is allowed to settle out by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank) as needed. The remaining wastewater then undergoes more treatment.

Activation Logging: Near formation area is irradiated with neutrons that transform some nuclei into isotopes. The isotopes produced can be detected by radioactive energy levels and decay time. The original elements can be described from this behavior.

Activator: A chemical, heat, radiation, or mechanical action that starts or accelerates a chemical reaction.

Active: A corrosion state where a metal is corroding without control by a reaction product (or corrosion product layer).

Active Center: In chain-growth polymerization, the highly reactive spot on the growing polymer chain where new monomer is added. The four most common types are a free-radical (atom with an unpaired electron), carbanion (carbon-centered negative ion), carbocation (carbon-centered positive ion), or a metal complex (as in Ziegler–Natta polymerization).

A

Active Well: A well in mechanical condition for production or service use (i.e., in active production or service use).
Actual Annual Contract Quantity: The amount of LNG a buyer physically takes delivery of during a year under a long-term supply contract.
Actuals: Physical cash commodities, as opposed to future commodities.
Actuator: A device that, by remote influence, can operate valves or other equipment.
AD: Assistant driller.
Adaptor: A piece of equipment that connects pipe, flanges, or other equipment with different root threads or connection mechanisms.
Adaptor Spool: An adaptor that allows BOPs to be connected to wellhead flanges of various sizes.
ADB: See *Asian Development Bank*.
Addition Polymerization: Also known as chain-growth polymerization. The mechanism in which large numbers of usually identical small molecules are joined together to rapidly form a single large molecule. This involves the addition of a reactive center (anion, cation, or unpaired electron) to a multiple bond to form a new bond and a new reactive center—which reacts with another multiple bond, etc. The finished chain then hangs around without reacting while more of the starting material reacts to form new polymer chains.
Additive: (1) A chemical substance that, when blended with a petroleum product, has the effect of improving one or more of its properties or performance characteristics. (2) Any materials incorporated in finished petroleum products for improving their performance in existing applications or for broadening the areas of their utility. (3) A compound incorporated into a gas, liquid, or solid system to alter the properties for a particular purpose.
Adhesion: Attractive forces between unlike molecules or compounds. For example, the attractive forces between water molecules and the walls of a clean glass tube are stronger than the cohesive forces; this leads to an upward turned contact or meniscus at the wall.
Adiabatic: (1) No exchange of heat with the surroundings. (2) A term describing a thermodynamic process in which no heat is added to or removed from the system.
Adit: A passage driven from the surface into the mine, also known as a drift.
Adjustable Choke: A pressure step-reduction choke that can be changed while actively flowing the well.
Admeasurements: The confirmed or official dimensions of an LNG ship.
ADO: See *Average daily quantity*.
ADP: See *Annual delivery program*.
ADP (Training): Accelerated development program.
Adsorb: A process where a gas molecule attaches itself to a surface, such as in a coal seam or in a shale formation.
Adsorption: (1) Not to be confused with absorption, adsorption is the buildup of a molecule at a surface (such as an oil/water interface). Adsorption generally occurs because different parts of a molecule have an affinity for the two different

phases on either side of the interface. (2) A physical process in which the molecules of a gas of dissolved substances or of liquids adhere in extremely thin layers to the exposed surface of solid substances with which they come into contact.
Adsorption Band (Seismic): The range of wavelength energy that can be adsorbed by a given formation.
Advanced Turbine Systems: Industrial gas turbines, approximately 5 and 15 MW in capacity, for distributed generation, industrial, and cogeneration markets; and gas turbines, combined-cycle systems, 400 MW, for large, baseload, central-station, electric-power generation markets. ATS expectations are to meet or exceed 60% system efficiencies in the utility market and to increase efficiencies of industrial turbines by 15%. The new turbines emit far less nitrogen oxides, carbon dioxide, and unburned hydrocarbons than current gas turbine systems. See *Combined-cycle gas turbine*.
Advanced Waste Treatment: Any process of water renovation that upgrades treated wastewater to meet specific reuse requirements. It may include general cleanup of water or removal of specific parts of wastes insufficiently removed by conventional treatment processes. Typical processes include chemical treatment and pressure filtration. Also called "tertiary treatment."
Aeration: (1) Introduction of air. (2) The process of adding air to water. Air can be added to water by either passing air through water or passing water through air. In wastewater treatment, air is added to freshen wastewater and to keep solids in suspension. With mixtures of wastewater and activated sludge, adding air helps mixing and provides oxygen for the microorganisms treating the wastewater. (3) The introduction of air or gas into a liquid.
Aeration Liquor: Mixed liquor. The contents of the aeration tank including living organisms and material carried into the tank by either untreated wastewater or primary effluent.
Aeration Tank: The tank where raw or settled wastewater is mixed with return sludge and aerated. The same as "aeration bay," "aerator," or "reactor."
Aerobic: A condition in which dissolved oxygen is present in the aquatic (water) environment.
Aerobic Bacteria: Bacteria that will live and reproduce only in an environment containing oxygen that is available for their respiration (breathing), namely, atmospheric oxygen or oxygen dissolved in water. Oxygen combined chemically, such as in water molecules (H_2O), cannot be used for respiration by aerobic bacteria.
Aerobic Decomposition: Decomposition and decay of organic material in the presence of "free" or dissolved oxygen.
Aerobic Digestion: The breakdown of wastes by microorganisms in the presence of dissolved oxygen. This digestion process may be used to treat only waste-activated sludge, or trickling filter sludge and primary (raw) sludge, or waste sludge from activated sludge treatment plants designed without primary settling. The sludge to be treated is placed in a large aerated tank where aerobic microorganisms decompose the organic matter in the sludge. This is an extension of the activated sludge process.

A

Aerobic Process: A waste treatment process conducted under aerobic (in the presence of "free" or dissolved oxygen) conditions.
Aeroderivative Turbine: An industrial gas turbine, the design of which is derived from aerospace turbines, generally between 10 and 50 MW.
AFE (Expense): Authority for expenditure on a well (authorized funds for drilling or workover).
AFE (Well Operation): Annular fluid expansion.
AFLAS: A high-temperature seal elastomer.
AFP: Annular friction pressure.
After Closure Analysis: A fracture performance test method.
After Cooler: Heat exchanger for cooling gas after compression.
Aftermarket Conversion: A standard, conventionally fueled, factory-produced vehicle to which equipment has been added that enables the vehicle to operate on an alternative fuel.
AFUDC: Allowance for funds used during construction.
AFV: Annular flow valve.
AGA: American Gas Association.
Agate: Siliceous rock with alternating bands of chalcedony and colored chert.
Agency Service: An arrangement that allows a gas buyer to give an agent authority to act on the buyer's behalf to arrange or administer pipeline transportation and/or sales services.
Agglomerates: Larger particles of material made up of small, independent pieces.
Agglomeration: (1) A concentration process based on the adhesion of pulp particles to water. (2) Forming larger droplets, bubbles, or particles from smaller droplets, bubbles, or particles. (3) The grouping, or coming together of dispersed suspended matter into larger particles, called "iloc," which settle more rapidly.
Aggregate (Cementing): An essentially inert mixture of particles of a particular size range.
Aggregate Receipt Points: (1) A hub where different supply sources intersect on a gas pipeline; (2) multiple producer meters entering a pipeline. See *Hub or market center.*
Aggregation: Attraction and adherence of clumps of small particles.
Aggregator: (1) Acts on behalf of groups of producers to collect producer supplies and sell the gas in commingled blocks to end users. Prior to deregulation, a limited number of aggregators operated. Aggregators do not take title to the gas but simply find markets and negotiate prices for pools of producers. Also called core transport agent. (2) Also a firm that bargains on behalf of a large group of consumers to achieve the lowest possible price for utilities such as electricity and gas. The firm "aggregates or combines many smaller customers into one large customer for purposes of negotiation and then purchases the utility commodity on behalf of the group."

Aging: The change in physical properties of raw materials that are being stored. They change slowly at room temperature and quicker at higher temperatures.
AHD (Depth): Along hole depth or measured depth.
AHV (Subsea): Anchor handling vessel.
Air: Standard density of dry air, free of CO_2 at 0°C, is 1.292 g/L.
Air Blower: A device used to ventilate manholes and lift stations.
Air Can: Buoyancy device on a spar.
Air Changes: Expression of the amount of air movement or air leakage into or out of a building in terms of the number of building volumes or room volumes exchanged.
Air Conditioner: Assembly of equipment for the simultaneous control of air temperature, relative humidity, purity, and motion.
Air-Conditioning System: Assembly of equipment for air treatment to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of a conditioned space.
Air Cooler: Heat exchanger that produces cooling and/or condensation of a fluid using a fan-forced flow of ambient air. The fluid flows through the inner side of a bundle of tubes provided with external fins to increase the exchange surface.
Air Density: Equal to 0.763 lb/ft^3 at standard temperature and pressure.
Air-Dried Basis: Analysis of a coal sample articulated by the moisture content in equilibrium with the surrounding atmosphere.
Air Drilling: (1) Drilling with air instead of drilling mud (requires diverters at the surface to handle cuttings and formation fluids). (2) A rotary drilling technique in which compressed air is used instead of fluids to circulate, or bring to the surface, bits of rock and other cuttings from the drill bit.
Air Gap: (1) The clearance between the highest water surface that occurs during the extreme environmental conditions and the underside of the deck. (2) In plumbing, an unobstructed vertical distance through free atmosphere between the opening of a pipe or faucet supplying water to a tank and the water surface of the tank at flood level.
Air Gun: (1) Seismic source for ocean seismic work. (2) Chamber from which compressed air is released to produce shock waves. The air gun is the most common technique used for seismic surveys at sea.
Air Handling Unit: Consists of a fan and one or more coils (heating and/or cooling), filters, mixing boxes, dampers, and their associated controls. Typically the fan and the coils are mounted within a single cabinet.
Air Hoist: A hoist operated by compressed air; a pneumatic hoist. Air hoists are often mounted on the rig floor and may be used to lift joints of pipe and other heavy objects.
Air Injection: An enhanced recovery technique in which air is injected into the petroleum formation to increase reservoir pressure.
Airlift: (1) A production technique in which an air balance beam pumping unit is used to lift oil to the surface. (2) A surface piston-driven pumping

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unit, similar to a beam lift unit. (3) A device for raising liquids by injecting air near the bottom of a riser pipe submerged in the liquid.

Air Pollutant: Any material emitted into the atmosphere either by human activity or natural processes and adversely affecting man or the environment.

Air Pollution: Usually the presence of substances in the atmosphere resulting either from human activity or natural processes, present in sufficient concentration, for a sufficient time, and under circumstances such as to interfere with comfort, health, or welfare of people or the environment.

Air Stripping: Remediation technique to strip volatile contaminants from contaminated groundwater after a spill. It works to oxidize components and to activate bacteria that can digest hydrocarbons.

Air-To-Air Heat Exchanger: Exchanger that transfers heat from an exhaust airstream to a separated supply airstream.

Air Weight: The weight of a string in air without the effect of buoyancy provided by wellbore fluids.

AIS: Annular isolation sleeve.

Akubras: We thought we would put this in because we have met people from New Zealand who didn't know what they were and understand that there are a few New Zealanders in New South Wales. Akubras are a kind of you beaut hat that all real Ostrayans (e.g., Greg Norman) wear.

AL: Artificial lift.

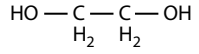
ALARA: As low as reasonably achievable.

Alarm Point: Preset value of a monitored parameter at which an alarm is actuated to warn of a condition that requires corrective action.

Albian: The oldest terrain from the Cretaceous period.

Alcohol: (1) The family name of a group of organic chemical compounds composed of carbon, hydrogen, and oxygen. A series of molecules vary in chain length and are composed of a hydrocarbon plus a hydroxyl group; $CH_3–(CH_2)_n–OH$ (e.g., methanol, ethanol, and tertiary butyl alcohol). (2) Any chemical compound where the hydroxy functional group –O–H is bound to a carbon skeleton. You are probably most familiar with the diols (compounds with two hydroxy groups), which are used in the manufacture of polyesters, and the phenols, where a hydroxy group is bound to an arene.

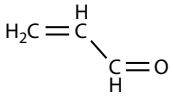
A commonly used diol is 1,2-ethanediol, while fulvic acid is a common environmental phenol:



Alcohols: The family name of a group of organic chemical compounds composed of carbon, hydrogen, and oxygen. A series of molecules vary in chain length and are composed of a hydrocarbon, plus a hydroxyl group (e.g., methanol, ethanol, and tertiary butyl alcohol).

Aldehydes: (1) One of several families of compounds formed as products of incomplete combustion in engines using gasoline, methanol, ethanol,

propane, or natural gas as fuels. As a general rule of thumb, the presence of methanol or methyl ethers in the fuel will lead to formaldehyde as the primary aldehyde in the exhaust, while ethanol or ethyl ethers will lead to acetaldehyde as the primary aldehyde in the exhaust. In both cases, other aldehydes are present, but in much smaller quantities. Formaldehyde and acetaldehyde are toxic and possibly carcinogenic. (2) Any chemical compound containing the functional group –C(O)H. Acrolein, the simplest aldehyde that is also a monomer capable of undergoing addition polymerization, is responsible for the distinctive smell of burning fat. Here is a picture:



Alfred Nobel: A Swedish inventor, businessman, and famous posthumous philanthropist (1833–1896). He developed the mercury percussion detonator (1863) and numerous other advances in explosives technology to make blasting safer and easier. He made a lot of money, which he left in his will to provide prizes for people whose work had been of great benefit to humanity and economists. See *Nobel Prize*.

ALG: Algerian.

Algae: Microscopic plants that contain chlorophyll and live floating or suspended in water. They also may be attached to structures, rocks, or other similar substances. Algae produce oxygen during sunlight hours and use oxygen during the night hours. Their biological activities appreciably affect the pH and dissolved oxygen of the water.

Algal Bloom: Sudden, massive growths of microscopic and macroscopic plant life, such as green or blue-green algae, which develop in lakes and reservoirs.

Algicide: Any substance that will kill algae.

Aliphatic: Carbon and hydrogen compounds that may be branched or straight chained. Aliphatics may be paraffin (saturated) or olefinic (unsaturated).

Aliphatic Hydrocarbon: (1) Hydrocarbons in which the carbon atoms are arranged in open chains that may be straight or branched. (2) Organic hydrocarbon compounds in which the carbon atoms are joined in open chains, as opposed to ring structures of aromatic and naphthenic compounds. Examples are ethane, propane, and butane. Many are building blocks for petrochemicals.

Aliquot: Portion of a sample.

Alkali: (1) Any of certain soluble salts, principally of sodium, potassium, magnesium, and calcium, that combine with acids to form neutral salts and may be used in chemical processes such as water or wastewater treatment. Examples include calcium carbonate, sodium hydroxide, and sodium bicarbonate. (2) A strongly basic solution.

Alkali Metal: A strongly basic metal such as sodium or potassium.

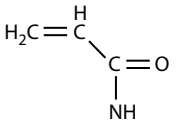
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Alkaline: (1) The condition of water or soil that contains a sufficient amount of alkali substances to raise the pH above 7.0. (2) Forming or containing an alkali, and by extension, any base. Strictly speaking, an alkali is the hydroxide or carbonate salt of an element in the first two columns of the periodic table (those unstable alkali and alkaline earth metal things). (3) Basic or pH over 7.
Alkaline Flooding: Large-scale injection of pH > 7 fluids. The basic materials may react with oils to form reactants that can reduce viscosity or affect wetting.
Alkalinity: The capacity of water or wastewater to neutralize acids. This capacity is caused by the water's content of carbonate, bicarbonate, hydroxide and occasionally borate, silicate, and phosphate. Alkalinity is expressed in milligrams per liter of equivalent calcium carbonate. Alkalinity is not the same as pH because water does not have to be strongly basic (high pH) to have a high alkalinity. Alkalinity is a measure of how much acid must be added to a liquid to lower the pH to 4.5.
Alkane: (1) Carbon compound containing only carbon and hydrogen and single bonds only. (2) Straight or branched chain hydrocarbons with single-bonded carbon atoms. Describes most oils.
Alkanoic Acid: The proper IUPAC term for what we typically call carboxylic acids.
Alkenes: (1) Carbon compounds containing carbon and hydrogen incorporating one or more double bonds. (2) Straight or branched chain chemicals with some double bonds between carbons.
Alkyd: A resin formed by reaction of polyhydric alcohols and polybasic salts. Saturated or unsaturated oils or fats are involved.
Alkylate: The product of an alkylation reaction. It usually refers to the high-octane product from alkylation units. This alkylate is used in blending high-octane gasoline.
Alkylation: (1) A refining process for chemically combining isobutane with olefin hydrocarbons (e.g., propylene, butylene) through the control of temperature and pressure in the presence of an acid catalyst, usually sulfuric acid or hydrofluoric acid. The product, alkylate, an isoparaffin, has high-octane value and is blended with motor and aviation gasoline to improve the antiknock value of the fuel. (2) A refinery process for chemically combining isoparaffin with olefin hydrocarbons. The product, alkylate, has high-octane value and is blended with motor and aviation gasoline to improve the antiknock value of the fuel.
Alkyl Halide: A carbon compound containing a covalent bond between a halogen (fluorine, chlorine, bromine, iodine) and an alkane.
Alkyne: Carbon compound containing carbon and hydrogen incorporating one or more triple bonds.
Allocated Pool: A pool in which the total oil or gas production is restricted and allocated to specific wells as defined in a proration agreement.
Allocation: The process of determining ownership of hydrocarbons delivered to the meter or LACT unit on a lease.

Allocation Method: A method of allocating volumes to affected parties when an imbalance occurs.
Allochthonous: Formations transported by fault or similar earth shift movements.
Allogenic: Rock constituents and minerals derived elsewhere from older formations and redeposited.
Allowable: The production limit set on a specific well by a government regulatory body. Rarely seen.
Allowable Working Pressure or Stress: The maximum stress allowed by code or other agreement or study as a fraction of test pressure. Design pressure of the system is related to hoop stress.
Alloy: A composition of two or more metals.
Alluvial Fan: Land counterpart of a river delta. Characteristic of sediments that have been transported by a fast-moving stream, then dropped out of the flow as the stream velocity drops as it spreads out. Typical of zones of heavy water runoff such as those found at the base of mountains in arid and semiarid climates where flash floods may be seen. Often poorly sorted with pebble to boulder-sized sediments. Weak cementing typical.
Alluvium: (1) Unconsolidated to well sorted to poorly sorted (gravel to sand sized) particles transported by water. (2) A deposit of rock materials such as clay, silt, and sand that have been transported by flowing water.
Alpha Decay: Radioactive decay process where the loss of an alpha particle from the nucleus lowers the atomic number by two and the atomic mass by four.
Alpha Wave: The initial wave of gravel transport when packing a well with a deviation over 55°.
Alternate Path Technology: A patented screen design that allows gravel-packing slurry to flow past an annular bridge point that would normally stop the placement of gravel.
Alternating Current: Electrical current that reverses direction repeatedly and rapidly. The change in current is due to a change in voltage that occurs at the same frequency.
Alternative Fuel: As defined pursuant to the EPACT, methanol, denatured ethanol, and other alcohols, separately or in mixtures of 85% by volume or more (or other percentage not less than 70 as determined by the DOE rule) with gasoline or other fuels, CNG, LNG, LPG, hydrogen, coal-derived liquid fuels, fuels other than alcohols derived from biological materials, electricity, or any other fuel determined to be substantially not petroleum and yielding substantial energy security benefits and substantial environmental benefits.
Alternative Fuel Capability: The on-site availability of a power plant to burn more than one fuel.
Alternative-Fueled Vehicle: A vehicle either designed and manufactured by an original equipment manufacturer or a converted vehicle designed to operate in either dual-fuel, flexible-fuel, or dedicated modes on fuels other than gasoline or diesel. This does not include a conventional vehicle that is limited to operation on blended or reformulated gasoline fuels.

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Alternative-Fueled Vehicle Converter: An organization (including companies, government agencies, and utilities) or an individual who performs conversions involving alternative-fueled vehicles. An AFV converter can convert (1) conventionally fueled vehicles to AFV's, (2) AFV's to conventionally fueled vehicles, or (3) AFV's to another alternative fuel.
Alum: Aluminum and potassium sulfate compound. Used was water clarifying.
Aluminum Activation Log: An investigation that focuses on aluminum content, an indirect measurement of clay content.
Aluminum Stearate: A mud degasser chemical.
Ambient Air: Surrounding air (usually outdoor air or the air in an enclosure under study).
Ambient Temperature: (1) Environmental temperature unaffected by other heat sources, such as radiation from artificial objects. (2) The temperature of the surroundings, usually an average surface temperature or test surface temperature.
American Candle: A standard candle whose illuminating power is sometimes employed as a unit in determining this characteristic of kerosene. Other units are the International and Hefner candles.
American Melting Point: Used for paraffin wax, it is an arbitrary 3°F above the ASTM D87 test for melting point of paraffin wax.
American National Standards Institute: (1) The coordinating organization for US federated national standards system. (2) A nonprofit organization (501(c)3) that administers and coordinates voluntary standardization and conformity assessment system.
American Petroleum Institute: A trade association and standards organization that represents the interests of the oil and gas industry. It offers publications regarding standards, recommended practices, and other industry-related information.
American Society for Testing and Materials: (1) An organization that develops and publishes technical standards for an extensive range of materials and products. (2) The ASTM sets standards, quality specifications, and standard test procedures for determining the quality of petroleum products.
Amide: Any carbon compound containing the functional group –C(O)NH. Acrylamide, CH_2=CH–C(O)NH, is one of the nastiest pieces of work you could hope to come across, but poly(acrylamide) is an innocuous compound found in disposable nappies. Get a disposable nappy and tear it open; you will find cottony padding stuff and a gritty substance—this grit is small particles of cross-linked poly(acrylamide):



Acrylamide

Amination: Use of ammonia–nitrogen by bacteria to form new bacteria.
Amine: (1) Any carbon compound containing the nitrogen bound only to carbon or hydrogen. The functional group for a *primary* amine is $–NH_2$, for a *secondary* amine –NH–, and for a *tertiary* amine nitrogen bound to the three carbon chains. Amino acids are carbon compounds containing both amine and carboxylic acid groups—for example, glycine, $NH_2–CH_2–COOH$ (biochemists give this compound the symbol (G)). (2) Organic base used in refining operations to absorb acidic gases (H_2S, COS, CO_2) occurring in process streams. Two common amines are monoethanolamine (MEA) and diethanolamine (DEA).
Amine Unit: A natural gas treatment unit for removing contaminants (H_2S, COS, CO_2) by the use of amines. Amine units are often skid-mounted, so they can be moved to the site of new gas production. Gas containing H_2S and other impurities must be cleaned up before it is acceptable to gas transmission pipelines.
Amino Acid: A carbon compound containing both an amine (NH_2) and a carboxylic acid (–C(O)–OH) functional group. Amino acids are the building blocks of proteins, which can be considered a special case of condensation polymers. Twenty main amino acids are responsible for most of the incredible variation in proteins, and these have been given one-letter symbols (G, Q, V, etc.) by biochemists. An example is glycine, $NH_2–CH_2–COOH$ (biochemists give this compound the symbol [G]).
Ammonia: A colorless, nonflammable, and liquefied gas with a strong smell (NH_3); it is easily liquefied by compression or by cooling to about –33°C (–27.4°F). In returning to the gaseous state, it absorbs substantial amounts of heat from its surroundings (i.e., 1 g of ammonia absorbs 327 cal of heat). Because of this property, it is frequently employed as a coolant in refrigerating and air-conditioning equipment; it is used in the manufacture of urea and other fertilizers.
Ammonification: Conversion of organic nitrogen to ammonia–nitrogen resulting from the biological decomposition of organic matter (i.e., dead plant and animal tissue, fecal matter).
Amorphous: Without crystal form.
Amorphous Kerogen: Kerogen that lacks distinct form or shape under microscopic examination. May describe oil-prone kerogen.
Amortization: (1) Strictly speaking, this is defined as the depreciation of intangible assets. However, it is commonly used interchangeably with the term depreciation. (2) Depreciation, depletion, or periodic charge to expense asset costs (usually capital costs) over a period of time (usually years) subject to accounting rules.
AMP: See *American melting point*.
Amp: See *Ampere*.
Ampacity: The amount of current (measured in amperes) that a conductor can carry without overheating.
Ampere: Unit of current measurement. The amount of current that will flow through a 1 Ω resistor when 1 V is applied.

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Ampere-Hour: The quantity of electricity equal to the flow of a current of 1 A for 1 h.
Amperometric: A method of measurement that records electric current flowing or generated, rather than recording voltage. Amperometric titration is an electrometric means of measuring concentrations of substances in water.
Amphiphilic: From the Greek meaning "both" (something like *amphi*) and "lover" (something like *philos*). An amphiphile is a molecule that has a strong attraction toward both polar solvents (like a hydrophile) and nonpolar solvents (like a hydrophobe) and will end up concentrated at the interface between the two.
Amphoteric Metal: Metal that may be corroded by either acids or alkalines.
Amphoteric Surfactant: A surfactant whose charge is dependent on another variable, normally pH.
Amps: A copolymer. Acrylamido–methyl–propane sulfonate polymer.
Anaerobic: A condition in which atmospheric or dissolved molecular oxygen is not present in the aquatic (water) environment.
Anaerobic Bacteria: Bacteria that live and reproduce in an environment containing no "free" or dissolved oxygen. Anaerobic bacteria obtain their oxygen supply by breaking down chemical compounds that contain oxygen, such as sulfate.
Anaerobic Decomposition: Decomposition and decay of organic material in an environment containing no "free" or dissolved oxygen.
Anaerobic Digester: A wastewater solids treatment device in which the solids and water (about 5% solids, 95% water) are placed in a large tank where bacteria decompose the solids in the absence of dissolved oxygen.
Analog: A format that uses continuous physical variables such as voltage amplitude or frequency variation to represent information. Contrast with digital.
Analogous Reservoir: A comparable reservoir with many similar characteristics (e.g., lithology, depositional environment, porosity, perm, drive mechanism, and produced fluids) that can be used for behavior projection comparison studies.
Anchor: A device with slips that holds equipment in the wellbore.
Ancillary Component: A component (e.g., bend stiffeners and buoyancy modules) used to control flexible pipe behavior.
Ancillary Services: Services necessary to support the transmission of energy from resources to loads while maintaining reliable operation. They include reactive power supply, voltage support, regulation, automatic generation control, spinning reserve, and frequency control, among other things.
Angle of Repose (Sand in Pipe): The deviation angle (from vertical) at which a solid material will no longer fall down the pipe, but will begin to accumulate on the pipe wall. The angle of repose for dry, round sand is about 62° and for wet sand about 50°–60° depending on size, shape, and moisture.
Angstrom: A unit of length equal to 10^{-10} m.

Angular Unconformity: An unconformity in which the beds below the unconformity dip at different angles than the beds above it.
Anhydrite: $CaSO_4$ formation. Usually formed as an evaporite from a drying lake of trapped seawater.
Anhydrous: Dry—without water.
Aniline Point: (1) The minimum temperature for complete miscibility of equal volumes of aniline and the sample under test. Products with high aromatic or naphthenic contents have lower aniline points than products with high paraffinic content. (2) The minimum temperature for a complete mixing of equal volumes of aniline, a liquid that has selective solvent action on hydrocarbons, and the oil being tested. Used in some specifications to indicate the aromatic content of oils, also in calculating approximate heat of combustion (ASTM D611).
Anion Exchange: Process where a special resin exchanges chloride or hydroxide for contaminant anions such as fluoride, nitrate, sulfate, and bicarbonate. Water purification is the primary use.
Anionic: A negatively charged chemical species, like the hydroxide OH^-, carbonate CO_3^{2-}, or sulfate SO_4^{2-}, is called an anion. In an electrochemical cell, an anion will move toward the anode to lose its extra electron and generate a current.
Anionic Surfactant: A negatively charged surfactant. Normally water wets sands.
Anisotropy: Differences in rock—segments showing different responses when measured.
Anithic Fault: A secondary fault, often in a set, with opposite direction to the primary fault.
Annealing: Heating to and holding at an appropriate temperature and then cooling at a suitable pace for such purposes as reducing hardness and improving machinability.
Annex B: Operator's development plan for an offshore installation. It requires government approval before it can be implemented.
Annual Contract Quantity: The annual delivery quantity contracted for during each contract year as specified in a gas sales or LNG contract.
Annual Delivery Program: A key document for both the buyer and seller in determining how they will work together over the life of an LNG project to achieve the efficient delivery and receipt of LNG cargoes, normally agreed between the parties before the beginning of each contract year. For an ex ship sale, the ADP deals with the dates on which the sellers' LNG ships will deliver LNG to the buyers' terminals. For a free on board (FOB) sale, the ADP covers the dates of arrival of the buyers' ships at the LNG plant. Whether the sale is ex ship or FOB, the ADP provides a basis for decisions on how buyers and sellers will operate their facilities during the contract year covered. Usually, the procedures to be adopted to develop the ADP are agreed upon in the sales and purchase agreement (SPA). See *Sales and purchase agreement, CIF contract, Ex ship contract, and FOB contract*.

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Annubar: A gas flow rate measurement device using Pitot tubes. Common in pipelines.
Annular Blowout Preventer: A well control device, usually installed above the ram preventers, that forms a seal in the annular space between the pipe and wellbore or, if no pipe is present, over the wellbore itself.
Annular Flow: Using the annulus as the flow path.
Annular Injection: Injection of fluids down the annulus or "backside." Common as a gas supply path for gas lift. Also used in some fracturing operations, to spot fluids downhole when no packer is used or a type of injection valve is in the tubing to allow entry of chemicals, gas, or water.
Annular Packoff: A device that seals the annulus to pressure or flow.
Annular Pressure: (1) Pressure in an annular space. (2) Pressure in an annular area. May be a vented or trapped annuli.
Annular Pressure Relief Valve: Used in reverse circulating to prevent pipe collapse.
Annular Preventer: An elastomer bag or doughnut-type seal, pushed into contact with the pipe or tools in the blowout preventer (BOP). It is designed to seal around pipe or any other irregular surface tools (packers, guns, pumps) that may be in the BOP. May also be called a Hydril preventer.
Annular Safety Valve: A downhole safety valve that shuts off the annulus.
Annular Valve: The valve on the side of the tree that controls access to the annulus.
Annular Velocity: The velocity of fluids flowing in the annulus. Important in cleanup and displacement processes.
Annulus: (1) The space around a pipe in a wellbore, sometimes termed the annular space. (2) The space between the drill string and the earthen wall of the wellbore or between the production tubing and the casing. (3) The area between the OD of an inside string and the ID of an outside string.
Annulus Sea Assembly: The mechanism that provides pressure isolation between each casing hanger and the wellhead housing.
Annunciator: A sound-generating device that intercepts and speaks the condition of circuits or circuit operations. A signaling device that gives a visual or audible signal (or both) when energized.
Anode: (1) The positive electrode used in electrolysis where metals are collected. (2) The positively charged site in a cell. Oxidation site is the site of metal loss in corrosion.
Anode Corrosion Efficiency: The ratio of the mass loss of actual corrosion of an anode to the theoretical corrosion mass loss calculated from the quantity of electricity that has passed between the anode and the cathode using Faraday's law (from NACE).
Anode, Sacrificial: A formed metal bar (zinc, aluminum, etc.) attached by electrical wire to a structure to be protected and buried in conductive soil near that structure.
Anodic Inhibitor: A substance that slows the reaction at the anode.

Anodic Protection: Polarization to a higher oxidizing potential to achieve a reduced corrosion rate (promotes passivity).
Anodizing: Oxide coating of a metal surface to reduce corrosion.
Anomalous: Unusual data or measurement that is away from or out of the range of other data.
Anoxic: (1) Conditions where concentration is very low, usually less than 0.1 mg/L of water. (2) A condition in which the aquatic (water) environment does not contain enough dissolved molecular oxygen, which is called an oxygen-deficient condition. Generally refers to an environment in which chemically bound oxygen, such as in nitrate, is present.
ANSI: See *American National Standards Institute*.
Anthracite: (1) A hard, compact variety of mineral coal that has a high luster. It has the highest carbon count, the fewest impurities, and the highest calorific content of all types of coals. (2) The most highly metamorphosed form of coal.
Anthropogenic: A fancy way of saying "man-made" that hides its lack of political correctness in Greek. Think of "anthropoid" and "genesis."
Antiagglomerants (Hydrate Control): Chemicals that prevent hydrate crystals from sticking together and forming a larger mass.
Anticlinal Traps: Formed as a result of a folding of the strata into the shape of an arch or a dome, enabling any gas or oil to collect in a reservoir rock at the crest of the fold.
Anticline: (1) An upfold or arch of stratified rock in which the beds or layers bend downward in opposite directions from the crest or axis of the fold. (2) It is a subsurface geologic structure in the form of a sine curve or an elongated dome. The formation is favorable to the accumulation of oil and/or gas.
Anticline Traps: These are formed when the rock layers have been folded upward to form a dome. The trap looks like an inverted bowl with the upper layer of seal rock holding the fluids in the reservoir rock in place.
Antifoamer: A material that can quickly destabilize foam in a production fluid treating facility. Commonly needed after treatment with foamers, diesel, some polymers, some acids, and gasified fluids.
Antifouling: Any action designed to reduce or prevent fouling (deposits) on a surface.
Antiknock: Resistance of a gasoline (petrol) to detonation in a combustion chamber.
Antiknock Fluid: Common parlance for the chemical mixture containing tetraethyl lead as the knock-inhibiting ingredients and ethylene dichloride and/or ethylene dibromide as scavengers of the lead products formed in combustion. Used as knock suppressant in gasoline.
Antithetic Fault: A secondary fault, often in a set, with an opposite direction to the primary fault.
Antiwhirl Bit: A drill bit that, by its cutter placement, causes the bit to be forced against the side of the hole.
Anvil (Perforating): The strike plate over a TCP, drop-bar firing system.

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AOF: See *Absolute open flow.*
AOFP: Absolute open flow potential.
AOR: Authorized overrun.
APB: Annular pressure buildup.
APD: Approved permit to drill.
APD (DOI): Application for permit to drill.
APE: Area petroleum engineer.
APE: Authorization for expenditure.
Aperture: The unobstructed opening size (diameter, length and width, or other shape factor).
API: See *American Petroleum Institute.*
API Fluid Loss: A standard fluid leak-off test published by API.
API Gravity: An arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API; it may be calculated in terms of the following formula:

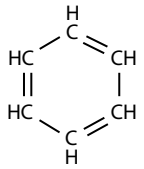
$$\text{Degrees API} = [141.5/(\text{sp. gr. } 60°\text{F}/60°\text{F})] - 131.5$$

The higher the API gravity, the lighter the compound. Light crudes generally exceed 38° API and heavy crudes are commonly labeled as all crudes with an API gravity of 22° or below. Intermediate crudes fall in the range of 22° to 38° API gravity.
API Monogram: The logo of the American Petroleum Institute (API) that is placed on certain pieces of oil field equipment by the equipment manufacturer. API licenses the use of the monogram on equipment that meets the API's minimum standards. It offers publications regarding standards, recommended practices, and other industry-related information.
API Service Classification: A system of letter designations agreed by API, SAE, and ASTM to define broad classes of engine service. Also used for service classification of automotive gear lubricants.
API Unit: The unit of radioactivity used for natural gamma-ray logs.
Apparent Resistivity: Resistivity recording where the measured value differs from the true or defined state by the influence of the mud column, invasion of a zone by fluids, or wellbore anomalies.
Apparent Viscosity: The viscosity at a given shear rate and a given temperature.
Appraisal: Activity immediately following successful exploration drilling, for example, the drilling of a delineation well to determine the size and characteristics of the discovered reservoir.
Appraisal Drilling: (1) Drilling carried out following the discovery of a new field to determine the physical extent, amount of reserves, and likely production rate of the field. (2) Wells drilled in the vicinity of a discovery or wildcat well in order to evaluate the extent and the importance of the find.
Appraisal Well: (1) A well drilled as part of an appraisal drilling program. (2) A well drilled as part of an appraisal drilling program that is carried

out to determine the physical extent, reserves, and likely production rate of a field.
APR: Trademark name for an annular pressure response valve—for a DST string. See *Annular pressure relief valve*.
APRV: See *Annular pressure relief valve*.
AQL: Acceptance quality level.
Aquastat: Thermostat for use in water.
Aquicide: A relatively impermeable stratum that does not transmit water fast enough to supply a well.
Aquifer: (1) A water-containing formation that may or may not be directly connected to the hydrocarbon-bearing zone. A connected aquifer may or may not offer pressure support to the pay. (2) A geologic formation capable of transmitting significant quantities of groundwater under normal hydraulic gradients. (3) Water reservoirs that are conditioned to hold the gas. Natural gas must be brought in to "condition" the site, and it takes 4 years before the site can be used.
Aquitard: (1) A geologic formation that may contain groundwater but not capable of transmitting significant quantities of groundwater under normal hydraulic gradients. (2) A geologic formation through which no water flows. It may be an effective seal to the movement of water.
ARA: Abbreviation for Amsterdam–Rotterdam–Antwerp commonly used in shipping to designate discharge or loading at one of these three ports.
Arbitrage: Trading the same commodity in more than one market in order to profit from different prices in the markets.
Arch: A large, load-supporting formation that may serve to reduce the total overburden load on a pay zone. These formations may cover hundreds of square miles over a basin. A second use is as a semi-stable structure of sand grains around a perforation or other opening that keeps sand from flowing so long as the flowing pressure holds the arch in place.
Archean: An eon of geologic time extending from about 3.9 billion to 2.5 billion years ago.
Archie Correlation: Empirical relationships between the formation resistivity factor, the porosity, the water saturation, and the resistivity of the fluid in the pore in clean, granular rock.
Archie Equation: An empirical relationship between the formation resistivity, F, and porosity, Φ, in which $F = 1/\Phi m$, where the porosity exponent or cementing factor, m, is a constant for a particular formation. Typical m's are 1.8 to 2.0 for consolidated sandstones and 1.3 for poorly consolidated sandstones.
ARDS: The refiner's shorthand for "atmospheric residual desulfurization," a refining process that removes sulfur from oils.
Area of Interest: (1) The area immediately surrounding a successful well in which the investors (in the good well) have an implied right to participate in any future wells drilled by the same operator. (2) The area surrounding a well within which drawdown and production has changed the saturation and energy of the system.

A

Area Open to Flow: The flow area generated by perforations across a zone of interest. Typical calculated perforation entrance hole areas are 1% to 6% of the pipe body. Used in pressure drop calculations.
Area Rental: The cost of renting an oil and gas license area for a defined period of time.
Area-to-Volume Ratio (Mineral): The area of the surface of a grain to its physical volume.
Area-to-Volume Ratio (Pore/Fracture Volume): Exposed area of a pore or fracture to the volume of fluid in the pore or fracture.
Arenaceous: Sand particles, 0.625 to 2 mm on the Udden–Wentworth scale.
Arene: Any carbon compound containing a six-membered ring of carbons, each of which forms only one chemical bond outside of the ring. This is called a phenyl ring, and though it looks like it has alternating single and double bonds, all the bonds are actually the same. Benzene is the simplest arene (see *Benzene*); other examples are toluene, fulvic acid, and trinitrotoluene:



Benzene

Argillaceous: Rocks or substances composed of clay minerals, less than 0.625 mm, or having a high proportion of clay in their composition such as shale.
Argon–Oxygen Decarburization: A practice of added refinement of steel through the decline of its carbon content.
Arkose: A sandstone containing 25% or more of feldspar, usually derived from igneous rock.
Armor: Shielding over a cable or other device that needs to be protected from crushing.
Aromatic Hydrocarbons: Hydrocarbons characterized by unsaturated ring structures of the carbon atoms. Commercial petroleum aromatics are benzene, toluene, and xylenes.
Aromatics: (1) Class of hydrocarbons that have at least one benzene ring as part of their structure. It generally describes benzene and benzene derivatives. These products are used as components of unleaded gasoline and as feedstocks for petrochemicals such as cyclohexane and para-xylene, both of which are used in end products like nylons and polyesters. (2) Hydrocarbons characterized by unsaturated ring structures of carbon atoms. Commercial petroleum aromatics are benzene, toluene, and xylene (BTX). (3) One of the three principal groups or series of hydrocarbon compounds that occurs naturally in crude oil. New formulations of gasoline with increased octane levels often contain increased amounts of aromatics.

Arrest Marks (Failure/Crack Development): Characteristic markings (ridges, tears, risers, etc.) on fracture surfaces after fatigue crack of fracture propagation (also known as beach marks, clamshell marks, and conchoidal marks).

Arroyo: A steep-sided gulley in arid areas that carries runoff, usually at high velocities, for very short times after a rain.

Artesian Water: Water that is overpressured and may rise above the formation.

Articles of Agreement: The document containing all particulars relating to the terms of agreement between the master of the LNG vessel and the crew. Sometimes called ship's articles or shipping articles.

Artificial Drives: Techniques for producing oil after depletion or in lieu of natural drives; include waterflooding, natural gas reinjection, inert gas injection, flue gas injection, and in situ combustion.

Artificial Lift: (1) Any of the techniques, other than natural drives, for bringing oil to the surface. (2) Pumping an oil well with a rod, tubing, or bottom-hole centrifugal pump may be termed artificially lifting crude oil to the surface or doing so by mechanical means. (3) Is a way of bringing oil to the surface when the reservoir pressure has declined. The method involves pumping an oil well with a rod, tubing, or bottom-hole centrifugal pump.

Ash: (1) Noncombustible residue of lubricating oil or fuel; lubricating oil detergent additives containing metallic derivatives are a common source of ash (see also *Sulfated ash*). (2) The amount of ash or nonvolatile, incombustible content left from heating petroleum oils to the point of complete burning of the oil. Ash content is expressed in weight percent of the original sample.

Asian Development Bank: A major multilateral financing institution engaged in LNG project finance. See *Export credit agencies (ECAS)* and *Multilateral* institutions.

Asked: The average price asked by those persons recently willing to sell a commodity. The bid is the purchase price and asked is the selling or offer price.

ASME: American Society of Mechanical Engineers.

Asphalt: (1) A dark-brown-to-black cement-like material containing bitumens as the predominant constituent, obtained by petroleum processing, and used primarily for road construction. It includes crude asphalt as well as the following finished products: cements, fluxes, the asphalt content of emulsions (exclusive of water), and petroleum distillates blended with asphalt to make cutback asphalts. *Note*: The conversion factor for asphalt is 5.5 barrels per short ton. (2) A dark-brown-to-black cementitious material: solid, semisolid, or liquid in consistency in which the predominating constituents are bitumens. Petroleum asphalt, as distinguished from asphalt occurring as such in nature, is refined from crude petroleum into commercial grades of widely varying consistency. Asphalt is a natural constituent of asphaltic-base crude oils, some of which are refined primarily for its recovery.

Asphalt Cement: A refined asphalt, or combination of refined asphalt and flux, of suitable consistency for paving purposes.

A

Asphaltic Concrete: A plant mix of asphalt cement with coarse-graded mineral aggregate, used in the construction of asphalt bases, binder courses, and surface courses.
Assay: (1) A description of the yield/quality characteristics of a mineral such as oil. The term also refers to the procedure for determining the quality of the oil. (2) Analyze.
Assay (Crude Assay): A written laboratory analysis of every defining factor about a crude oil, including yield proportions of each product at different heated temperatures, given various refinery configurations.
Assemblage: The collection of minerals that characterize a rock or facies.
Asset Deal: The purchase/sale of an oil and gas property (e.g., a field with commercial or technical reserves) or infrastructure.
Asset Intensity: The amount of capital a company requires to maintain production at constant levels, computed by multiplying current year production by the 3-year average F&D cost/Mcfe and dividing the product by current year cash flow from operations.
Assignment: In oil and gas usage, assignment is a transfer of a property or an interest in an oil or gas property, most commonly the transfer of an oil or gas lease. The assignor does the transferring and the assignee receives the interest of property.
Assimilation: Use of ammonia and nitrate–nitrogen by plants for growth.
Associated Gas: (1) Gas that occurs with oil, either as free gas or in solution. Gas occurring alone in a reservoir is unassociated gas. (2) Natural gas found in association with oil, either dissolved in the oil or as a cap of free gas above the oil. (3) Natural gas found mixed with oil in underground reservoirs that comes out of solution as a by-product of oil production. In these fields, natural gas production fluctuates with oil production. See *Nonassociated gas*.
Associated Liquids: Liquid hydrocarbons found in association with natural gas.
Associated Reservoir: Oil and gas reservoir with a gas cap. Gas production from these reservoirs may be restricted in order to preserve the gas cap energy and ultimate recovery.
Associated-Tree Natural Gas: In immediate contact, but not in solution, with crude oil in a reservoir. One usually distinguishes between associated (free) gas, dissolved gas, and nonassociated gas.
Astern: A backward direction in the line of a vessel's fore and aft line. If a vessel moves backward, it is said to move astern, "opposite to" ahead.
Asthenosphere: The weak section of soft rock in the upper mantle just below the lithosphere. It is involved in plate movement. The depth is 70 to 100 km below the surface.
ASTM: See *American Society for Testing and Materials*.
ASV: Annular safety valve.
Athie Wagon: A trailer or other vehicle, designed for soft ground, often used as the staging platform for fighting well fires.

Atlantic Basin Market: See *LNG markets*.
Atmospheric Crude Oil Distillation: The refining process of separating crude oil components at atmospheric pressure by heating to temperatures of about 600° to 750°F (depending on the nature of the crude oil and desired products) and subsequent condensing of the fractions by cooling.
Atmospheric Distillation: A basic refining process in which crude oil is heated in order to break it down into a number of intermediate components from which finished products can be made.
Atmospheric Pressure: The pressure due to the weight of the atmosphere (air and water vapor) on the earth's surface. The average atmospheric pressure at sea level has been defined as 14.696 lb per square inch absolute—see *psia*.
ATP: Advanced technology parts.
At-Risk Condition: A certificate condition that places the responsibility for under-recovery of costs regarding pipeline expansion or new construction on the pipeline sponsor, rather than on the pipeline's other customers.
ATS: See *Advanced turbine systems*.
Attapulgite Clay: A colloidal, viscosity-building clay used in water-based muds. They generate viscosity due to the mechanical interference of their straw-shaped bodies.
Attenuation: (1) Attenuation is to reduce or lessen in amount (e.g., a reduction in the amount of contaminants in a plume as it migrates from the source). (2) When a form of energy is propagated through a medium, its amplitude (energy level) is decreased. This decrease is termed attenuation.
Attic Oil: An unscientific, but descriptive, term for the oil above the borehole in horizontal wells; oil in the top few feet of a productive interval that will gravitate or be pressured into the horizontal drain hole.
Austenitic Steel: A steel with a microstructure consisting of austenite at room temperature.
Australian Offset: A humorous reference to a well drilled miles away from proven production.
Australian Research Council: Australia's peak science funding body. The ARC is responsible for running the competitive grant process that is used to determine which proposed research is funded by the Commonwealth government. The ARC's Research Centres Programme established and continues to support the Key Centre for Polymer Colloids.
Authigenic: A clay or other mineral that was formed within the pore spaces of the rock. The material is most often formed by reaction or precipitation from connate fluids.
Autochthonous: Formations that formed in the present locations and have not been transported.
Autoclave: A vessel used for conducting chemical reactions or high pressure sterilization.
Autogas: LPG used as an automotive engine fuel. Usually a mixture of propane and butane.

A

Autoignition: The spontaneous ignition and resulting rapid reaction of a portion of or all the fuel–air mixture in the combustion chamber of an internal combustion engine. The flame speed is many times greater than that following normal ignition.
Autoignition Temperature: The lowest temperature at which a gas will ignite after an extended time of exposure.
Automatic "J": A set or release mechanism where pickup or setdown will release or set the tool.
Autorefrigeration: The process in which LNG is kept at its boiling point, so that any added heat is countered by energy lost from boil-off.
Autotrophic Bacteria: Bacteria that use inorganic carbon (i.e., carbon dioxide) for energy and cell growth.
AUV (Subsea): Autonomous underwater vehicle.
Available Overpull: The amount of unused pull capacity of a rig after picking up the entire string weight.
Average Daily Quantity: (1) The monthly contracted quantity of gas divided by the number of customers' operating days in that month. (2) A contracted quantity of gas divided by the number of operating days in the specified contract period.
Average Day: The temperature condition corresponding to a typical day in an average temperature year. The gas sales or requirements for an average day are annual totals divided by 365 days.
Average Demand: Measure of the total of energy loads placed by customers on a system divided by the time period over which the demands are incurred.
Average Government Take: The proportion of pre-take cash flow that the government takes on average over a defined period.
Average Power: The average over time of a modulated signal.
Average Temperature Year: Long-term average recorded temperature.
AV (Flow): Annular velocity.
AV (Fluids): Apparent viscosity.
Avgas: High-octane aviation gasoline used in piston-type aircraft engines.
Aviation Gasoline (Blending Components): Naphthas that will be used for blending or compounding into finished aviation gasoline (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene, and xylene). Exclude oxygenates (alcohols, ethers), butane, and pentanes plus. Oxygenates are reported as other hydrocarbons, hydrogen, and oxygenates.
Aviation Gasoline (Finished): A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in aviation reciprocating engines. Fuel specifications are provided in ASTM Specification D910 and Military Specification MIL-G-5572. *Note*: Data on blending components are not counted in data on finished aviation gasoline.
AWGRS: Alaska well's group reporting system.

Aw Rod Thread: A thread for tools and equipment that has three parallel threads per inch (similar to a BW thread). Used in applications of 1.75″ OD thread or less.
AWV: Annulus wing valve.
Axial Fan: Fan that moves air in the general direction of the axis about which it rotates.
Axial Load: A tension or compression force, usually along the length of an object.
Azimuth (Logging): In a horizontal plane, it is the angle (measured clockwise) of well path departure usually from true or magnetic north. It may also be expressed as the compass direction of the path of the wellbore as measured by a borehole survey. (*Note*: Check the specifics of the survey for details.)

B

Babbitt: A soft metal alloy used in some seals and bearings.
Backbite: A backlash of tongs that results in a grip in the wrong direction.
Backfill: Waste rock materials that support the roof once the ore has been removed.
Backflow: (1) A flow condition, caused by differential pressure, resulting in the flow of liquid into the potable water supply system from sources other than those intended; or the backing up of liquid, through a conduit or channel, in a direction opposite to normal flow. (2) Return flow from injection of a fluid into a formation.
Backflow Preventer: Any effective device, method, or construction used to prevent backflow into a potable water system.
Back Flushing: Reverse flow of a fluid, usually in a well treatment or injection well, where the flow from the reservoir to the wellbore, often at high drawdown, is used to clean fluids and shallow particulate damages from the near-wellbore area.
Background Radiation: The radiation intensity in the environment before a specific radiation source is considered.
Backhaul: (1) A natural gas transportation service that requires movement of gas from a point of receipt to a point of delivery such that the contractual direction of movement on the pipeline is in a direction opposite to the flow of the gas. (2) An operation or transaction that results in the movement of gas in a direction opposite to the normal flow direction in a pipeline.
Back-in (Contract): A type of interest in a well or lease that becomes active at a specified time or a specified event.
Back-in-Provision: A term used to describe a provision in a farmout agreement whereby the person granting the farmout (the farmor) has the option to exchange a retained override for a share of the working interest.
Back-in Unit: A portable servicing or work-over rig that is self-propelled, using the hoisting engines for motive power. Because the driver's cab is mounted on the end opposite the mast support, the unit must be backed up to the wellhead.
Back Off: (1) To unscrew one threaded piece (such as a section of pipe) from another. (2) Unscrewing a tool or equipment. In pipe recovery, back off of a joint precedes recovery of the upper section in a well. Common in plug and abandonment or sidetrack operations.
Back Pressure: A pressure caused by a restriction or fluid head that exerts an opposing pressure to flow.

B

Back Pressure Valve: A flow control valve that provides some control when running or pulling a string.
Back Reamer: A tool to enlarge a drilled hole.
Back Scuddling: Reverse circulating.
Back-Side: The annulus above the packer.
Back-Stopping: Arranging for alternate supplies of gas in the event the primary source fails to deliver.
Back Surge: Sudden backflow of a well, usually to clean the perforations.
Backup Ring (Seals): A ridged ring-like support next to a seal to provide higher pressure or temperature support.
Backup Wrench or Tong: A tool that keeps the pipe string from rotating while a joint is made up.
Backwardation: (1) A market where the current or near-term delivery prices are higher than that for further forward months. The opposite of backwardation is contango—a market situation where prices are higher for forward delivery dates than for nearer delivery dates. (2) A market situation for refined oil product prices. Backwardation occurs where future anticipated prices are lower than current or near-term prices. (3) A market situation in which prompt physical crude or refined product sells at a premium to forward months' prices for the same commodity. An *inverted market*; the opposite of *contango*.
Back Wash: (1) Usually reverse circulation. (2) The process of reversing the flow of water through the filter media to remove the entrapped solids.
Bacteria: (1) Single-celled organisms that probably provide the bulk of the biomass on our planet. There are more bacterial cells within the human body than human cells. One of the most interesting things about bacteria is that our macroscopic concepts of *species* are rather inappropriate; genetic material can be swapped from one species to another with disturbing ease, leading some scientists to call bacteria a *superorganism*. The fantastic durability and longevity of bacteria (some concentrate plutonium inside themselves and happily live inside high level–nuclear waste facilities, while others are believed to have survived for tens of millions of years in rock formations) have led some other scientists to speculate they are adapted to life in deep space and are continually raining down on us from above. (2) Primitive organisms (mostly plants) that are generally free of pigment and reproduce by dividing in one, two, or three planes. They are single-celled, do not require light for their life processes, and can be grown in special cultures out of their native environment.
Bacterial Culture: In the case of activated sludge, bacterial culture refers to the group of bacteria, classed as *aerobes*, and facultative organisms (see *Facultive organisms*) and covers a wide range of organisms. Most treatment processes in the United States grow facultative organisms which utilize the carbonaceous (carbon compounds) BOD. Facultative organisms can live when oxygen resources are low. The nitrifying organisms, obligate

aerobes (require oxygen), must have at least 0.8 mg/L of dissolved oxygen throughout the whole system to function properly during nitrification process.

Bacterial Degradation: Breaking down alkanes by bacterial action. Commonly by pseudomonis and ultramonis bacteria and other bacterial strains that digest parts of the crude oil structures. Useful for remediating oil spills or tank-bottom residuals.

Bacterial Oxidation and Reduction: Reactions involving aerobic decay, organic matter oxidation, fermentation, anaerobic decay, etc.

Bacterial Remediation: Liquefaction or break down of oily waste or clean up of oil spills using naturally occurring oil consuming bacteria, chiefly ultramonis and pseudomonis.

Bactericide: (1) An additive to inhibit bacterial growth in aqueous component or phase of fluids, preventing bacterial degradation of the fluid and the resulting foul odors. (2) A product that kills bacteria in the water or on the surface of the pipe.

Baffles: Plates in a separator on which the flow impinges and breaks out gas.

Bag-Off: Inflatable devices in a pipeline meant to stop flow.

BAHX: See *Brazed aluminum heat exchanger.*

Bail: A cylindrical steel bar (similar to the handle or bail of a bucket, but much larger) that supports the swivel and connects it to the hook.

Bailer: (1) A hollow tube with a trap door or ball seat, run on wireline, which can be used to spot or remove solid material from a well bore. (2) A long, cylindrical container fitted with a valve at its lower end, used to remove water, sand, mud, drilling cuttings, or oil from a well in cable-tool drilling.

Balance: The amount of gas put into the pipeline and the amount of gas taken out of the pipeline are equal on a fixed time basis.

Balanced Plug: A cement plug set with no downhole flow conditions, which allows temporary or permanent shut off in a well. It takes into account the densities of all fluid columns, both in the string and in the annulus.

Balance Point: The point at which forces acting on a pipe in a well (usually while running) are equal.

Balance Point (Coiled Tubing or Snubbing): Static condition of the length of tubing in the well, where buoyed tube weight (well fluid sensitive) equals the well pressure acting against the cross-sectional area of the tube. The balance point does not include any frictional forces exerted due to the friction with the well or the stripper assembly.

Balancing: (1) The requirement imposed by both electricity grids and natural gas pipelines that demands supply and demand to be equal over a certain time period. (2) The practice by shippers of offsetting (balancing) their gas deliveries from the pipeline with injections of gas supplies into the pipeline on a regular basis.

Balancing Agreement: Contractual agreement between legal parties to account for differences between chart-measured quantities and

total-confirmed quantities at a measuring point such as a plant. They are used to track over/under production relative to entitlements between producers; over/under deliveries relative to measured volumes between operators of wells, pipelines, and LDCs.

Balancing Item: Differences between the sum of the components of natural gas supply and the sum of the components of natural gas disposition. These differences may be due to quantities lost or to the effects of data-reporting problems. Reporting problems include differences due to the net result of conversions of flow data metered at varying temperature and pressure bases and converted to a standard temperature and pressure base; the effect of variations in company accounting and billing practices; differences between billing cycle and calendar period time frames; and imbalances resulting from the merger of data-reporting systems that vary in scope, format, definitions, and type of respondents.

Balancing Service: Gas balancing service that accommodates imbalances between actual customer usage and the gas delivered for that customer's use.

Ball-and-Seat Valve: A device used to restrict fluid flow to one direction. It consists of a polished sphere, or ball, usually of metal, and an annular piece, the seat, ground and polished to form a seal with the surface of the ball. Gravitational force or the force of a spring holds the ball against the seat. Flow in the direction of the force is prevented, while flow in the opposite direction overcomes the force and unseats the ball.

Ballast: (1) Heavy substances loaded by a vessel to improve stability, trimming, sea-keeping, and to increase the immersion at the propeller. Seawater ballast is commonly loaded in most vessels in ballast tanks, positioned in compartments right at the bottom and in some cases on the sides, called wing tanks. On a tanker, ballast is seawater that is taken into the cargo tanks to submerge the vessel to a proper trim. (2) An electrical circuit component used with fluorescent lamps to provide the voltage necessary to strike the mercury arc within the lamp, and then to limit the amount of current that flows through the lamp.

Ballasting: Ballasting commences as soon as possible after the completion of discharge and final draining. It involves taking ballast (water) into either separately segregated tanks or into cargo tanks.

Ballast Tank: Compartments at the bottom or on the sides of a ship that are filled with liquids for stability and to make the ship seaworthy. Any shipboard tank or compartment on a tanker normally used for carrying salt water ballast. When these compartments or tanks are not connected with the cargo system, they are called segregated ballast tanks or systems.

Ball Catcher: A cylinder at the surface to catch ball sealers before the fluid is routed through the choke.

Ball Diverter: Ball sealer.

Ball Dropper: A device that injects balls into the flowing treating fluid downstream of the high pressure pump.

Ballooning (Drilling): A phenomenon in which fluids are lost to the rock during over-pressured operations, as found in increased pressures

from equivalent circulating density operations, and then flow back when pressure is reduced. This should not be confused with a kick.

Ballooning (Pipe): An increase in pipe outside diameter (OD) as internal pressure is applied (shortens pipe).

Ball Operated: Mechanical device activated by pumping a ball of a certain size down the tubing in the injected or circulated fluid.

Ball-Out: (1) The process of effectively shutting off the entire zone and cause pressure to rise sharply when using ball sealers. (2) To plug open perforations by using ball sealers.

Ball Sealers: Small, rubber-covered, hard-centered balls that can seal individual perforations during a chemical treatment.

Ball (Tool Operation): A steel, aluminum, brass, or plastic ball pumped or dropped downhole to shift or operate a tool.

Ball Valve: Any of the several valves that rotate a ball with a flow passage to allow or deny flow.

Banana Blade: A banana-shaped reamer blade that allows milling either up or down.

Banded Iron Ore: A sediment with alternating layers of chert and iron rich minerals.

Band or Banded: An attachment strap to affix cable or capillary tube to the outside of the tubing.

Bandwidth: Technically, the difference, in Hertz (Hz), between the highest and lowest frequencies of a transmission channel. Identifies the capacity or amount of data that can be sent through a given circuit.

B Annulus: An outside annulus, one out from the A annulus, usually production casing × production casing or surface casing. (*Note:* There may be regional differences in the A, B, and C annulus designations.)

Barchan: A crescent-shaped sand dune with a convex face upwind and a concave face downwind.

Bare Boat Charter: A charter in which the bare boat is chartered without crew; the charterer, for a stipulated sum takes over the vessel for a stated period of time with a minimum of restrictions; the charterer appoints the master and the crew and pays all running expenses.

Barefoot Completion: A very simple, open hole, pay zone completion with minimum downhole equipment. Also called an open hole completion. The casing is usually run to the top of the pay and is cemented above the pay.

Bar-Finger Sand: An elongated lens of sand formed during the distribution of sediment in a delta.

Barge: Non-self-propelled marine vessels used as cargo tankers, equipment and supply carriers, crane platforms, and support and accommodation bases in offshore drilling, and as submarine pipe-laying vessels.

Bar (Geologic): A mass of sand or other materials deposited in the bed of a stream channel.

Bar Hole: A hole of small diameter made in the ground to obtain a sample for searching a gas leak in a pipeline.

Barite: (1) One of the many forms of the barium sulfate mineral. Barite is used in drilling mud as a weighting agent and can produce a slurry of over 20 lb/gal in water. (2) Barium sulfate, a mineral frequently used to increase the weight or density of drilling mud. Its relative density is 4.2 (meaning that it is 4.2 times denser than water). See *Barium sulfate*, *Mud*.

Barite Plug: A settled plug made of particles of barite or even barite and sand that is placed to seal off a zone or the wellbore.

Barium Sulfate (Scale): (1) Barium sulfate scale is produced in the well and in facilities as the result of precipitation when incompatible waters (one having Ba ion and the other SO_4 ion) are mixed or when the equilibrium of the flowing fluid is reduced and a precipitate is triggered by over saturation or a physical upset. May also be associated with radioactivity when a radium or uranium isotope is part of the crystalline lattice structure. (2) A chemical compound of barium, sulfur, and oxygen ($BaSO_4$), which may form a tenacious scale that is very difficult to remove. Also called barite.

Barometric Damper: Mechanically balanced damper that rotates from changes in pressure within breeching to bleed air into the breeching to maintain steady draft.

Bar (Pressure): Pressure in atmospheres, approx 14.7 psia.

Bar Rack: A screen composed of parallel bars, either vertical or inclined, placed in a sewer or other waterway to catch debris. The screenings may be raked from it.

Barrel: (1) A volumetric unit of measure for crude oil and petroleum products equivalent to 42 gal or 158.978 L. See *Barrel of oil equivalent*. (2) An oilfield measurement barrel is 42 gal or 5.615 ft^3 or 6.28 barrels = 1 m^3. Note that reservoir barrels undergo shrinkage by the reservoir volume factor as gas escapes. Stock tank barrels are measured after gas escapes.

Barrel Equivalent: A laboratory measuring scale for expressing mixtures of products used to formulate muds. One gram of material added to 350 cc of liquid is equivalent to 1 lb of material added to a 42 gal barrel.

Barrel of Oil Equivalent: (1) The oil equivalence of natural gas is normally based on the amount of heat released when the gas is burned as compared with burning a barrel of oil. For typical natural gas, burning 6000 standard cubic feet liberates about the same amount of heat as burning one barrel of average crude. (2) Barrel of oil equivalent is equal to gas volumes divided by six and added to crude and natural gas volumes.

Barrel Pump: A small, usually hand driven pump with a long dip tube used to move chemicals from drums and barrels.

Barrels per Calendar Day: Total throughput divided by the number of calendar days. The total divided by actual number of days in operation (i.e., stream days) gives the stream-day rate, which equals or exceeds the calendar-day rate. Calendar day is a term describing the throughput of a facility that occurs on a daily basis averaged over a long period of time. Calendar-day rate times 365 gives the average annual rate.

Barrels per Day: A unit of measurement used in the industry for the production rates of oil fields, pipelines, and transportation.
Barrels per Stream Day: The maximum number of barrels of input that a distillation facility can process within a 24 h period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime.
Barrier Coating (Corrosion): A coating with a high resistance to permeation of liquids/gasses.
Barrier Coating (Protective): A coating applied over a surface to prevent handling damage.
Barrier Island: A long thin sandbar parallel to shore formed by wave action.
Barrier (NORSOK Definition): One of several dependent barrier elements, which are designed to prevent unintentional flow of a formation fluid. A barrier is an envelope preventing hydrocarbons from flowing unintentionally from one formation into another formation or to the surface. Barrier elements that make up the primary barrier are those elements that are or might be in direct contact with well pressure during normal operation. These elements provide the initial and inner envelope preventing unintentional flow of reservoir fluid to surface or another zone. Barrier elements that make up the secondary barrier are those that are or might be exposed to contact with well pressure should any of the elements described as a primary barrier fail. These elements provide an envelope outside the primary barrier envelope providing a second barrier preventing unintentional flow of reservoir fluid to the surface or another zone.
Bar-Vent (Perforating): A vent in the tubing or treating string open by a drop bar used to fire a perforating gun.
Basalt: The most common volcanic rock. Usually fine grained.
Base: A substance that takes up or accepts protons. A substance that dissociates (separates) in aqueous solution to yield hydroxyl ions. A substance containing hydroxyl ions, which reacts with an acid to form a salt or which may react with metals to form precipitates.
Base Case Capacity: Comprises existing operations, along with expansions or projects that have received board approval and financing.
Base Fluid: The starting fluid for a pill or a treatment, before additives.
Base Gas: (1) The gas required in a storage pool to maintain sufficient pressure to keep the working gas recoverable. (2) The gas required in a storage reservoir to cycle the working gas volume.
Base Load Capacity: (1) Generating equipment normally operated to serve loads on an around-the-clock basis. (2) Power plants normally operated to serve loads on an around-the-clock basis.
Base Management: The efficient delivery of proved developed reserves through excellence in reservoir, well, and system management.
Base Map: A map containing boundaries, locations, and survey points.
Basement Rock: (1) Ancient rock that lies below the sedimentary strata; it does not contain oil or gas. (2) Unproductive rocks, usually igneous or metamorphic, at the bottom of a sedimentary rock sequence.

B

Base Metal: A metal that is not considered a precious metal.
Base Number: The amount of acid required to neutralize all or part of a lubricant's basicity, expressed as potassium hydroxide (KOH) equivalents.
Base Oils: Refined output streams used as raw material in the manufacture and blending of finished lubricants. Base oils are either paraffinic or naphthenic based.
Base Period: A recent 12-month period that serves as the "sample" period for demonstrating pipeline operational costs on which the pipeline's future rates will be based.
Base Pipe: The inside pipe of a sand screen or other equipment on which other equipment or parts are added.
Base Power: Power that is generated at a high-capacity factor.
Base Pressure: Standard unit of pressure used in determining gas volume. Volumes are measured at operating pressures and then corrected to base pressure volume. Base pressure is normally defined in any gas measurement contract. The standard value for natural gas in the United States is 14.73 psia, established in 1969 by ANSI as Standard Z-132.1. Also called *base conditions*. The standard pressure specified in US state regulations on base pressure varies slightly from state to state.
Base Temperature: An arbitrary temperature to which measurements of a volume of gas are referred. The standard value in the United States is 60°F (520°R) for natural gas as established by ANSI as Standard Z-132.1.
Basic Oxygen Furnace: A steel production method where oxygen is forced at high speeds through retractable water cooled lance which accelerates the burning off of unwanted elements.
Basic Sediment and Water: The solids and water entrained in crude oil.
Basin: (1) A depression on the earth's surface into which sediments are deposited, usually characterized by sediment accumulation over a long interval; a broad area of the earth beneath which layers of rock are inclined, usually from the sides toward the center. (2) A large area with a general containment and often a thick accumulation of rock.
Basket: A device placed in the drill or work string that catches debris when a drillable object is being milled or drilled downhole.
Basket or Basket Sub: A device used to catch debris in the wellbore; often a part of the string.
Basket Price: The blanket or average price of crude oil in the world market. For example, the basket price of $18/bbl could mean an average price of average gravity. Lower gravity crude with high-transit cost would bring less than $18, and conversely, higher gravity crude with low sulfur and close to market would be a premium—a basket of crude oils of differing gravities, sulfur content, sweet and sour.
$BaSO_4$: See *Barium sulfate*.
Batch: A measured amount of crude oil or refined products in a pipeline or storage tank.

Batch Mixing: Mixing a specific volume of a treating fluid in a properly sized tank as opposed to mixing on the fly.
Batch Process: A treatment process in which a tank or reactor is filled, the wastewater (or solution) is treated, or a chemical solution is prepared and the tank is emptied. The tank may then be filled and the process repeated. Batch processes are also used to cleanse, stabilize, or condition chemical solutions for use in industrial manufacturing and treatment processes.
Batch Treating (Chemical Treating): Slugging a chemical such as a biocide or a corrosion inhibitor in high concentration to accomplish either placement or super-concentrated treating.
Batholith: An irregular intrusion of an igneous rock into another rock.
Bathymetry: The study and mapping of ocean floor topography.
Battery: (1) Two or more tanks connected together to receive oil production on a lease; tank battery. (2) Equipment to process or store crude oil from one or more wells.
Battery (Fluid Treating): The separation facilities.
Baud: A unit of signaling speed. The speed in baud is the number of discrete conditions or signal elements per second. If each signal event represents only one bit condition, then baud is the same as bits per second. Baud rarely equals bits per second.
Baud Rate: The rate at which data are transferred over an asynchronous RS-232 serial connection.
Baume (Density): A density scale used in mineral acid strength measurement.
Baumé Gravity: Gravity expressed on the Baumé scale for liquids lighter or heavier than water. The API gravity scale is now used for liquids by the petroleum industry instead of the Baumé scale.
Bauxite: A sintered aluminum-based proppant with very high strength, 3.2 g/cc density, and high abrasion characteristics.
Bayrite: A clay-based drilling mud–gelling agent.
bbl: See *Barrel*.
b/cd: See *Barrels per calendar day*.
bcf: See *Billion cubic feet*.
bcm: Billion cubic meters. Volumetric unit of measurement used for natural gas. One bcm or one billion cubic meters is equivalent to 35.314 standard cubic feet.
BD/BCD: See *Barrels per day/Barrels per calendar day*.
Beach Gas: Natural gas transported via offshore pipelines to a number of gas gathering and processing terminals located at or near a coastal region.
Beach Marks (Failure/Crack Development): Characteristic markings (ridges, tears, risers, etc.) on fracture surfaces after fatigue crack of fracture propagation (also known as clamshell marks, conchoidal marks, and arrest marks).

B

Beach Price: Price applying to natural gas at landfall.
Bead Tracer: An isotope tracer in a bead with the same density of the flowing fluid that is used to track fluid-flow rates and therefore fluid entry and exit points along the wellbore.
Beam: The width of a ship; also called *breadth*. (2) A steel or other structural member.
Beam Pump: An artificial lift system, common to low-pressure, lower rate oil wells, with a plunger type bottom hole pump operated from the surface by a rod string.
Beam Pumping Unit: A machine designed specifically for sucker rod pumping. An engine or motor (prime mover) is mounted on the unit to power a rotating crank. The crank moves a horizontal member (walking beam) up and down to produce reciprocating motion. This reciprocating motion operates the pump.
Bean: A flow restriction common in downhole chokes, surface chokes, and some subsurface safety service valve (SSSVs).
Bean-Up Strategy: An engineered sequence of choke settings in the start-up of a well to apply stresses in the formation in a manner that will strengthen the formation and avoid failure.
Bearden Unit of Consistency: An estimation of the pumpability of a slurry. Has no direct correlation to viscosity.
Bed: A subdivision of the classification of a sequence of rocks. A bed usually has similar lithographic features and is separated from other groupings by recognizable boundaries. (2) A layer of rock, usually sediments, that is homogeneous (the same) in composition. One bed is separated from another by a bedding plane.
Bed (Bedding Plane): A term used for a geological stratum and the interface between strata.
Bedding Plane: Surface separating layers in sandstone. Usually bedding planes mark the transition of the particle transport event. An accumulation of minerals or other materials laid down at the time of rock deposition or generated by reworking, which may create significant vertical permeability barriers in a sedimentary rock.
Bed Filtration: A buildup of particles on the upstream side of a filter that improves the filter's ability to remove particles from fluid (will also raise the differential pressure across the filter).
Bed Load: The sediment that moves slowly along the bottom of a river channel.
Bedrock: The firm base rock to which is anchored the geological structure that is of interest to petroleum geologists.
Bed Wrap: The innermost wrap of coil or cable on a spool or reel.
Behind-Pipe Reserves: Behind-pipe reserves are expected to be recovered from zones in existing wells, which will require additional completion work or future recompletion prior to the start of production.
Behind the Pipe: Oil and gas reservoirs penetrated or passed through by wells, but never tapped or produced. Behind the pipe usually refers to tight

formations of low permeability that, although recognized, were passed through because they were uneconomical to produce at the time. Today, however, with the growing scarcity of oil and its high prices, many of these passed-through formations are getting a second look by producers.

Belching: Flowing slugs of material.

Bell Nipple: A funnel-shaped pipe at the top of the casing that guides toolstring entry and may have a side port for fluid pumping.

Below Rotary Time (Drilling): A time that reflects the slide time in which the pipe is not rotating and drilling.

Belt: A flexible band or cord connecting and wrapping around each of two or more pulleys to transmit power or impart motion.

Belt Effect: Added friction in a deviated well as wireline or coil rubs against the top of the deviated section as the tube or cable is pulled out of a well.

Belt Guard: A protective grill or cover for belt and pulleys.

Benchmark: A selected reference point for comparing performance.

Benchmarking Measures: Data and information used as a point of reference against which industry performance is measured.

Bending Cycle (Coiled Tubing): Cycling coiled tubing from a yielded position, through a transition region, and back again. Running coiled tubing from the reel into a well and back to the reel involves six bends or three cycles.

Bend Radius: Radius of the curvature of flexible pie measured to the pipe centerline.

Beneficiation: (1) To improve the chemical or physical properties of the ore and to improve the grade by removing gangue material. (2) A chemical process that changes the state of clay or other minerals to make it meet specific performance levels.

Bentonite: A reference to colloidal clay (generally montmorillinite or smectite); generates plastic viscosity due to clay behavior, size, and electrostatic layer. A slurry of which will weigh not less than 9 pounds per gallons.

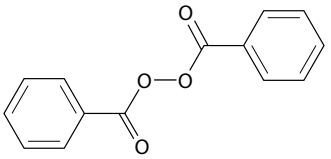
Bent Sub: (1) A short section of a tool or pipe that is formed at an angle or is modified downhole by a motor to assist in entering deviated wellbores or drilling off the path of the wellbore. (2) A short cylindrical device (generally angular) installed in the drill stem between the bottommost drill collar and a downhole motor.

Benzene: (1) An aromatic hydrocarbon present in small proportion in some crude oils and made commercially from petroleum by the catalytic reforming of naphthenes in petroleum naphtha. Also made from coal in the manufacture of coke. Used as a solvent in manufacturing detergents, synthetic fibers, and petrochemicals and as a component of high-octane gasoline. (2) An aromatic hydrocarbon present to a minor degree in most crude oils. Some important products manufactured from benzene are styrene, phenol, nylon, and synthetic detergents.

Benzoic Acid Flakes: A common diverter. It can sublime or go directly from a solid to a gas.

B

Benzoyl Peroxide: A common initiator used to start chain-growth polymerization. It undergoes a decomposition reaction at the peroxide (O–O) bond. Here is a picture:



Berea Sandstone: Quarried sandstone with a UCS range of 4500 to 9000 psi, used commonly in laboratory flow testing.
Bernoulli's Equation: The equation used in the design of chokes that explains the manner in which pressure in the body of the choke, downstream of the first pressure drop, is lower than the eventual recovery pressure at the end of the choke.
Best Bid: In the context of bids for firm transportation capacity to be released, the highest bid that qualifies under the specified criteria.
Beta Factor (Flow): A correction factor for the Darcy equation to account for changes in pressure and fluid saturation along a fracture.
Beta Particle: An electron emitted with high energy and velocity from a decaying nucleus.
Beta Rating (Filtration): A conditional ratio requirement on a filtering system that compares the number of particles of a certain size in the unfiltered and filtered fluid. A beta rating of 1000 at 5 μm means that there is one particle of 5 μm or greater size in the filtered fluid for every 1000 particles of 5 μm or greater size in the unfiltered fluid.
Beta Wave (Gravel Packing): The returning wave of gravel after the alpha wave when packing a well over about 55° deviation.
Better Site Design: The practice of handling stormwater through nonstructural and natural approaches to new and redevelopment projects to reduce impacts on watersheds by conserving natural areas, reducing impervious cover and better integrating stormwater treatment. Better Site Design is similar to Low Impact Development (LID) and is one of the principles of Smart Growth.
BHA: See *Bottom hole assembly*.
BHCIP: Bottom hole closed in pressure.
BHCP: Bottom hole circulating pressure.
BHCS: Bottom hole compensated sonic.
BHCT: Bottom hole circulating temperature.
BHFP: Bottom hole flowing pressure.
BHFT: Bottom hole flowing temperature.
BHG: Bottom hole gauge.
BHIP: Bottom hole injection pressure.
BHL: Bottom hole location.

BHP: See *Bottom hole pressure.*
BHp: Brake horsepower.
BHp: See *Blinding boiler horsepower.*
BHPI: Bore hole pressure integrity.
BHS: Bottom hole seismic.
BHS: Bottom hole sample.
BHSIP: Bottom hole shut-in pressure.
BHST: Bottom hole static temperature.
BHT: See *Bottom hole temperature.*
BHTP: Bottom hole treating pressure.
BHTV: Bottom hole televiewer; a sonic caliper tool, not a television.
Bias Weld: A weld technique on diagonal cut strips of steel, superior to the butt-weld process for joining flat strips of metal together before rolling into coiled tubing.
BiC: Best in class.
Bicarb: Bicarbonate of soda, used in acid neutralization operations.
Bicarbonate: A compound containing the HCOO– ion.
Bicenter Bit: A bit that, when rotated, drills a hole larger than its diameter.
Bid: The price that market participants are willing to pay.
bid, bpd, or bbl/d: See *Barrels per day.*
Bidirectional Valve: Valve designed for blocking the fluid in upstream and downstream directions.
Bifuel Vehicle: A vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional fuel using only one fuel at a time.
Big Hole Charge (Perforating): A perforating charge with the liner shaped to create a large entrance hole but a shallow penetration. See *Deep penetrating charge*.
Bilateral Contract: An agreement between two willing parties. In a competitive electric market, bilateral contracts would be agreements between suppliers and customers that specify the terms and conditions for pricing and delivery of electric services.
Billion Cubic Feet: Volumetric unit of measurement used to measure the volume of large quantities of natural gas, abbreviated as bcf. One bcf equals one billion standard cubic feet, which is equivalent to 2.832×10^4 m^3.
Bill of Lading: A document by which the Master of a ship acknowledges having received in good order and condition (or the reverse) certain specified goods consigned to him by some particular shipper, and binds himself to deliver them in similar condition, unless the perils of the sea, fire or enemies prevent him, to the consignees of the shippers at the point of destination on their paying him the stipulated freight. A bill of lading specifies the name of the master, the port and destination of the ship, the goods, the consignee and the rate of freight; documentation legally demonstrating a cargo has been loaded. The bill of lading is signed by the Master of the ship and the contract supplier.

B

Bimetal Corrosion: A type of corrosion found when dissimilar metals are joined. One part becomes the cathode and the other the anode and accelerated corrosion may be seen.
Binder (Coating): The nonvolatile portion of a coating.
Bingham Plastic: A rheological model used to describe flow in some fluids. Bingham fluids have a linear shear-stress, shear-rate behavior after crossing an initial shear-stress boundary. Plastic viscosity (PV) is the slope of the line. Yield point is the threshold.
Bioaccumulation: A test measuring the concentration or buildup of potential harmful chemicals in a living organism.
Bioassay: An assay method using a change in biological activity as a qualitative or quantitative means of analyzing a material's response to biological treatment. A method of determining toxic effects of industrial wastes or other wastes using live organisms, for example, fish, as test organisms.
Bioaugmentation: Remediation technique that introduces natural hydrocarbon digesting bacteria and materials such as enzymes to remove hydrocarbons from soil, water, or even air.
Biochemical: Chemical change resulting from biological action.
Biochemical Oxygen Demand: (1) Biochemical oxygen demand is the oxygen demand by microorganisms during the stabilization of organic matter under prescribed condition, usually over a 5 day period; Biochemical oxygen demand 5 (BOD5) specifically denotes the oxygen demand over a 5 day period at 20°C. (2) The rate at which organisms use the oxygen in water or wastewater while stabilizing decomposable organic matter under aerobic conditions. In decomposition, organic matter serves as food for the bacteria and energy results from its oxidation. Biochemical oxygen demand measurements are used as a measure of the organic strength of wastes in water.
Biocide: A chemical or treatment that kills bacteria.
Biocompatible: A material may be regarded as biocompatible if it may be put into living organisms without rejection or detrimental effects. Materials may also be considered to be bioinert if they do not interact with the body at all (like titanium knee implants).
Biodegradable: Capable of being eaten or otherwise decomposed by some kinds of living creatures. Bacteria and fungi are the main culprits; we usually use the word edible for things that can be eaten by animals. It is important to consider the timescale involved; paper is biodegradable, but can remain for a very long time before getting decomposed. Most synthetic polymers are not easily biodegradable (poly(acrylamide) is a rare example of one that is readily degraded), but many are susceptible to breakdown by ultraviolet radiation from the sun and will crumble away in about the same time as an equivalent sheet of paper.
Biodegradation: (1) A process by which microbial organisms transform or alter, through enzymatic action, the structure of chemicals introduced into the environment. (2) Breakdown of heavier oil to a lighter hydrocarbon by bacterial action. (3) The breakdown of organic matter by bacteria to more stable forms which will not create a nuisance or give off foul odors.

Biodiesel: Any liquid biofuel suitable as a diesel fuel substitute, additive, or extender. A diesel substitute made from transesterification of oils of vegetables such as soybeans, rapeseed, or sunflowers (end product known as methyl ester) or from animal tallow (end product known as methyl tallowate). Biodiesel can also be made by transesterification of hydrocarbons produced by the Fisher–Tropsch process from agricultural byproducts such as rice hulls.
Bioflocculation: A condition whereby organic material tend to be transferred from the dispersed form in wastewater to a settleable material by mechanical entrapment and assimilation.
Biogenesis: Formed by the presence or the actions of living organisms, for example, coral reefs and atolls. Biogenesis is also the theory that all life is derived from previously living organisms.
Biogenic Gas: Bacteria generated natural gas, found at shallow depths and in many water wells. Usually contains Carbon 14 (C14) isotope. See also *Thermogenic gas* as a gas that has a biological origin but has been modified from the original organic state by time at temperature and other effects, to produce a gas with no C14.
Biogenic Source (Sedimentary Rocks): Rocks such as coal resulting from decomposition of animal or plant deposition.
Biogenic Theory: A theory of petroleum formation in which the petroleum is thought to have originated from plant and animal material that has undergone transformation from deep burial.
Biological Aerated Filter: A biological wastewater treatment process that utilizes fixed film media (i.e., expanded shale and polystyrene beads) for growth and retention of biological microorganisms responsible for BOD removal and nitrification.
Biological Marker: Compounds found in petroleum or rock extracts that possess a carbon chain or skeleton that contains a link with a natural product. Common biomarkers in petroleum include isoprenoids, triterpanes, and steranes.
Biological Process: A waste treatment process by which bacteria and other microorganisms break down complex organic materials into simple, nontoxic, more stable substances.
Biomass: (1) The amount of living matter in a given area or volume. (2) A mass or clump of organic material consisting of living organisms feeding on the wastes in wastewater, dead organisms, and other debris.
Biomass Gas: A medium Btu gas containing methane and carbon dioxide, resulting from the action of microorganisms on organic materials such as a landfill.
Biooxidation: A process where bacteria is used to stimulate oxidation reactions in aqueous circumstances.
Biophasic: The simultaneous flow of two immiscible fluids.
Biopolymer: (1) A polymer produced by a living plant, animal fungus, bacterium, or other biological entity. (2) Water soluble polymers produced by bacterial action on carbohydrates.

B

Biosolids: A primarily organic solid product produced by wastewater treatment processes that can be beneficially recycled. The word *biosolids* is replacing the word *sludge*.
Biostimulation: Stimulation of the growth of algae and other aquatic plants resulting from overfertilization of lakes, rivers, and estuaries.
Biostratigraphy: A segment of geoscience where fossils are used to date or identify a reservoir.
Biosurvey: A survey of the types and numbers of organisms naturally present in the receiving waters upstream and downstream from plant effluents. Comparisons are made between the aquatic organisms upstream and those organisms downstream of the discharge.
Biosynthesis: The production of a chemical by bacteria or other living organisms.
Biot: A theory of acoustic propagation in porous and elastic media that takes fluid behaviors into account.
Biot's Constant: The relationship between pore pressure and stress.
Bioturbation: Reworking of the sediment by burrowing animals.
Bioventing: Remediation technique that provides air to increase bacterial growth.
Bird: A device with moveable vanes attached to an underwater seismic streamer.
Bit: A sophisticated cutting tool utilized in drilling. Two types are currently used, rock bits (roller cone) and diamond bits. Roller cone bits are the most commonly used. High performance diamond bits are selected when their extended work life is important—most noticeably in deep wells and where operating costs are high.
Bit Breaker: A heavy plate that can hold the bit in the rotary table to make or break it from the drill string.
Bit Program: A plan for the expected number and types of bits that are to be used in drilling a well.
Bit Record: (1) A record of bit run, depth, rate of penetration, etc., in a wellbore. (2) A report that lists each bit used during a drilling operation.
Bit Rotary: The tool attached to the lower end of the drill pipe; a heavy steel head equipped with various types of cutting or grinding teeth of which some are fixed and some turn on bearings. A hole in the bottom of the drill permits the flow of drilling mud being pumped down through the drill pipe to wash the cuttings to the surface and also cool and lubricate the bit.
Bit Spudding: A bit used to start the borehole; a bit that is a variation of the fishtail or drag bit, one used in soft, unconsolidated, near-surface material.
Bit Sub: A short section inserted between the drill bit and the drill collar.
Bitumen: A noncrystalline solid or viscous mixture of complex hydrocarbons that possesses characteristic agglomerating properties, softens gradually when heated, is substantially soluble in trichloroethylene, and is obtained from crude petroleum by refining processes.

Bituminous: A relatively soft coal containing a tar-like substance called bitumen. It is of higher quality than lignite coal but of poorer quality than anthracite. It was usually formed as a result of high pressure on lignite. It is often referred to as black coal.
Bituminous Coal: A soft coal, intermediate in coal development, containing 15% to 20% volatiles.
Bituminous Coating: An asphatic or tar-based protective surface coating.
Bit Weight (Drilling): The applied downhole axial force component from the string weight.
Bit Whirl (Drilling): A bit's motion when it does not rotate about its center. This may manifest itself in out of round holes and severe bit damage. Generally a poor drilling performance.
B/L: See *Bill of lading*.
Black Oil: (1) A traditional crude oil containing alkanes (straight carbon chains) of C5 to C30+ liquids. (2) The heavy and dark petroleum products such as fuel oil. The distinction between black and white products is important for transportation purposes, as a black product carrier must be cleaned before it can be used to carry white oils. Black products may also be described as dirty cargoes.
Blackout: The failure of generation, transmission, or distribution systems resulting in complete loss of electric voltages.
Black Shale: A term that indicates a shale with a higher organic content than a brown or gray shale.
Black Start: The initial operation of a facility that begins with no utilities in service.
Blaine Fineness: A measure of the particle size of cement.
Blank: An unperforated piece of casing or tubing in an otherwise perforated section. Used for isolation.
Blanking Plug: A plug run to seal off tubing.
Blank Off: To close in the end.
Blast Furnace: A shaft furnace where solid fuel is burned with an air blast that smelts ore in a continuous operation using very high temperatures.
Blasting Cap: An initiating or detonating device in an explosive.
Blast Joint: An abrasion and erosion resistant tube that is run wherever direct sand impingement is a problem.
Bleed: To drain off liquid or gas, generally slowly, through a valve called a bleeder. To bleed down, or bleed off, means to release pressure slowly from a well or from pressurized equipment.
Bleeding: The tendency of a liquid component to separate from liquid–solid or semisolid mixture, as oil from lubricating grease in storage.
Bleeding Core: A permeable core from which hydrocarbon escapes without differential pressure application.
Bleed Off: To vent or drain off fluids from a pressured well.
Blender: The device that takes in fluid feed, mixes it in sand, and then transfers it onto the pump truck.

B

Blending: (1) The technique of combining two or more petroleum liquids to produce a product with specific characteristics. (2) The process of mixing two or more oils having different properties to obtain a product of intermediate properties.
Blending Components: See *Motor or aviation gasoline blending components*.
Blending Plant: (1) A facility that has no refining capability but is either capable of producing finished motor gasoline through mechanical blending or blends oxygenates with motor gasoline. (2) Manufacturing facility for the production of finished lubricants using a combination of base oils and chemical/oil based additives.
Blind Box: A flat bottom, short steel tool run on wireline to tag the surface of water or solids in the well. It is nearly the drift diameter of the tubular.
Blind Flange: A flange plate without an opening, normally used as seal-off assurance over an unused line.
Blinding Boiler Horsepower: Media clogging in various types of filters; equal to the evaporation of 34.5 lb of water at 212°F, having a total heat content of 33,472 Btu.
Blinding (Screen): Obstructing an aperture or opening by particles or debris.
Blind Nipple: A nipple that can be blocked off from formation pressure and give a false pressure measurement.
Blind Pool: (1) An oil and gas partnership that has not committed to a specified project at the time of amassing capital. (2) Money put into a drilling fund that is held by the fund managers until prospects for drilling are found. The rationale for the blind fund is that with ready money, the fund managers can act quickly when good opportunities for investments arise. Blind fund money usually is kept in an interest-bearing account while waiting for a hot prospect.
Blind Rams: The ram sections in a blowout preventer that are used to close against each other and isolate the well when no pipe is in the well.
Blind Zone: A layer of rock that cannot be detected by seismic or in logging where the recorded resistivity is too low.
Blister Copper: An impure intermediate product in the refining of copper, produced by blowing copper matte in a converter.
Blistering (Elastomer): A surface deterioration caused by gas trying to escape too rapidly from an elastomer and tearing the surface of the material.
Blistering (Steel): Surface corrosion associated with gas adsorption.
BLM: US Bureau of Land Management.
BLM (Wireline): Braided line measurement.
Block: (1) The subdivision of a nation's exploration and production acreage. Blocks are generally defined in terms of latitude and longitude, at 1° intervals. (2) A geographic area that includes several separate oil and gas license tracts. (3) One or more pulleys, or sheaves, mounted onto a common framework in order to rotate on a common axis. The crown block is an assembly

of sheaves mounted on beams at the top of the derrick or mast. The traveling block is an assembly of sheaves mounted on a framework that allows the block to move up and down using the drilling line that is reeved over the crown block sheaves and through the traveling block sheaves.

Block Caving: A method of caving where a substantial block of ore is partly cut from the adjoining blocks by a series of drifts that are removed by undercutting the ore.

Block Fault: A set of formation blocks, separated by normal faults into different elevations.

Block (Flow): An obstruction to flow, either partial or full.

Block (Lease): A large geographical lease area that may contain separate structures, proven fields, or other interests.

Block Leases: A contract with diverse owners of separately leased oil and gas tracts that enables an oil company to drill one or two test wells instead of one well per tract.

Block Number: The numerical designation assigned to offshore lease and license tracts, or subdivisions of the tracts.

Block (Rigging): A pulley (sheave) or a set of pulleys, mounted in a housing. The blocks on a rig are the crown (stationary) block at the top of the derrick and the traveling block.

Block Squeeze: A cement squeeze into an area of perforations. Often done initially over the frac pressure.

Block Valve: The valve that blocks flow into the downstream conduit when in the closed position.

Bloodborne Pathogen: A disease causing organism which lives in the blood and some other types of body fluids of infected persons.

Blooie Line: A straight through flow line from a wellhead to a flare pit. Often used in diverting flow during a well-control incident.

Bloom: The fluorescent color of lubricating oil as shown by reflected light when this color differs from that shown by transmitted light.

Blue Gas: Gas volume that separates from the water produced.

Blow Down: (1) The depress ring of a reservoir through production of gas. This can occur with either gas or oil reservoirs at any stage in their life cycle. (2) Condensate and gas produced simultaneously from the outset of production. (3) Discharge of water from a steam boiler or other recirculating system that contains high total dissolved solids.

Blowdy: Free gas separating from the liquid at the bottom of the separator. Generally indicates poor separator performance.

Blower: A device used to ventilate manholes and lift stations.

Blowing a Well: Opening a well to let it blow for a short period to free the well tubing or casing of accumulations of water, sand, or other deposits.

Blow Molding: A plastics-forming process that uses compressed air to shape the final product by expanding it to fit the mold.

Blown Bitumen: A bitumen for uses other than road making prepared by blowing air through a base feed-stock under controlled conditions.

B

Blowout: (1) An uncontrolled flow of gas, oil, or water from a well due to the release of pressure from a reservoir possibly due to the failure of the containment system. (2) An uncontrolled release of fluids from a well.
Blowout Preventer: (1) A special assembly of heavy-duty valves, commonly called the blowout preventer stack, installed on top of a well which can be closed to prevent high-pressure oil or gas from escaping (a blowout) from the well hole during drilling operations. (2) A conditional surface-pressure barrier often consisting of a set of hydraulically operated rams containing equipment designed to grip pipe, seal around pipe, shear off pipe, or seal an open hole during drilling or a workover. It may also contain an annular preventer.
Blowout Preventer Control Panel: A device to control, open and close the blowout preventers. See *Blowout preventer*.
Blowout Preventer Control Unit: A device that stores hydraulic fluid under pressure in special containers and provides a method to open and close the blowout preventers.
Blowout Preventer Stack: The assembly of well-control equipment including preventers, spools, valves, and nipples connected to the top of the wellhead.
BLPD: Barrels of liquid per day.
Boatswain (Bosun): On an LNG vessel, tantamount to a foreman; directly supervises maintenance operations.
BOD (Design): Basis of design.
BOD (Reaction): See *Biochemical oxygen demand*.
BOD5: Refers to the five-day biochemical oxygen demand. The total amount of oxygen used by microorganisms decomposing organic matter increases each day until the ultimate BOD is reached, usually in 50 to 70 days. BOD usually refers to the five-day BOD or BOD5.
Body: Any portion of the wellhead or tree that contains wellbore pressure.
Body Lock Rig: Locks slips, mandrels, or cones in place in a downhole tool.
BOE: Barrels of oil equivalent. A method of equating the energy produced by a hydrocarbon gas to a standard oil measurement. One barrel of oil has about the same heat producing capacity as 6000 ft^3 of gas at standard conditions.
Bohlin: A specialized viscosimeter.
Boiler: (1) A closed vessel in which a liquid is heated or heated and evaporated. Boilers are often classified as steam or hot water, low pressure or high pressure, and capable of burning one fuel or a number of fuels. (2) Vessel in which a liquid is heated with or without vaporization; boiling need not occur.
Boiler Feed Pump: Pump which returns condensed steam, makeup water, or both directly to the boiler.
Boiler Feed Water: Water supplied to a boiler by pumping.
Boiler Horsepower: Equivalent to 33,475 Btu/h.
Boiling Point: The temperature at which the pressure exerted by molecules leaving a liquid equals the pressure exerted by the molecules in the air above it. A free-for-all of molecules leaving the liquid then ensues. In a solution,

the boiling point will be increased by a number that depends on the number of particles in solution:

$$\text{delta}(T) = K_b \times (\text{number of solute molecules per liter})$$

where
delta(T) is the rise in the boiling point
K_b is called the *ebullioscopic constant* and varies from one solvent to another

Boiling Range: The spread of temperatures, usually expressed in degrees Fahrenheit, over which oil starts to boil or distill vapors and proceeds to complete evaporation. Boiling range is determined by ASTM test procedures for specific petroleum products.
Boiling Temperature: Temperature at which steam bubbles begin to appear within a liquid. When the fluid is a pure compound, the boiling point is unique for each pressure.
Boil Off: A small amount of LNG evaporates from the tank during storage, cooling the tank and keeping the pressure inside the tank constant and the LNG at its boiling point. Rise in temperature is countered by LNG being vented from the storage tank.
Boil-Off Vapor: Usually refers to the gases generated during the storage of volatile liquefied gases such as LNG. Natural gas boils at slightly above –163°C at atmospheric pressure and is loaded, transported, and discharged at this temperature, which requires special materials, insulation and handling equipment to deal with the low temperature and the boil-off vapor (heat leakage keeps the cargo surface constantly boiling).
Bomb: A thick-walled pressure container of pressure measuring instruments or a sample container.
Bomb Hanger: Hanger for bottom hole–pressure recorder (bombs).
Bond: The level of adherence of one substance to another.
Bonded Petroleum Imports: Petroleum imported and entered into customs-bonded storage. These imports are not included in the import statistics until they are (1) withdrawn from storage free of duty for use as fuel for vessels and aircraft engaged in international trade or (2) withdrawn from storage with duty paid for domestic use.
Bonding: A very low-impedance path accomplished by permanently joining noncurrent-carrying metal parts. It is done to provide electrical continuity and to offer the capacity to safely conduct any current.
Bonding Conductor: The conductor that connects the noncurrent-carrying parts of electrical equipment, cable raceways, or other enclosures to the approved system ground conductor.
Bonding Jumper: A conductor used to assure the required electrical connection between metal parts of an electrical system.
Bonnet: The section of the valve housing that covers the stem and protects the seals.

B

Bonus: Usually, the bonus is the money paid by the lessee for the execution of an oil and gas lease by the landowner. Another form is called an oil or royalty bonus. This may be in the form of an overriding royalty reserved to the landowner in addition to the usual one-eighth royalty.
Bonus money (Contract): Any funds paid to a mineral owner in addition to least of royalties.
Book Value: The current value of an asset (e.g., an oil field) as recorded in the owner's balance sheet. This will not necessarily equate to the market value of the asset. Rather it reflects the historical capitalized cost less depreciation charged to date.
Booster: A pump system installed to maintain or increase pressure in pipelines so that liquids and gases keep flowing.
Booster Cap: A detonating cap between two detonating cords in a series of perforating guns.
Booster Pump (Pipeline): A pump located along the length of a pipeline to raise the pressure and overcome friction or elevation losses.
Booster Station: An installation built in an onshore or offshore pipeline to increase the pressure of the fluid in the pipeline. Also applies to oil and NGL pipelines. See *Compressor station*.
Boot Sub: A device run in the drill string just above the mill to catch cuttings.
BOP: See *Blowout preventer*.
BOPD: Abbreviation of barrels of oil per day. See *Barrels per day*.
BOP Stack: See *Blowout preventer stack*.
Borax Logging: A test technique using an injected solution of borax and a detection tool to spot channels.
Bore: The inside diameter of a tool or pipe.
Borehole: (1) The hole in the earth made by the drill; the uncased drill hole from the surface to the bottom of the well. (2) The hole as drilled by the drill bit.
Borehole Compensated Sonic: A log that measures the interval transit time for a compression wave to move a unit of distance, usually 1 ft.
Borehole Televiewer: A sonic caliper, developed in the late 1960s, which generated a sonar picture of the wellbore.
Bore Polishing: Excessive smoothing out of the surface finish of the cylinder bore in an engine to give it a mirror-like appearance, resulting in depreciation of ring sealing and oil-consumption performance.
Bottled Gas: Liquefied petroleum gas (LPG) stored in a liquid state in steel containers at moderate pressure and ambient temperatures. (2) Trade term for LPG or LP-gas.
Bottle Neck: A restriction in a flow path.
Bottom Casing Packoff: The seal in the annulus between a hanging pipe and the next pipe outward.
Bottom Hole: The lowest or deepest part of a well.
Bottom Hole Assembly: (1) The components, together as a group, that make up the lower end of the drill string comprising the drill bit, drill collars, drill pipe, and ancillary equipment. (2) The portion of the drilling assembly

below the drill pipe. It can be very simple, composed of only the bit and drill collars, or it can be very complex and be made up of several specialty components. (3) The equipment or tools at the bottom of the tubing or drill string. It is often changed to achieve the desired result. (4) The lower end of the drill string or drilling string comprising the drill bit, drill collars, heavy weight drill pipe (mud motor if present), and other ancillary equipment; the business end of the drill string.

Bottom Hole Choke: A restriction in a profile near the bottom of the well that allows some gas expansion and holds a backpressure on the formation. Rarely used, but considered for hydrate control.

Bottom Hole–Gas Separator: Gas anchor or separator used in front of a pump to deflect most of the free gas to improve pump efficiency.

Bottom Hole Plug: A bridge plug or cement plug placed near the bottom of the hole to shut off a depleted, water-producing, or unproductive zone.

Bottom Hole Pressure: The pressure at the bottom of the well. In a producing well the bottom hole pressure may be the bottom hole flowing pressure or the bottom hole shut-in pressure. In a drilling or work over environment, the bottom hole pressure is exerted by the column of fluid in the hole.

Bottom Hole Pressure Test: A test that measures the reservoir pressure of the well, obtained at a specific depth or at the midpoint of the producing zone. A flowing bottom hole pressure test measures pressure while the well continues to flow; a shut-in bottom hole pressure test measures pressure after the well has been shut in for a specified period of time. See *Bottom hole pressure*.

Bottom Hole Pump: Any of the rod pumps, high-pressure liquid pumps, or centrifugal pumps located at or near the bottom of the well and used to lift the well fluids.

Bottom Hole Sampler: A tool that takes bottom hole samples of fluids or solids.

Bottom Hole Temperature: (1) Static (noncirculating, nonflowing, and stable), flowing, or circulating temperature at the bottom of the well. (2) In deep wells, 15,000 ft and deeper, bottom hole temperatures are above the boiling point of water, ranging up to 400°F. At these depths and temperatures, water based–drilling muds cannot be used and only oil based–drilling muds can be used.

Bottom Out: (1) The final drilling depth. (2) To reach the objective depth in drilling a well.

Bottom Plug: (1) In cementing, the first plug pumped with the two-plug system. It isolates the mud and cement slurry and allows passage of the cement slurry when the plug *bumps* or reaches the float shoe or float collar. It is hollow with a diaphragm that is ruptured by pressure. (2) A cement wiper plug that precedes cement slurry down the casing. The plug wipes drilling mud off the walls of the casing and prevents it from contaminating the cement. See *Cementing*, *Wiper plug*.

B

Bottoms: The heavy portions, or fractions, of a crude oil that do not vaporize during distillation; the accumulation of sediments, mud, and water in the bottoms of lease tanks.
Bottom-Shot Detector: A device in a perforating gun that signals through a delayed shot or sound that the detonating cord has fired to the bottom of a gun.
Bottoms Up: Circulating the bottom hole fluid to the top of the well.
Bound Fluid Log: A log that measures bound-fluid volume.
Bound Water: Water that is trapped in or on the matrix minerals and cannot move.
Bowl: A section of the wellhead or of a tool that allows slips to be inserted to hold pipe or equipment.
Bow Spring Centralizer: A low to moderate strength centralizer formed by arched, spring-like straps of metal.
Bow Thrusters: Propeller at the lower sea-covered part of the bow of the ship which turns at right angles to the fore-and-aft line and thus provides transverse thrust as a maneuvering aid.
Box: The female part of the connection.
Box Tap: Another name for a tapered tap. Used to screw into boxed off connections.
Box Threads: (1) The threads in the box or female connection. (2) Threads in the female section, or box, of a tool joint. See *Tool joint*.
Boycott Settling Range: The deviation between 30° and 60° where refluxing (dropout and reverse flow) of particles and heavier liquid occurs in a lower rate well. The area in which gas bubbles may rise through fluid at about 4 to 7 times than that in a vertical well.
BPD: See *Barrels per day*.
BPM: Abbreviation of barrels per minute; the pumping rate of small rotary pumps.
B Profile: Seldom used name for an SSSV profile.
Bracelet Anodes: Clamshell-type rings of anodes that clamp around a pipeline.
Brackish Water: Indefinite term meaning water with small amounts of salt. Saltier than fresh water.
Bradenhead: (1) A packer or pack off installed at surface on a well that enables the use of one size pipe inside another and allows flow into or out of each pipe separately. (2) An older (actually trademarked) name for the wellhead.
Braided Stream: A depositional environment with several channels that may or may not be connected.
Braided Wireline: A strong wireline of various sizes used in retrieving tools heavier than slickline can handle. Electrical line is a braided line with a center conductor.
Brake: The braking device on the drawworks or air hoist to stop a load being lifted. It is a device for arresting the motion of a mechanism, usually by means of friction, as in the drawworks and air hoist brakes.

Brake Band: A part of the brake mechanism consisting of a flexible steel band lined with a material that grips a drum when tightened. On drawworks, the brake band acts on the drum to control the lowering of the traveling block and its load.
Brake (Drilling): The main device for stopping the travel of the drawworks of a rig when running or pulling a drill string.
Branch Circuit: Conductors between the last overcurrent device and the outlets.
Branch Circuit (General Purpose): A branch circuit that supplies outlets for lighting and power.
Branch Circuit (Individual): A branch circuit that supplies only one piece of equipment.
Branch Circuit (Multiwire): A branch circuit having two or more ungrounded circuit conductors, each having a voltage difference between them, and a grounded circuit conductor (neutral), having an equal voltage difference between it and each ungrounded conductor.
Branch Connection: A pipe connection.
Branch Sewer: A sewer that receives wastewater from a relatively small area and discharges into a main sewer serving more than one branch sewer area.
Brazed Aluminum Heat Exchanger (Plate Fin Heat Exchanger): Heat exchanger made of overlapping aluminum plates. Fluids flow through channels carved on the surface of the plates. These channels are connected to inlet and outlet manifolds.
Break: A fracture or opening in a pipe, manhole, or other structure due to structural failure and/or structural defect.
Break an Emulsion: To separate the emulsion into its components.
Break Bulk: To commence the discharge of cargo.
Break Circulation: (1) To start the mud pump for restoring circulation of the mud column. Because the stagnant drilling fluid thickens or gets gelled during the period of no circulation, higher pump pressure is usually required to break circulation. (2) Start circulating fluid from a static condition.
Breaker: A chemical added to a gel that breaks down the gellant structure.
Breaker Points: Contacts that interrupt the current in the primary circuit of an electrical system, such as in a spark-ignition engine.
Breakfast Cereal: A possible future application of synthetic polymers. Using polyester instead of wheat could give a product with a much longer shelf life, and you probably couldn't tell the difference once it is covered with sugar and artificial coloring.
Breaking Down (Drill String): To separate the stands into single joints.
Breakout: (1) Occurrence when one section of drill pipe is unscrewed from another (deliberately on the drill floor). (2) To unscrew one section of pipe from another section, especially drill pipe, while it is being withdrawn from the wellbore. During this operation, the tongs are used to start the unscrewing operation. (3) To separate, for example, gas from a liquid or water from an emulsion. (4) Unscrewing a joint of pipe.

B

Breakout Block: A plate that fits in the rotary table and holds the drill bit while it is being unscrewed from the drill collar.
Breakout Cathead: A device attached to the catshaft of the drawworks, used as a power source for the tongs that is used in unscrewing the drill pipe; usually located opposite the driller's side of the drawworks.
Breakout (Drilling): An enlargement of the borehole.
Break Point: The point in time when the effluent contaminant concentration in a controlled air stream (usually an adsorption device) begins to increase as the adsorbing device becomes saturated.
Breakthrough: (1) A flood front breaking through into a producing well. (2) In an adsorption device, the increase in outlet concentration of the controlled contaminant from the break point as the adsorbing media reaches saturation.
Break Tour: To start a work shift.
Break Tour (Pronounced *Tower*): To begin operating 24 h a day. Moving the rig and rigging up are usually carried out only during daylight hours. When the rig is ready for operation at a new location, crew break tour.
Breathing: The movement of gas (oil vapors or air) in and out of the vent line of storage tanks due to daily temperature changes. A cause of evaporation losses in light oil products in storage.
Breccia: Fragmented (not wear-rounded) grains. Rocks along moving faults may have this texture.
Breeching: Passage for conducting the products of combustion from a fuel-fired appliance to a vent or chimney.
Brent: A large oil field in the UK sector of the North Sea. Its name is used for a blend of crudes widely used as a price marker or benchmark for the international oil industry. Brent crude currently has an average quality of 38°API.
Brent Blend: A light, sweet crude oil produced in North Sea; a benchmark for pricing of many foreign crude oils.
Bridge: (1) Loosely used to refer to the navigating section of the vessel where the wheelhouse and chart room are located; erected either amid ship, aft, or very rarely fore over the main deck of a ship. (2) A blockage in the wellbore caused by a mass of particles that lock together and prevent pipe movement or flow.
Bridge Plug: A permanent or retrievable plug set typically on wireline to isolate a section of the well.
Bridging: (1) Collection of materials, usually from the formation that interlocks at some point in the well, often in the annulus and may stop flow or stick the pipe in place. (2) An expandable plug used in a well's casing to isolate producing zones or to plug back to produce from a shallower formation; also to isolate a section of the borehole to be filled with cement when a well is plugged.
Bridging Material: Fluid loss control material that bridges against the leak-off site.

Bridle (Beam Lift): The wire rope attachment of the horse's head to the polish rod on a beam lift pump jack.
Bridle (Logging): The insulated, downhole end of a logging cable.
Bright Spot: A specific seismic reflection that may indicate gas.
Bright Stocks: High viscosity, fully refined, and dewaxed lubricating oils produced by the treatment of residual stocks and used to compound motor oils.
Bright Water™: A water control product.
Brine: A mixture of water and a soluble salt. Most common brines are sodium chloride (NaCl), potassium chloride (KCl), and calcium chloride ($CaCl_2$). Brine densities may range from 8.33 to > 19 lb/gal (1 to >2.28 g/cc). The USGS definition of brine is a salinity of more than 35,000 mg/L (after USGS, 1984).
Brinell Hardness: A measure of the hardness of the material, generally measured by pushing a small ball into the surface and measuring the force used to displace the ball to a set depth.
Briquette: A block of compressed charcoal that is used as fuel.
British Thermal Unit (Btu): An energy unit; the quantity of heat necessary to raise the temperature of 1 lbm of water 1°F from 58.5°F to 59.5°F under a standard pressure of 30 in. of mercury at 32°F. The following conversions would apply to natural gas that contains exactly 1000 Btu per cubic foot, which is approximately true for most gas delivered in the United States:

1 cubic foot (cf) = 1,000 Btu
1 therm 100 cf = 100,000 Btu
1 thousand cf = 1 million Btu
1 billion cf = 1 trillion Btu
1 trillion cf = 1 quad 1 quadrillion Btu

Brittle Fracture: A fracture created with little or no plastic deformation.
Broach: A device used to reround slightly collapsed tubulars.
Broaching (Flow): Venting of fluids to surface through channels in cement or behind pipe (well control barrier failure) or unintended fracturing into an adjacent formation.
Broker: (1) Gas merchant who charges a fee for matching sellers to buyers and who may help arrange gas transportation, but does not take title to the gas. (2) An agent employed to buy or sell goods or to negotiate for a principal. A broker in the oil industry is a person who executes the buy and sell orders of a customer in return for a commission or fee. The broker is usually paid by the seller and is thus legally the seller's agent.
Brookfield Rheometer: A viscometer used for some fluid measurements, particularly when solid suspension properties are needed.
Brown Coal: See *Lignite*.

B

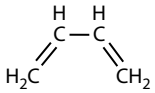
Brownfield: (1) An existing onshore or offshore facility, for example, *brownfield modification* is an upgrade to an existing facility. (2) A mature field on decline or in the final stages of productive life.
Brownian Motion: Irregular motion of colloidal-sized particles when suspended in a fluid. The effect in simplest terms is caused by thermal-driven motions.
BRT (Drilling): Below rotary table.
Brunei: Small country on the north coast of Borneo; wealthy because of its large deposits of crude oil. The Sultan of Brunei has a property in the Northern Territory that is larger than the country.
BS&W: Bottom settlings and water. The heavy material which collects in the bottom of storage tanks, usually composed of oil, water, and foreign matter.
BSD: Operating capacity of a refinery expressed in barrels per day the unit is operating or *on stream*.
BTM: Buoyant turret mooring. Developed for typhoon or iceberg prone areas where a rapid disconnection/reconnection is required. The disconnectable part of the turret is a submerged buoy which supports the crude oil and gas risers and the mooring legs. In the operating mode, the mooring buoy is connected to the turret by a structural connector. The turret structure is located in the forepeak of the tanker and is supported on a weathervaning bearing. The turret extends up through the tanker with the reconnection winch, flowline and control manifolds, and fluid swivels located above the main deck. The disconnection and subsequent reconnection is carried out from the tanker without external intervention.
Btu: British thermal unit. Btu is the standard unit of measurement for heat. A Btu is defined as the amount of energy needed to raise the temperature of 1b of water 1°F from 58.5° to 59.5° under standard pressure of 30 in. of mercury.
BTX: The acronym for the commercial petroleum aromatics benzene, toluene, and xylene. See *Benzene*, *Toluene*, and *Xylene*.
Bubble Flow: Flow of liquids enabled by the rise of gas bubbles in a well.
Bubble Point: (1) The temperature and pressure at which a liquid first begins to vaporize into gas. (2) The temperature at which the first bubbles appear when a liquid mixture is heated. (3) The pressure at which gas begins to break out of under-saturated oil and form a free gas phase in the matrix or a gas cap.
Buckling: The deformation of pipe in compression as it moves from straight to sinusoidal to helical shapes in the hole, usually in the elastic range.
Buckling Point: The point in the well or the weight applied where the pipe buckles (sinusoidal bending) and stops or significantly slows when the pipe is running in a horizontal well.
Buck Up: (1) To tighten a connection. (2) To tighten up a threaded connection (such as two joints of drill pipe).
Buffer: (1) A chemical used to keep the pH in a certain range without extremes of high or low pH. (2) A solution or liquid whose chemical makeup neutralizes acids or bases without a great change in pH.

Build Angle: The angle of the inclination in the kickoff section when describing a deviated well.
Building Sewer: A gravity-flow pipeline connecting a building wastewater collection system to a lateral or branch sewer. The building sewer may begin at the outside of the building's foundation wall or at some distance (such as 2 to 10 ft) from the wall, depending on local sewer ordinances. Also called a *house connection* or a *service connection*.
Building Wastewater Collection System: All of the wastewater drains pipes and their hardware that connect plumbing fixtures inside or adjacent to a building to the building sewers. This includes traps, vents, and cleanouts.
Build Ramp: The rate of increase of the deviation of a well.
Build Section: The part of the wellbore that is changing deviation, usually building toward a maximum deviation angle.
Bulk Cargo: Any liquid or solid cargo loaded on to a vessel without packaging (e.g., oil or LNG).
Bulk Density: (1) The amount of mass of a soil per unit volume of soil, where mass is measured after all water has been extracted and total volume includes the volume of the soil and that of air space between the soil grains. (2) The density of a rock as it naturally occurs (as compared to the specific density of the grains). Includes the pore structure.
Bulkhead: Name given to any vertical partition that separates different compartments or spaces from one another on a ship.
Bulking: A decrease in the settleability of an activated sludge, as measured by a significant rise in the Sludge Volume Index.
Bulk Modulus (K): Applied stress over change in volume.
Bulk Mud Components in Storage: Hopper type tanks for storage of drilling-fluid components.
Bulk Plant or Bulk Terminal: Wholesale receiving and distributing facilities for petroleum products. Commonly includes railroad sidings, truck-loading racks, and sometimes water and product pipeline receiving facilities; storage tanks for gasoline, kerosene, and heating oils; warehouse for storing and handling lubricating oils, greases, and other products sold in drums and packages.
Bulk Station: A facility used primarily for the storage and/or marketing of petroleum products, which has a total bulk storage capacity of less than 50,000 barrels and receives its petroleum products by tank car or truck.
Bulk Tank: On a drilling rig, a large metal bin that usually holds a large amount of a certain mud additive, such as bentonite, that is used in large quantities in the makeup of the drilling fluid.
Bulk Terminal: A facility used primarily for the storage and/or marketing of petroleum products, which has a total bulk storage capacity of 50,000 barrels or more and/or receives petroleum products by tanker, barge, or pipeline.
Bullet Gun: An older perforating method where hardened steel bullets were fired from short barrels and designed to penetrate the casing, cement, and formation.

B

Bullet Perforator: A tubular device that, when lowered to a selected depth within a well, is engaged in forcing the projectiles (bullets) through the casing and cement to provide holes through which the formation fluids may enter the wellbore.
Bullet Tanks: Horizontal pressure tanks that are the shape of a very fat bullet. Bullet tanks are used to store normal butane, propane, and propylene.
Bullheading: Forcing fluids in the pipe into the formation at a pressure higher than the pore pressure and sometimes higher than the fracturing breakdown pressure; used to displace a kick out of the pipe when wellbore and wellhead pressure limits permit.
Bull Plug: A screw-in plug, normally used at the bottom of a string if no fluid entry is desired.
Bull Wheel: Old term for a large, often wooden wheel, in a cable tool rig.
Bump Down: Lengthy rod string stroke hitting the bottom of the pump.
Bumped: In cementing operations, pertaining to a cement plug that comes to rest on the float collar.
Bumper Block: Timbers wrapped with wire mesh or other retaining medium located below the crown to act as a cushion in the event the block is raised too far.
Bump the Plug: Reaching the bottom with the plug during a cementing operation or fluid displacement operation.
Bunker C Fuel Oil: A heavy residual fuel oil used by ships and industry and for large scale heating installations, similar in requirements to No. 6 grade fuel oil.
Bunker Fuel: Any diesel or fuel oil supplied to fuel a ship's engines, that is, to run the ship rather than as cargo to be transported for sale. The *bunkers* are the place where the fuel is stored in the ship.
Bunker Fuel Oil: A heavy, residual fuel oil used in ships' boilers and large electric power–generating plants.
Bunkers and Stock Changes: Energy used in ocean vessels and energy consumed from countries' and users' own energy stocks.
Buoy: A floating object employed as an aid to mariners to mark the navigable limits of channels, their fairways, sunken dangers, isolated rocks, telegraph cables, and so forth; reference points for navigation.
Buoyancy: The amount of weight that is offset by the lift from the fluid when a piece of equipment is immersed in the fluid.
Buoyed Weight: The weight of a string or a piece of equipment immersed in the wellbore fluid. It is strongly dependent on the density of the wellbore fluid.
BUR (Drilling): buildup rates, increase in well inclination during drilling.
Burner: Part of a fuel-burning device (as a boiler or furnace) where flame is produced.
Burner Capacity or Rating (Flare): The maximum Btus that can be released from a burner while burning with a stable flame and satisfactory combustion.
Burner Fuel Oils: Trade term for distillate and residual oils sold for heating homes and buildings.

Burner Tip: The point at which natural gas is used as a fuel.
Burning Oil: Kerosene, mineral seal, or other light petroleum oils of such gravity and other properties that can be used for illuminating and similar purposes.
Burning Point: The lowest temperature at which a volatile oil in an open vessel will continue to burn when ignited by a flame held close to its surface. It determines the degree of safety with which kerosene and other illuminating oils can be used.
Burning Shoe: Usually a flat bottom mill.
Burn Over: To mill a piece of equipment (and often to catch it with an overshot).
Burr: A raised metal lip, for example, around a perforation.
Burst: The internal fluid pressure that causes the onset of pipe yield.
Burst Disk: A frangible disk designed to release pressure at a specific level.
Burst Rating: The actual minimum burst pressure derated by a safety factor. The derated burst is used as a maximum when pumping.
Bushing: (1) A pipe fitting on which the external thread is larger than the internal thread to allow two pipes of different sizes to be connected. (2) A removable lining or sleeve inserted or screwed into an opening to limit its size, resist wear or corrosion, or serve as a guide.
Butadiene: (1) A butane derivative that is one of the most widely used raw materials in the manufacture of synthetic rubber. (2) Common monomer in chain-growth polymerization; an important constituent of acrylonitrile-butadiene-styrene (ABS) rubber. Here is a picture:



Butane: A normally gaseous straight-chain or branch-chain hydrocarbon extracted from natural gas or refinery gas streams. It includes isobutane and normal butane and is designated in ASTM Specification D1835 and Gas Processors Association Specifications for commercial butane. See *Isobutane* and *Normal butane*.
Butane Splitter: A type of fractionator vessel at a gas reformer plant that produces commercial propane as well as normal and isobutanes. Splitters are fired with natural gas to provide heat for the distillation.
Butterfly Valve: A quick opening, low pressure valve, common in large openings through which solids move, which allows high flow rate when open.
Button: A small disk-shaped electrode used in microresistivity pads.
Button Slip: A slip for high-alloy (hard) casing.
Button-Up: Secure the well or close in.
Butylene: (1) An olefinic hydrocarbon recovered from refinery processes. (2) Butylene is a colorless, flammable, and liquefied gas with detectable odor.

Butylenes are formed during the cracking (breaking down of large molecules) of petroleum fractions. It is used for the production of high-octane gasoline, secondary and tertiary butyl alcohols, and synthetic rubber.

Buy Back Agreement: (1) An agreement between a host government and a contractor under which the host pays the contractor an agreed price for a piece of work, usually the development of an oil or gas field. Once the development is completed and hydrocarbons are being produced, the contractor will be paid back its costs (cost recovery) often with interest and will receive a profit element, often referred to as a remuneration fee. The contractor will often be penalized for not delivering the development on time or on budget and will usually benefit from delivering under budget. Once the contractor has received all of its remuneration, it ceases to be a partner in the project that reverts to the national oil company. (2) Agreement between a host and a contract lease holder under which the host pays the contractor an agreed price for all or part of the produced hydrocarbons.

Buy/Sell Arrangement: An agreement whereby a party sells gas at the wellhead to a party with priority space in the pipeline queue, and then repurchases the gas downstream, paying transmission costs and any prearranged differentials.

BWOB: By weight of the blend.

BWOC: By weight of cement.

BWOW: By weight of water.

BWPD: Barrels of water per day.

BW Rod Thread: A thread for tools and equipment that has three parallel threads per inch (similar to an AW thread); used in applications greater than 1.75″ OD.

BX Ring: A metal-to-metal seal for a flange.

Bypass: (1) A pipe connected around a valve or other control mechanism in a flow line for the purpose of maintaining flow during adjustments or repair work. (2) A pipe, valve, gate, weir, trench, or other device designed to permit all or part of a wastewater flow to be diverted from usual channels or flow. Sometimes refers to a special line which carries the flow around a facility or device that needs maintenance or repair. In a wastewater treatment plant, overload flows should be bypassed into a holding pond for future treatment.

Byproduct: (1) A substance obtained incidentally during the manufacture or production of some other substance. (2) A secondary or additional petroleum product not of primary importance in the conventional refinery operating schedule such as residual fuel oil, coke, asphalt, and road oil.

Byproduct (Reaction): A product, sometimes undesirable, of a reaction designed to create something else.

C

C: See *Celsius*.
C&F: See *Cost & freight*.
C_2H_4: See *Ethylene*.
$(C_2H_4)_nH_2$: See *Polyethylene*.
C_2H_5OH: See *Ethanol and Fuel ethanol*.
C_2H_6: See *Ethane*.
$C_2H_6O_2$: See *Ethylene glycol*.
C_3H_6: See *Propylene*.
C_3H_6O: See *Propylene oxide*.
C_3H_8: See *Propane*.
$C_3H_8O_2$: See *Propylene glycol*.
C_4H_{10}: See *Butane, Isobutane, and Normal butane*.
$C_4H_6O_2$: See *Vinyl acetate*.
C_4H_8: See *Butylene and Isobutylene*.
C_6H_{14}: See *Hexane and Isohexane*.
$C_6H_4(CH_3)_2$: See *Xylene*.
$C_6H_5CH_3$: See *Toluene*.
C_6H_6: See *Benzene*.
CAA: Clean Air Act.
Cabinet Heater: A heating unit, usually wall mounted, which is enclosed in a cabinet. This device usually relies upon convection as the method of heating.
Cable: One of various braided cables, with or without isolated conductance wires, used for well operations.
Cable Head: The connection of the braided cable to the rope socket or attachment to the tool string in a wire line-conveyed BHA.
Cable Tool Rig: (1) A type of drilling device used from the 1850s to the 1930s that employed a heavy chisel-like bit, which was suspended on a cable and dropped repeatedly into the rock at the bottom of the hole. (2) An early drilling rig that uses a heavy chisel bit on a cable, dropped vertically, to pound through rocks.
$CaBr_2$: Calcium bromide.
CAC: See *Criteria air contaminants*.
$CaCl_2$: Calcium chloride salt.
$CaCO_3$: Calcium carbonate.
Cage Wrench: A wrench for connecting the cage of a sucker rod pump to the rod string.
Caisson (Pipe): Large outer pipe, often a form or a barrier.

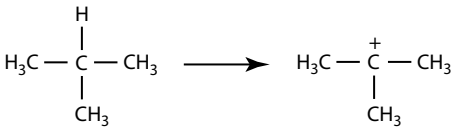
C

Cake: Filter or mud cake, stranded by dehydration on the face of a permeable formation by fluid loss.
Calcareous Coating: A calcium carbonate coating.
Calcite: Calcium carbonate ($CaCO_3$). May be rock (limestone) or a scale formed from supersaturated solution at the site of a chemical or physical upset.
Calcium Bromide: $CaBr_2$, water-soluble brine weighting agent.
Calcium Carbonate: $CaCO_3$, limestone, a common formation or, when in particles, a weighting or fluid loss agent.
Calcium Chloride: $CaCl_2$, a water-soluble brine weighting agent.
Calcium Hydroxide: $Ca(OH)_2$, slaked lime.
Calcium Oxide: CaO, quick lime.
Calcium Reducers: Soda ash, bicarbonate of soda, caustic soda, and some phosphates. Act to reduce the effects of calcium in a fluid.
Calcium Sulfate: Gyp or anhydrite, $CaSO_4$.
Calcium Treated: Calcium or other divalent ion added to a fluid to inhibit shale or clay dispersement.
Calculated Absolute Open Flow: A theoretical figure of a well's maximum production.
Calendar Month: The period beginning on the first "gas day" of the calendar month and ending on the first "gas day" of the next month.
Calibration: Comparison to a standard and adjustment to fit.
Caliche: A calcium-rich surface soil.
Caliper Log: A recording of the diameter changes in a well made by a tool with mechanical arms that touch the wellbore or a sonic signal bouncing off the borehole wall.
Call Option: An option that provides the holder the right, but not the obligation, to buy an asset (a commodity or financial instrument) at a specified strike price for a specified period of time. If the market price is below the strike price at any given moment in the option period, exercise of the option would not occur as to do so would incur a loss for the holder. The holder's only loss is then the premium paid for the option. Selling a call obligates the seller to sell at the agreed strike price during the option period. A call option is the opposite of a put option.
CALM: See *Catenary anchor leg mooring.*
Calorific Value: (1) A measure of the amount of energy released as heat when a fuel is burned. (2) The quantity of heat produced by the complete combustion of a fuel. This can be measured dry or saturated with water vapor, net or gross. The general convention is dry and gross. See also *Heating value*.
Calorimetry: Calorimetry is a technique for measuring the heat generated or lost in a chemical reaction. The reaction is carried out in such a way that as much as possible the heat change is transferred to another material, raising its temperature. The heat generated can then be calculated from the amount of the material heated and its specific heat.

Cambrian: A geological time from 500 to 570 million years ago. Often signals the earliest hydrocarbon-productive rocks.
C Annulus: An outside annulus, next out from the B annulus, usually production casing × production casing or surface casing. (*Note*: there may be regional differences in the A, B, and C annulus designations.)
CAOF: See *Calculated absolute open flow.*
CAP: Capacity.
Capacitance Tool: Measures a fluid's capacitance—uses the wellbore fluid as the fluid between plates of a capacitor.
Capacity Allocations: Allotment of space in a pipeline.
Capacity Assignment: The process by which an entity that holds the rights and obligations to pipeline capacity transfers those rights and obligations to another entity.
Capacity Brokering: The assignment of rights to receive firm gas transportation service.
Capacity Constraint: A restriction or limitation at any point along a pipeline system that affects acceptance, movement, or subsequent redelivery of natural gas. A pipeline company determines the sufficiency of its capacity to deliver gas to customers.
Capacity Emergency: A condition that exists when a system's or pool's load exceeds its operating capacity and cycling reserve margin, plus firm purchases from other systems and available imports from adjacent systems.
Capacity Release: Enables a shipper (releasing shipper) who has reserved firm transportation capacity to release–sell excess capacity to a replacement shipper. The revenue received from the replacement shipper can be used to offset some of the costs associated with reserving firm transportation. Although capacity release deals can be negotiated between shippers, the preferred method of releasing capacity is with the use of a pipeline's electronic bulletin board through a closed bidding process. Capacity release has created a secondary market and has increased efficiency in the gas transportation market.
Cap a Well: Control a blowout or seal at the surface after a P&A.
CAPEX: Capital expenditure.
Capillaries: (1) The minute spaces, cracks, or pores in rock through which hydrocarbon fluids move in response to natural forces. (2) Small passages, usually between rock grains. These passages may have ability to absorb fluids and the pressures necessary to expel the fluids may vary inversely with capillary diameter.
Capillary Action: A complex force governing some fluid movements, especially in smaller pores. Capillary action is the result of adhesion and surface tension forces. Adhesion (or attraction) by a fluid to the walls of a pore creates an attracting (or repelling) force, which along with surface tension and cohesion keeps the fluid together. Thus, in a capillary or small pore, the level of the fluid may be above or below the surrounding level in larger pores. This helps explain water blocks.

C

Capillary Fringe: The zone of a porous medium above the water table within which the porous medium is saturated but is at less than atmospheric pressure. The capillary fringe is considered to be part of the vadose zone, but not of the unsaturated zone.
Capillary Pressure: Pressure differential between two immiscible fluid phases occupying the same pores caused by interfacial tension between the two phases that must be overcome to initiate flow.
Capillary Pressure Curve: The pressure necessary to achieve a given nonwetting fluid saturation of a rock.
Capillary String: A very small string, usually run along the outside of the tubing and banded to the tubing. Commonly used for hydraulic control of safety valves and sliding sleeves. May also transmit bottom-hole gauge data.
Capillary Suction: Process where water rises above the water table into the void spaces of a soil due to tension forces between the water and soil particles.
Capital Asset: An investment or asset that can create a produce or service that will produce income.
Capital Cost or Expenditure: Costs that apply to building or acquiring a capital asset.
Capital Investment: Money spent for an asset expected to produce income over its useful life.
Capping: Tightly closing a well so that oil or natural gas cannot escape.
Cap Rock: (1) A sealing formation of very low permeability that forms the top or the seal in a reservoir. (2) An impervious layer of rock that overlies a reservoir rock, thus preventing hydrocarbons from escaping to the surface. (3) Is a hard impervious formation that forms a cap over permeable layers of sedimentary rock. This prevents the further upward migration of oil and gas and traps the hydrocarbon.
Captive Customer: Buyer that can receive natural gas from only one service provider, with no access to alternate fuel sources; usually describing a residential or small commercial user, but may apply to a large industrial and electric utility user that is attached to a single pipeline.
Captive Refinery Oxygenate Plants: Oxygenate production facilities located within or adjacent to a refinery complex.
Carbanion: An anion where the negative charge is localized on a carbon atom is imaginatively called a carbanion. The best way to generate a carbanion is to remove a H^+ ion from a hydrocarbon. Since carbanions are conjugate bases to extremely weak acids indeed, they are fiendishly reactive bases.
Carbenium: If a negatively charged hydride (H^-) ion is removed from a hydrocarbon, what is left is a positively charged carbenium ion, a form of carbocation.



Carbide Blast Joint: An erosion-resistant covering or main pipe that is used when tubing is set deeper than the perforations or on the long string across from the upper perforations in a side-by-side completion.
Carbocation: (1) A positively charged chemical species where the positive charge is localized on a carbon atom. Both carbenium ions (which have three bonds to a positively charged carbon) and carbonium ions (which may have five or more bonds to a positively charged carbon) are examples of carbocations. (2) Carbon compound with a positive charge localized on a carbon atom.
Carbon: The base of all hydrocarbons; capable of combining with hydrogen in almost numberless hydrocarbon compounds. The carbon content of a hydrocarbon determines, to a degree, the hydrocarbon's burning characteristics and qualities.
Carbon 14 Isotope: One of three naturally occurring isotopes of carbon. The half-life of the C14 isotope makes it ideal for determining the difference between thermogenic methane (C14 absent) and biogenic gas.
Carbonaceous Oxygen Demand: A measure of the amount of dissolved oxygen required for the biological oxidation of compounds containing carbon in the sample. Same as biochemical oxygen demand (BOD).
Carbonaceous Stage: A stage of decomposition that occurs in biological treatment processes when aerobic bacteria, using dissolved oxygen, change carbon compounds to carbon dioxide. Sometimes referred to as "first-stage BOD" because the microorganisms consume organic or carbon compounds first and nitrogen compounds later.
Carbonate: Any of the many rocks composed of calcium carbonate (limestone) or magnesium carbonate (dolomite) or other acid-soluble rocks with a common CO_{3-}^{2} ionic charge. The pores may be poorly connected and matrix permeability (nonfractures) is often much lower than sandstones.
Carbonate Rocks: Are "chemical or biochemical" in origin; they form within the basin of deposition and are called intrabasinal rocks; composed of calcite and argonite; have high porosity and permeability and where scientists usually find oil and gas.
Carbon Black: (1) A solid or finely divided carbon recovered by burning natural gas or oil in a deficient supply of air or by thermal decomposition. Used in compounding rubber and making inks, paints, etc. (2) Also known as channel black, lamp black, furnace black, thermal black, or acetylene black. It is an odorless solid; mainly used in automobile tire manufacture and road construction.
Carbon Cycle: All reservoirs and fluxes of carbon; usually thought of as a series of the four main reservoirs of carbon interconnected by pathways of

exchange. The four reservoirs, regions of the Earth in which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (include fossil fuels). Each of these global reservoirs may be subdivided into smaller pools ranging in size from individual communities or ecosystems to the total of all living organisms (biota). Carbon exchanges from reservoir to reservoir by various chemical, physical, geological, and biological processes.

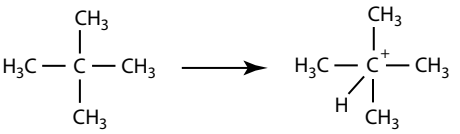
Carbon Dioxide: (1) A colorless, odorless, nonpoisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion. Although CO_2 does not directly impair human health, it is a greenhouse gas that traps the Earth's heat and contributes to the potential for global warming. (2) A colorless gas. Corrosive when occurring with water. An acid gas. The most common cause of corrosion in the oil industry.

Carbon/Hydrogen Ratio: The ratio, either on a weight or on a molecular basis, of carbon to hydrogen in a hydrocarbon material. Materials with a high carbon/hydrogen ratio (e.g., coal) are solid. The ratio is useful as a preliminary indication of the hydrogen quantity needed to convert the hydrocarbon to a gas and/or liquid (American Gas Association [AGA]).

Carbonic Acid: CO_2 and water. A common corrosion source in wells.

Carboniferous: A geologic time of 290–365 million years ago.

Carbonium: If there are five or more bonds to a single carbon atom, it will be short of electrons and have a positive charge—this species is called a carbonium ion, a form of carbocation. The easiest way to make one is to add a hydrogen ion (H^+).



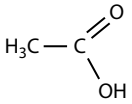
Carbon Monoxide: A colorless, odorless gas slightly lighter than air. It is poisonous if inhaled, in that it combines with blood hemoglobin to prevent oxygen transfer. It is produced by the incomplete combustion of fossil fuels with a limited oxygen supply (as in automobiles). It is a major component of urban air pollution, which can be reduced by the blending of an oxygen-bearing compound such as alcohols and ethers into hydrocarbon fuels.

Carbon Monoxide Nonattainment Area: Areas with carbon monoxide design values of 9.5 ppm or more (generally based on data for 1988 and 1989).

Carbon–Oxygen Log: A log that measures the ratio of carbon to oxygen within the formation. Useful for spotting oil.

Carbon Residue: (1) Standard tests that measure the amount of carbon left behind after combustion under controlled conditions. Two methods are available, the Conradson and the Ramsbottom Carbon Residue tests. (2) The amount of carbonaceous material left after evaporation and pyrolysis of an oil by standard test methods ASTM D189 and D524.

Carbon Sequestration: Long-term storage of carbon dioxide underground.
Carbon Steel: A low-alloy steel, containing a mass fraction maximum of 2% carbon, 1.65% manganese, and residual quantities of other materials. Common in pipe manufacturing.
CarboProp™: A trademarked name for ceramic (man-made) proppant.
Carboxylate Group: When a carboxylic (alkanoic) acid is deprotonated (i.e., loses a H^+ ion), what is left is a negatively charged carboxylate ion.
Carboxylic Acid: Any carbon compound containing the functional group –C(O)OH. Formic acid (HCOOH) gives the distinctive smell of crushed ants, while acetic acid (CH_3COOH) gives VB its distinctive odor and taste.



Acetic acid

Carboxymethyl Cellulose: A modified cellulose polymer used in drilling fluids.
Carboxymethyl, Hydroxyethyl Cellulose: An anionic water-soluble polymer used in various fluids. Can be relatively clean breaking under the right conditions.
Carboxymethyl Starch: A natural starch used in drilling fluids.
Carburizing: Heat-treating process where carbon is introduced into a solid iron alloy by heating above transformation temperature range while in contact with a carbonaceous material (solid, liquid, or gas form of carbon). Usually quenched to produce a hardened outer shell.
Cargo Handling: The act of loading and discharging a cargo ship.
Cargo Plan: A plan giving the quantities and description of the various grades carried in the ship's cargo tanks, after the loading is completed.
Carothers: Wallace Hume Carothers (1896–1937) carried out the key early experiments that led to commercial polyesters, nylons, and neoprene while working for the DuPont corporation and almost single-handedly created the polymer industry in the United States. His amazing scientific achievements did not bring him happiness, and he tragically committed suicide by taking cyanide.
Carried Interest: (1) Interest created from an oil and gas lease that is free of some or all of the costs. (2) A fractional working interest in an oil and gas lease that arises from a deal between co-owners.
Carried Working Interest: A fractional interest in an oil and gas property conveyed or assigned to another party by the operator or owner of the working interest. In its simplest form, a carried working interest is exempt from all costs of development and operation of the property. However, the carried interest may specify "to casing point," "to setting of tanks," or "through well completion." If the arrangement specifies through well completion, then the carried interest may assume the equivalent fractional interest of operating costs upon completion of the well. There are many different types of carried

interests, the details varying considerably from arrangement to arrangement. One authority has observed, "The numerous forms this interest is given from time to time make it apparent the term 'carried interest' does not define any specific form of agreement but serves only as a guide in preparing and interpreting instruments."

Carrier Fluid: The fluid that carries proppant or other material into the well.

Carrier Rig: A self-propelled drilling or workover rig.

Carrying Capacity: The capacity of an injected or circulated fluid to transport a given sized and density solid into a zone or from a well.

Cartridge Filter: A filtering device that uses replaceable cartridge elements to filter liquids to a required level.

Cased and Perforated: A completion technique where casing is cemented in the drilled hole and perforations are placed at the most promising flow points based on log interpretations.

Cased-Hole Gravel Pack: A sand control completion that uses a screen and a gravel pack to stop formation sand production.

Cased-Hole Log: Any of several radioactive, chemical, or physical property logs that are run in a cased-hole environment. May be conveyed by electric line, coiled tubing, slick line (memory logs), or drill pipe (LWD).

Case Hardened: A hardening process that hardens only the outer surface of a metal. Processes include carburizing, nitriding, and flame hardening.

Cash-Out: A procedure in which shippers are allowed to resolve imbalances by cash payments, in contrast to making up imbalances with gas volumes in-kind. See *Imbalance trading*.

Casing: (1) Steel pipe that is cemented into a well to prevent the wellbore wall from caving in, to stop drilling fluids from losing circulation, and to prevent water and other fluids from invading the wellbore. (2) Metal pipe inserted into a wellbore and cemented in place to protect both subsurface formations (such as groundwater) and the wellbore. A surface casing is set first to protect groundwater. The production casing is the last one set. The production tubing (through which hydrocarbons flow to the surface) will be suspended inside the production casing. (3) Steel pipe used in oil wells to seal off fluids in the rocks from the borehole and to prevent the walls of the hole from caving. (4) Is installed during the drilling process to protect potable water zones near the surface from contamination, provide a smooth conduit for moving tools into and out of the hole, isolate downhole zones so they can be produced separately, and protect the hole from the drilling fluids. (5) One of several strings of steel pipe in a well design that, together with cement, forms a barrier to fluid movement along the drilled hole. It is commonly at least partly cemented in the wellbore.

Casing-Annular Pressure: Pressure in the annulus between the tubing outside diameter (OD) and the casing internal diameter (ID).

Casing Centralizer: One of several centralizer designs intended to keep the casing better centered in the borehole to get better cement jobs.
Casing Cladding: Expanding pipe installed in production casing or tubing to seal perforation holes or leaks caused by corrosion or erosion. Can be metal or plastic.
Casing Collar Log: A downhole log recording, given by magnetic deflection, of the location of couplings or other equipment.
Casing Coupling: The threaded connection, almost always upset to the outside.
Casing Crew: The personnel that specialize in handling and running casing.
Casing Cutter: A mechanical, chemical, or explosive device that cuts the casing at a specific point.
Casing Grade: A generic grade classifying the strength of the pipe: L80, P-110, etc. The numbers are the minimum yield of the steel in 1000s of psi.
Casing Gun: A large perforating gun, run into a well without tubing.
Casing Hanger: A support that is screwed onto the casing and fits into the casing head.
Casing Head: A term that applies to the wellhead flange that forms the transition between the pipe and the flange-build tree. It may be attached by threads, welding, pressure forming, or lock-ring/screw devices.
Casinghead: (1) The top of the casing set in the well; the part of the casing that protrudes above the surface and to which the control valves and flow pipes are attached.
Casinghead Gas: (1) Gas produced from an oil well as distinguished from gas from a gas well. The casinghead gas is taken off at the top of the well or at the separator. (2) Unprocessed natural gas produced from a reservoir containing oil.
Casing Head Gas and Gasoline: Natural gas condensate, usually C2 to C8+. The C5–C8 components condense to a very volatile liquid when the temperature decreases near the wellhead.
Casinghead Gasoline: Liquid hydrocarbons separated from casinghead gas by the reduction of pressure at the wellhead or by a separator or an absorption plant.
Casing Inspection Log: Uses eddy currents in a magnetic field to estimate casing thickness and anomalies.
Casing Jacks: A set of hydraulic lift cylinders that can be used to lift casing strings.
Casing Joint: Typically a length of casing with a connection on each end. Length may vary from less than 30 ft (9 m) to about 40 ft (12 m).
Casing Liner: A length of casing that runs from a set point to a point part way up in the previously set casing string, but usually not to surface. A liner may be used instead of a full casing string to save money, to maintain a larger ID for well equipment, or to prevent creating a trapped annular space.

C

Casing Patch: Any of several repair systems designed to set a patch over a leak in a well.
Casing Perforation: (1) The holes made in the liner of a finished well to allow oil or natural gas to flow into the production tube. (2) Holes made in the liner of a finished well to allow hydrocarbons to flow into the production tube.
Casing Plunger: A larger plunger designed to lift fluids when flowing gas up the casing without the presence of tubing.
Casing Point: (1) The depth at which a casing string is set, either by design or because the mud can no longer control the pressure of the next deeper zone without adding weighting agents that would break down upper intervals. (2) A term that designates a time when a decision must be made whether casing is to be run and set or the well abandoned and plugged. In a joint operating agreement, casing point refers to the time when a well has been drilled to objective depth, tests made, and the operator notifies the drilling parties of his or her recommendation with respect to setting casing and a production string and completing the well. On a marginal well, the decision to set pipe is often difficult. To case a well often costs as much as the drilling. On a very good well, there is no hesitation; the operators are glad to run casing and complete the well.
Casing Pressure: Pressure (intended or not) that occurs on the various outside annuli.
Casing Reciprocation: Movement of casing up and down to help remove mud and replace it with cement slurry.
Casing Roller: A downhole tool, commonly run on pipe to try to reform the casing after a partial collapse.
Casing Rotation: Rotating the casing string during primary cementing to remove mud and improve primary cement bonding and isolation.
Casing Scraper: A downhole tool with scraping teeth and brushes that is used to remove perforating burrs, "lipped down" areas in connection pins and remove mill scale, dried mud or cement, pipe dope, and other well completion debris.
Casing Seat: (1) The lowest point at which casing is set. (2) The set point of the end of casing. Should be in an impermeable, stable formation.
Casing Seat Test: A leak-off test (LOT) or a formation integrity test (FIT) test (check specifics for details), a pressurized test after primary cementing to make sure the bottommost seal with the formation will handle pressures needed for drilling the rest of the well.
Casing Shoe: A tapered guide shoe on the bottom of a casing string to assist in passing ledges and doglegs in the wellbore.
Casing Shoe Test: A pressure test of the casing seal, after the cement job, to the pressures necessary to safely control the pressure of the deeper zones.
Casing String: (1) A continuous string of casing, usually cemented over at least part of its length and usually extending back to surface from the set point. (2) The steel tubing that lines a well after it has been drilled. It is formed from sections of steel tube screwed together.

Casing Swage or Broach: A hardened steel tool, commonly run on wire line, which is used to reshape the casing.
Casing Tongs: (1) Wrenches specifically made for making up casing joints. (2) Pipe tongs used to make connections.
Casing Valve: A gas lift valve that is controlled by the casing or annulus gas supply pressure.
Casing Wear: Reduction in thickness × 100/original thickness. Most common wear is from rotating strings during drilling.
Casing Weight: The nominal weight per foot of the casing. Heavier weight casings of the same size are necessarily smaller ID.
$CaSO_4$: See *Calcium sulfate*.
$CaSO_4$–H_2O: See *Gypsum*.
Cast Iron Bridge Plug: A drillable plug that can be quickly and reliable set to isolate a section of the well.
Cataclastic Rock: Powdered rock created by crushing and shearing of tectonic movements.
Catalyst: (1) A substance whose presence changes the rate of chemical reaction without itself undergoing permanent change in its composition. Catalysts may be accelerators or retarders. (2) Substance that aids or promotes a chemical reaction between other substances, but does not, itself, enter into the reaction. (3) Compound that accelerates the rate of a chemical reaction and is not itself consumed in the reaction. (4) A substance used to accelerate or retard a chemical reaction without itself undergoing significant chemical change or change in volume during the process. (5) A chemical that enables or speeds up a chemical reaction without being consumed by the reaction.
Catalytic Cracking: (1) The refining process of breaking down the larger, heavier, and more complex hydrocarbon molecules into simpler and lighter molecules. Catalytic cracking is accomplished by the use of a catalytic agent and is an effective process for increasing the yield of gasoline from crude oil. Catalytic cracking processes fresh feeds and recycled feeds. (2) A petroleum refining process in which heavy hydrocarbon molecules are broken down (cracked) into lighter molecules by passing them over a suitable catalyst (generally heated). (3) A method of cracking that uses a catalyst to convert hydrocarbons to positively charged carbocations, which then break down into smaller molecules. This can be carried out at much lower temperatures than thermal cracking—still hot, 500°C–600°C as compared to around 700°C, but that difference adds up to a lot of dollars.
Catalytic Hydrocracking: A refining process that uses hydrogen and catalysts with relatively low temperatures and high pressures for converting middle boiling or residual material to high-octane gasoline, reformer charge stock, jet fuel, and/or high-grade fuel oil. The process uses one or more catalysts, depending upon product output, and can handle high-sulfur feedstocks without prior desulfurization.
Catalytic Hydrotreating: A refining process for treating petroleum fractions from atmospheric or vacuum distillation units (e.g., naphthas, middle

distillates, reformer feeds, residual fuel oil, and heavy gas oil) and other petroleum (e.g., cat-cracked naphtha, coker naphtha, gas oil) in the presence of catalysts and substantial quantities of hydrogen. Hydrotreating includes desulfurization, removal of substances (e.g., nitrogen compounds) that deactivate catalysts, conversion of olefins to paraffins to reduce gum formation in gasoline, and other processes to upgrade the quality of the fractions.

Catalytic Reforming: (1) A refining process using controlled heat and pressure with catalysts to rearrange certain hydrocarbon molecules, thereby converting paraffinic- and naphthenic-type hydrocarbons (e.g., low-octane gasoline boiling range fractions) into petrochemical feedstocks and higher-octane stocks suitable for blending into finished gasoline. Catalytic reforming is reported in two categories. They are as follows: Low pressure: A processing unit operating at less than 225 pounds per square inch gauge (psig) measured at the outlet separator. High pressure: A processing unit operating at either equal to or greater than 225 psig measured at the outlet separator. (2) A catalytic process to improve the antiknock quality of low-grade naphthas and virgin gasolines by the conversion of naphthenes and paraffins into higher-octane aromatics such as benzene, toluene, and xylenes.

Catch Basin: A chamber or well used with storm or combined sewers as a means of removing grit, which might otherwise enter and be deposited in sewers.

Cat Cracker: Trade term for the refinery operating unit where a catalytic cracking process is being carried out.

Categorical Limits: Industrial wastewater discharge pollutant effluent limits developed by the Environmental Protection Agency (EPA) that are applied to the effluent from any industry in any category anywhere in the United States that discharges to a publicly owned treatment works (POTW). These are pollutant effluent limits based on the technology available to treat the waste streams from the processes of the specific industrial category and normally are measured at the point of discharge from the regulated process. The pollutant effluent limits are listed in the Code of Federal Regulations.

Catenary Anchor Leg Mooring: A floating structure that performs the dual function of keeping a tanker moored on a single point and transferring fluids (generally oil, gas, or by-products) while allowing the ship to weather vane. It consists of a circular floating buoy anchored to the seabed by means of four, six, or eight chain legs draped radially in a catenary curve. The bottom ends of the chains are fixed to the seabed by either conventional anchor legs or piles. The buoy itself is free to move up and down, sideways, and in pitching and rolling motions. The tanker is moored by hawsers to a turntable attached through heavy-duty roller bearings to the top of the buoy. This turntable is free to rotate through 360° and is fitted with piping, valves, mooring equipment, floating hose connections, navigation aids, and, in most cases, lifting facilities to support maintenance activities.

Catenary Riser: A subsea riser with a large "*S*" that allows flexing and movement of the line.
Cat Head: A small drum on a winch on which a hoisting cable or rope can be wrapped.
Cathode: The negative site of a corrosion cell. Reduction reactions are typical.
Cathodic Corrosion: Corrosion, usually of an amphoteric metal, with a basic fluid.
Cathodic Protection: (1) Impressed current that offsets the current produced in a corrosion cell and reduces corrosion. (2) A method employed to minimize the rate of electrochemical corrosion of pipelines or structures. (3) Method used to minimize rate of electrochemical corrosion of structures, for example, installations offshore, pipelines, and storage tanks. (4) An electrical system for prevention of rust, corrosion, and pitting of metal surfaces that are in contact with water or soil. A low-voltage current is made to flow through a liquid (water) or a soil in contact with the metal in such a manner that the external electromotive force renders the metal structure cathodic. This concentrates corrosion on auxiliary anodic parts that are deliberately allowed to corrode instead of letting the structure corrode.
Cation: (1) An ion with a positive charge. (2) A positively charged ion in an electrolyte solution, attracted to the cathode under the influence of a difference in electrical potential. Sodium ion is a cation.
Cation Exchange Capacity: Related to concentration of cations on negatively charged clay surfaces that, when brine is present, can be exchanged/satisfied for/by cations in the brine. The total of exchangeable cations that a porous medium can absorb, expressed in moles of ion charge per kilogram of clay or mineral.
Cationic Cation: A positively charged chemical species, like the ammonium NH_4^+ and scandium Sc^{4+} ions, is called a cation. In an electrochemical cell, a cation will move toward the cathode to gain an electron to remove its excess positive charge.
Cationic Surfactant: A positively charged surfactant, normally oil-wet sands.
Cat Line: A small hoisting rope or cable.
CAT (Subsea): Connection actuation tool.
Cat Walk: A tool assembly/staging area before the vee door on a rig.
Caustic: A strong base chemical. Caustic soda is sodium hydroxide.
Caustic Soda: When used in industrial processes, sodium hydroxide is often known as caustic soda.
Cavings: Loose formation materials that fall into the wellbore.
Cavings Rock: Rock fragments that spall or break off the wellbore walls. Usually found as fill in the hole.
Cavitation: (1) The creating of a high-speed, very low-pressure vapor bubble that quickly and violently collapses. Very detrimental to surfaces in the near proximity. Often seen in severe turbulent flow. (2) Vaporization of a pumped

fluid resulting in vibration, noise, and destruction of equipment. This occurs when the absolute pressure of the system equals the vapor pressure of the fluid pumped. In a centrifugal pump, the impeller usually receives the most damage.

Cavity Completion: A completion that uses flow to purposely increase the size of the open hole wellbore.

CBHFP (Rock Mechanics): Critical bottom-hole flowing pressure; a measurement of sanding potential of the formation.

CBHT: Circulating bottom-hole temperature.

CBJ: Carbide blast joint.

CBL: Cement bond log.

CBM: See *Coal bed methane*.

CBNG: Coal bed natural gas.

CBOD: See *Carbonaceous oxygen demand*.

CBT: Cement bond tool.

CCDST: Closed-chamber DST.

CCF: One hundred cubic feet; 1 CCF is 100 ft^3 of natural gas at standard distribution pressure of 14.73 psi and 60° F.

CCGT: See *Combined-cycle gas turbine*.

CCL: See *Casing collar log*.

CCP (Completion): Cased, cemented, and perforated.

CCP (Compression): Gas compression plant.

CCT: Concentric coiled tubing.

CDA: Common data access is a not-for-profit subsidiary of Oil & Gas UK, set up in 1994 to provide data management services to its members and to the UK oil industry in general.

CD (Contract): Contract demand.

CDL: Compensated formation density log.

CDP: Common depth point.

CDP (Rock Mechanics): Critical drawdown pressure; maximum drawdown pressure for sand-free rate.

CDR (Flow): Chemical drag reducer.

CDR (Logging): Compensated dual resistivity.

CE: Completions engineer.

CEC: Cation exchange capacity.

Ceiling Temperature: Above a certain temperature, monomers can no longer be persuaded to form polymers by chain polymerization. This occurs when the loss in entropy arising from joining many molecules into one outweighs the energetic benefit of converting double bonds to single bonds. A chain-growth polymer raised above the ceiling temperature will degrade or depolymerize.

CEL: Cement evaluation log.

Cellar: A concrete or culvert pipe walled section below ground that often protects and shelters the annular access valves. Also used to house the BOPs on a drilling well.

Celloflake: A fluid loss additive for cement.
Cell Spar: A spar platform with multiple floatation sections.
Cellulase: Cellulase is an enzyme capable of depolymerizing cellulose to form glucose. Chemists use this sort of words—see if your teacher can tell you the definitions of "filtrate" and "filtrant" without having to think about it for a couple of minutes…. And if they get that one right, test them out on "carbenium" and "carbonium" ions!
Cellulose: Cellulose is a large component of the biomass of plants and the main source of food energy for the world's termite population. It can be considered to be a condensation polymer of glucose, like starch, but the links between the glucose monomers are slightly different.
Celsius: Temperature scale based on the freezing (0°) and boiling (100°) points of water at atmospheric pressure; formerly known as centigrade. To convert Celsius to Fahrenheit, multiply the number by 1.8 and add 32.
Cement: (1) To fix the casing firmly in the hole with cement, which is pumped through the drill pipe to the bottom of the casing and up into the annular space between the casing and the walls of the wellbore. After the cement sets (hardens), it is drilled out of the casing. The casing is then perforated to allow oil and gas to enter the well. (2) Sedimentary. Mineral material, usually precipitated chemically, that fills the spaces between individual grains of a consolidated (hard) sedimentary rock; the binding material that holds the grains together. The most common binders are silica, carbonates, and certain iron oxides. Other cements are clay minerals, barite, gypsum, anhydrite, and pyrite.
Cement Accelerator: An additive such as calcium chloride and salt in high concentrations that speeds the set of cement.
Cement and Cementation (Formation): Formation binding agents (calcite, clay, silica overgrowth, heavy oil, etc.) that hold the formation grains together.
Cementation: The material in the rock between the grains that binds the grains together.
Cementation Exponent: The porosity exponent, m, in the Archie factor.
Cement Bond: The strength and adherence of the cement to the pipe and the formation.
Cement Bond Log: A sonic log that determines the top of the cement column and estimates the quality of the cement bond between the casing and the formation. Works on transmission of a sound wave and identifies areas that conduct the wave and those that do not (free pipe ringing). Communication is likely if CBL > 10% of unbonded mv reading. Communication is unlikely if CBL < 5% of unbonded mv reading and bond length > 10 ft (3 m).
Cement Channel: A channel in the cement, usually caused by poor displacement of drilling mud.
Cement (Completions): Typically, the Portland, silicate, and/or pozzolan, etc., mixtures used to form a stone-like permanent seal between the pipe and the formation.

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Cement Density: The specific gravity of the set well cement, generally about 3.15 for Portland cement. Do not confuse with slurry density.
Cementing: The technique of pumping cement into the space between the casing and the wellbore wall in order to hold the casing in place.
Cementing Head: (1) A device attached to the top of the casing that allows connection of the flush and cement lines and allows plugs to be dropped. Special models may allow the cement to be rotated during cementing. (2) The connection between the wellhead and the lines from the cement trucks. A rotating head (uncommon except on top-drive rigs) allows the pipe to be rotated during the cement placement to assist in displacing mud and preventing channels.
Cement Packer: A recompletion technique in which cement is injected down the tubing and through a punched hole in the tubing to form a 300–500 ft thick seal between the tubing and the casing, often far about the bottom of the well. Useful for isolation of upper zones to shut off unwanted fluids or separate producing horizons.
Cement Plug: A plug of cement set by various methods that plugs the tubulars or the open hole.
Cement Poison: A material that stops cement from setting.
Cement Pump Time: The time after mixing of the cement slurry before the cement becomes so viscous that it cannot be pumped.
Cement Retainer: A temporary set plug to allow cement work above the tool. It is drilled out after the cement job.
Cement Retarder: A chemical additive such as lignosulfonate, salt in low concentration, or most muds that slow down the cement.
Cement Slurry Density: The specific gravity of the unset cement slurry as mixed at the surface. Does not account for water loss to leak off or segregation before the cement sets.
Cenozoic: A geologic epoch from today to 65 million years ago. Few major hydrocarbon-bearing strata unless fluids have migrated to a trap from older source rocks.
Centipoise: (1) Viscosity measurement, 1/100th of a poise. (2) A centipoise (cP) is 1/100th of a poise (P), which is the fundamental unit of dynamic viscosity in the CGS system of units. In the SI unit of systems, the fundamental unit of dynamic viscosity is the pascal second (Pa s), where 1 Pa s is equivalent to 10 P.
Centistokes: The centistoke (cSt) is 1/100th of a stoke (St), which is the fundamental unit of kinematic viscosity in the CGS system of units. In the SI system of units, the fundamental unit of kinematic viscosity is the millimeter squared per second (mm^2/s), which is equivalent to the centistokes.
Central Estimate: A range of exploration drilling scenarios from which the following activity levels, based on recent historical experience, are adopted as the central estimates.
Centralizer: A bladed or bow spring tool that helps center tools or pipe in the wellbore.

Centrifugal Compressor: Nonpositive displacement compressor that depends for pressure rise, at least in part, on centrifugal forces. A turbo compressor.
Centrifugal Fan: Fan in which the air enters the impeller axially and leaves it substantially in a radial direction.
Centrifugal Pump: (1) A rotating pump, commonly used for large-volume oil and natural gas pipelines, that takes in fluids near the center and accelerates them as they move to the outlet on the outer rim. (2) Pump with an impeller or rotor that spins in a housing and the drag forces on the fluids cause them to flow.
Centrifuge: (1) A device that separates materials by density through a centrifugal motion. (2) A mechanical device in which centrifugal force is used to separate solids from liquids and/or separate liquids of different densities.
CEQ: Council on Environmental Quality.
Ceramic (Frac): Usually ceramic (man-made) proppant.
CERCLA: A US Law—Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
Certificate of Discharge: An essential document for officers and seamen; official certification confirming completion of the employment for which engaged.
Certificate of Registry: A document specifying the nation registry of the vessel.
Certification Examination: An examination administered by a state or professional association that operators take to indicate a level of professional competence.
Certs: Certificates, usually on physical or chemical properties (e.g., MSDSs).
Cesium Acetate: A lower toxicity weighting agent for brine.
Cesium Formate: A lower toxicity (than zinc) weighting agent for higher-density brines.
CET: Cement evaluation tool.
Cetane: A pure paraffin hydrocarbon used as standard reference fuel in determining the ignition qualities of diesel fuels. It is arbitrarily given a cetane number of 100.
Cetane Index: An empirical method for determining the cetane number of a diesel fuel by a formula based on API gravity and the mid-boiling point (ASTM D975).
Cetane Number: (1) A term for expressing the ignition quality of a diesel fuel. (2) A measure of the ignition quality of a diesel fuel, expressed as a percentage of cetane that must be mixed with methyl naphthalene to produce the same ignition performance as the diesel fuel being rated. (3) A measure of the ignition quality of diesel fuel; the higher the number, the more easily the fuel is ignited under compression.
CF: See *Completion fluid*.
Cf: See *Cubic foot*.
C Factor: A selected constant in the API 14-E equation on fluid erosion.
CFC: See *Chlorofluorocarbons*.

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Cfd: Cubic foot per day.
CFD (Fluids): Computational fluid dynamics.
CFE: Core flow efficiency.
Cfh: Cubic feet per hour.
Cfm: Cubic feet per minute.
CFPP: Cold filter plugging point.
CFR: Critical flow rate.
CFR: See *Code of Federal Regulations*.
CFR Engine: See *Cooperative fuel research engine*.
Cfs: See *Cubic feet per second*.
CG: Connection gas, mud logging term.
CGA: Canadian Gas Association.
CGF: Central gas facility.
CGR: Condensate/gas ratio.
$(CH_2)_2O$: See *Ethylene oxide*.
$CH_2{=}CHCl$: See *Vinyl chloride and Polyvinyl chloride*.
$(CH_3)_2(C_2H_5)COCH_3$: See *Tertiary amyl methyl ether*.
$(CH_3)_3COC_2H_5$: See *Ethyl tertiary butyl ether*.
$(CH_3)_3COCH_3$: See *Methyl tertiary butyl ether*.
$(CH_3)_3COH$: See *Tertiary butyl alcohol*.
$CH_3{-}(CH_2)N{-}OH$: See *Alcohols*.
CH_3OH: See *Methanol*.
CH_4: See *Methane*.
Chain of Custody: A record of each person involved in the handling and possession of a sample from the person who collected the sample to the person who analyzed the sample in the laboratory and to the person who witnessed disposal of the sample.
Chain Reaction: A really dodgy film starring Keanu Reeves. Also, a mechanism that has no reason to stop, since the product is just as reactive as the reactants.
Chain Tongs: A type of hand- or power-operated wrench used to make up connections in pipe.
Chalcedony: A cryptocrystalline form of quartz with waxy luster.
Chalk: An often highly porous but lower-permeability carbonate composed of fine-grained marine sediments such a coccoliths.
Chamber Lift: A type of gas lift that uses the tubing–casing annulus for accumulation of produced liquids between lift cycles.
Channel (Cement): A flow area in the cement from inefficient cementing displacement of the drilling mud.
Channel (Formation): An interconnected pathway through the matrix of the rock or an open fracture or other feature that connects a reservoir and the wellbore.
Charge Capacity: The input (feed) capacity of the refinery processing facilities.
Charterer: The entity to whom the use of the whole of the carrying capacity of a ship for the transportation of cargo to a stated port for a specified time is given. See *Time charter party*.

Charter Party: Contractual agreement between a ship owner and a cargo owner, usually arranged by a broker, whereby a ship is chartered (hired) for either one voyage or a period of time.
Charter Rates: Tariff applied for chartering tonnage in a particular trade.
Chase: To run a pipe through a wellbore to determine if it is open.
Chat: Any of many types of conglomerates.
Cheater: A length of pipe used on a wrench to extend the leverage (HSE risk).
Checking (Corrosion): Slight breaks in a surface coating that do not penetrate to the underlying surface.
Check Shot Survey (Seismic): Determines formation seismic wave velocities over specific intervals. Measurement is made of travel time from surface to downhole geophones.
Check Trip: A trip back to bottom after a cleanout or other operation, to check for clearance.
Check Valve: A valve that only allows flow in one direction.
Chelant: A chemical that can tie up the molecules of an element, such as iron, and keep it in solution past the point where it should naturally precipitate.
Chemical Cutter: A pipe cutting tool that uses boron trifluoride sprayed through a nozzle at very high velocities.
Chemical Dissolution: Reactions involving the rock and connate fluids in which parts of the matrix are filled by scale or mineral growths or removed and become high-permeability flow channels.
Chemical Engineers: People who carry out chemical reactions in ten-ton reactors instead of test tubes. Real chemists tend to assume that chemical engineers just mix up reactions that other people have developed in big buckets, but I've looked at some of the books they have to read and they're full of hairy maths, so some parts of what they do must be kind of tricky. Their main job is actually to design the buckets, how they're stirred, and how things get in and out of them, so that they don't explode, shower the surrounding countryside with toxic waste, or otherwise cost the chemical company too much money. See *Industrial chemist*.
Chemical Flooding: One of several methods involving injecting a chemical into a formation to improve the production of hydrocarbon. May be from an injection well to a production well or injection into a producer with a soak period before recovery.
Chemical Formula: Gives the number and type of atoms making up a chemical compound. It indicates the number of atoms of each element that are part of the compound.
Chemical Hygiene Plan: A written plan to identify and control the hazards associated with laboratory work.
Chemical Oxygen Demand: (1) A measure of the oxygen-consuming capacity of organic matter present in wastewater. COD is expressed as the amount of oxygen consumed from a chemical oxidant in mg/L during a specific test. Results are not necessarily related to the BOD because the chemical oxidant may react with substances that bacteria do not stabilize. (2) COD is

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the equivalent amount of oxygen consumed under specified conditions in the chemical oxidation of the organic and oxidizable inorganic matter contained in a wastewater corrected for the influence of chlorides. In American practice, unless otherwise specified, the chemical oxidizing agent is hot acid dichromate.

Chemical Resistance: The ability to resist chemical attack.

Chemical Sediment: Sediment formed by precipitation from water, for example, salt from dehydration and scales.

Chemical Tracing: Using water-soluble chemicals to track the flow channels in the reservoir.

Chemical Transportation Emergency Center: A public service of the Manufacturing Chemists Association, which provides immediate advice in the event of a hazardous material emergency. (800) 424-9300.

Chemical Treating: Various chemical treatments including acidizing.

Chemical Treatment: A process involving the addition of chemicals to achieve a specific result.

Chemical Weathering: All the chemical reactions that act on rocks to produce stable minerals.

CHEMRAZ™: An elastomer used in seals.

CHEMTREC: See *Chemical Transportation Emergency Center.*

Cherry Picker (Fishing): An overshot fishing tool with a bottom cutter surface to allow milling the top slips or all the slips prior to retrieving a packer.

Cherry Picking: Pursuing desirable customers and ignoring less desirable customers. The term is commonly used to describe a company's tactic of trying to get the business of the largest energy or service users.

Chert: A hard, silicate sedimentary rock. Similar to flint, but with less-ordered structure. A cryptocrystalline form of quartz.

CHESS: Chemical hazard employee safety system.

Chevron Packing (Seal): A V-shaped seal very common on moving and static seals.

Chevron Pattern (Corrosion): A V-shaped pattern on a fatigue or brittle-fracture surface. The pattern may also be one of straight radial lines on round specimens.

CHFP: Cased-hole frac pack.

CHFR™: Cased-hole formation resistivity tool.

CHGP: Cased-hole gravel pack.

Chicksan™: A surface treating line connector that allows quick, pressure-tight bends in high-pressure pipe.

Chief Engineer: The senior engineer officer who generally oversees functioning of all mechanical equipment on ship, calculates fuel and water consumption and requirements, and coordinates operations with shore-side port engineer. See *Crew.*

Chief Officer: The officer next in rank to the master. Also called first mate, chief mate. See *Crew.*

Chilled Water: Water used as a cooling medium, particularly in air-conditioning systems, which is at below ambient temperature.
Chiller: Refrigerating machine used to transfer heat between fluids; complete, indirect refrigerating system of compressor, condenser, and evaporator with all operating and safety controls.
Chisel Bit: A device with a single bit running the width of the hole. Also called a dove-tail bit.
CHK: Choke.
CHKS: Backflow checks.
CHKS (Rig Up): Chicksans.
CHL: Cased-hole log.
Chloramines: Compounds of chlorine with organic and inorganic nitrogen.
Chloride Stress Cracking: Cracking of a metal under combined action of tensile stress and corrosion in the presence of chlorides and an electrolyte (NACE). Starts at a pit, scratch, or notch. Crack proceeds primarily along grain boundaries. The cracking process is accelerated by chloride ions and lower pH.
Chlorinated Hydrocarbons: A chlorine atom substituted onto an alkane (hydrocarbon chain). These materials have been identified as refinery catalyst poisons.
Chlorination: The application of chlorine to water or wastewater, generally for the purpose of disinfection but frequently for accomplishing other biological or chemical results (aiding coagulation and controlling tastes and odors).
Chlorinator: A metering device that is used to add chlorine to water.
Chlorine: An element existing as a greenish-yellow gas about 2.5 times heavier than air under normal temperatures and pressures. In liquid form, it is amber and about 1.5 times heavier than water.
Chlorine, Available: A measure of the oxidizing power of chlorinated lime and hypochlorites.
Chlorine Contact Unit: A baffled basin that provides sufficient detention time for disinfection to occur.
Chlorine Demand: (1) Chlorine demand is the difference between the amount of chlorine added to wastewater and the amount of residual chlorine remaining after a given contact time. Chlorine demand may change with dosage, time, temperature, pH, nature, and the amount of the impurities in the water. (2) The difference between the amount of chlorine added and the residual after a specified contact time. The demand may change with dosage, time, temperature, pH, and the nature and amount of impurities in the water.
Chlorine Dioxide: (1) A free-radical compound especially useful in killing bacteria in waters. It is a powerful biocide that dissolves biomass cell walls. It is nearly impossible for bacteria to develop immunity against ClO_2.

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Chlorine Log: A cased-hole log, using gamma-ray capture by chlorine atoms, that helps estimate the salinity or water behind pipe.
Chlorine Requirement: (1) The demand plus the residual. (2) The amount of chlorine that must be added to produce the desired result under stated conditions. The result (the purpose of chlorination) may be based on any number of criteria, such as a stipulated coliform density, a specified residual chlorine concentration, and the destruction of a chemical constituent. In each case, a definite chlorine dosage will be necessary. This dosage is the chlorine requirement.
Chlorite: A clay type marked by high iron content. Usually not water sensitive and only slowly acid soluble. Very occasionally existing as fragile, free-standing rims following sand grain dissolution over geologic time.
Chlorofluorocarbons: A family of inert, nontoxic, and easily liquefied chemicals used in refrigeration, air-conditioning, packaging, and insulation, or as solvents or aerosol propellants. Because they are not destroyed in the lower atmosphere, they drift into the upper atmosphere where their chlorine components destroy ozone. (2) Family of manufactured chemicals; also called chlorinated fluorocarbons.
Chlororganic: Chlororganic compounds are organic compounds combined with chlorine. These compounds generally originate from or are associated with living or dead organic materials.
Choke: (1) A device to restrict the rate of flow during the testing of an exploratory discovery. (2) A type of orifice installed at the surface on the tubing string to adjust and control the amount of oil or gas flowing from a well. It is customary to refer to the production of a well as so many barrels or thousands of cubic feet through a 1/4-in. or 1/2-in. choke or whatever the size of the opening. The flowing pressure exerted by the well's production gives an indication of the strength of the well and is helpful in determining whether a well is commercial. (3) A device used to create a controlled pressure drop and allow some expansion of the gas. A choke holds a backpressure on the well fluids, controlling the expansion rate of the gas. It is useful for optimizing natural gas lift in oil wells with sufficient gas to flow naturally or in some gas-lifted wells.
Choke Bean: A flow tube for a fixed bean-type choke.
Choke Line: A drilling and workover pressure control device. A line that is attached to the BOP stack and through which kick fluids can be circulated when the BOP is closed.
Choke Manifold: A set of valves and/or chokes used to control drilling fluid returns on a drilling well or, in a few cases, used to control flow from a high-rate well where the chokes may be in parallel or series.
Choke Trim: Pressure-controlling choke components, usually replaceable, expendable pieces.
CHOPS: Cold heavy oil production with sand.
CHP: See *Combined heat and power.*

Christmas Tree (X'mas Tree): (1) An assembly of valves mounted on the casinghead through which a well is produced. The Christmas tree also contains valves for testing the well and for shutting it in if necessary. (2) A subsea production system similar to a conventional land tree except it is assembled complete for remote installation on the seafloor with or without diver assistance. The marine tree is installed from the drilling platform; it is lowered into position on guide cables anchored to foundation legs implanted in the ocean floor. The tree is then latched mechanically or hydraulically to the casinghead by remote control. (3) Set of valves and elements placed on an oil well pipe, which allows safety operation of the well. (4) The control sections that sit above the basic wellhead. It may contain hangers, master valves, annular valves, wing valves, and gauges or pressure, flow rate, or monitoring measurement equipment. (5) Branching series of pipes, gauges, and valves on the top end of each production well to control flow of oil or gas. (6) The assembly of fittings and valves on the top of the casing that control the production rate of oil. (7) The arrangement of pipes and valves at the wellhead to control the flow of oil or natural gas and to prevent blowouts. See *Wellhead*.

Chromatogram: An analysis of hydrocarbons from a gas stream in order of molecular size.

Chrome: 13Cr is 13% chrome.

Chrome Tubing: One of several steel compositions for tubing that uses chromium for increased resistance to CO_2.

Chromometer, Colorimeter: Instrument used in determining the color of petroleum oils and petrolatum.

Churn Flow: A flow regime in which the rising gas bubbles have enlarged.

CIBHP: Closed-in bottom-hole pressure.

CIBP: See *Cast iron bridge plug.*

CID (Subsea): Chemical injection for downhole.

CIF Contract: See *Cost, insurance, and freight contract*.

Cilia: Hairlike protuberances found on certain protozoans (called ciliates) and multicelled aquatic invertebrates. They are used for locomotion or to cause flow of liquid.

Ciliates: A class of protozoans distinguished by short hairs on all or part of their bodies.

CIM: Canadian Institute of Mining.

CIRC: Circulate.

Circuit Breaker: A device used to open and close a circuit by automatic means when a predetermined level of current flows through it.

Circulate: Establishing flow down the tubing or drill pipe and up the annulus. Reverse circulating involves injecting down the annulus and up the drill pipe.

Circulate and Weight Method: A kick control method that circulates the well immediately and mud weight is brought up gradually (concurrent method).

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Circulating Pressure: The pressure generated by the mud pumps and, in normal circulation, exerted on the drill string.
Circulating System: Pumps drilling fluids down the hole, out of the nozzles in the drilling bit, and returns them to the surface where the debris is separated from the fluid.
Circulating Water: Water that circulates repeatedly around a loop, used in a water-cooled device or in a device that cools or heats water or air.
Circulation: The techniques for bringing rock cuttings from the bottom of the wellbore to the surface by continuously pumping drilling mud down through the drill string and up the annulus during rotary drilling.
Circulation Charge: See *Puncher charge.*
Circulation (Clean): Descriptive of drilling muds returning to the surface without rock cuttings.
Circulation Control Valve: Valve normally placed across the circulation point to allow isolation of the tubing strings or tubing/casing during production.
Circulation Losses: Losses for any reason while circulating the well.
Circulation Process: Is the round trip made by the drilling mud; down through the drill pipe and back up the annulus between the pipe and the wall of the borehole. If circulation is lost, the flow out of the well is less than the flow into the well; the mud may be escaping into some porous formation or a cavity downhole.
Circulation Squeeze: A secondary or repair cement method using upper and lower perforations and a packer set between. Circulation is established with water and mud remover chemicals to clean the channel. Cement is circulated with a set volume pumped, then the packer is released and pulled above the zone. The cement is displaced from the tubing. A secondary squeeze may be done.
Circulation Sub: A sub in the circulating string with a side port that can be opened remotely to allow circulation from that point.
Circulation Valve: A downhole valve in the treating string, operated by pressure pulsing or wire line that will allow the annulus to be circulated.
CIT (Corrosion): Corrosion inhibitor treatment.
CIT–OA: Casing integrity test–outside annulus.
CIT (Pressure Test): Casing integrity test.
Citric Acid: A weak organic acid that serves as a chelating agent for iron (slows iron hydroxide formation).
CIT (Subsea): Chemical injection for tree.
City Gas: Treated and conditioned gas for consumer use. Also known as sales gas.
City Gate: A point or measuring station at which a distributing gas utility receives gas from a natural gas pipeline company or transmission system.
City Gate Rate: The rate charged in a distribution utility by its suppliers; refers to the cost of the natural gas at the point at which the distribution utility historically takes title to the natural gas. Also called "gate rate."

City Gate Station (City Gate): The point or measuring station at which a gas distribution utility physically receives gas from a pipeline or transmission company; the point at which the backbone transmission system connects to the distribution system. There is not necessarily a change of ownership at a city gate station.
CIV: Chemical injection valve.
CIV (Completion): Completion isolation valve.
CIWHP: Closed-in wellhead pressure.
C/K (Drilling): Choke and kill line.
CL: Control line.
Cl_2: See *Chlorine.*
ClampOn™ Sand Detector: A brand name of a sand particle movement detector.
Clamshell Marks (Failure/Crack Development): Characteristic markings (ridges, tears, risers, etc.) on fracture surfaces after fatigue crack of fracture propagation (also known as beach marks, conchoidal marks, and arrest marks).
Clarification: Any process or combination of processes, the main purpose of which is to reduce the concentration of suspended matter in a liquid.
Clarifier: A large circular or rectangular tank or basin in which water is held for a period of time during which the heavier suspended solids settle to the bottom. Clarifiers are also called settling basins and sedimentation basins. May also be a tank or basin in which wastewater is held for a period of time during which the heavier solids settle to the bottom and the lighter materials float to the water surface.
Class A Cement: Construction-grade Portland cement.
Class C Cement: Finer-grind cement, higher early strength.
Class E and F Cements: High-temperature cements.
Class G and H Cements: Oil field-related cements.
Classification Society: Private organizations that arrange inspections and advise on the hull and machinery of a ship. They supervise vessels during their construction and afterward, in respect to their seaworthiness, and place vessels in grades or "classes" according to the society's rules for each particular type. It is not compulsory by law that a shipowner should have his vessel built according to the rules of any classification society. In practice, the difficulty in securing satisfactory insurance rates for an unclassed vessel makes it a commercial obligation. The major classification societies—American Bureau of Shipping, Lloyds Register of Shipping, Det Norske Veritas, Bureau Veritas, and Germanischer Lloyd—have included the International Maritime Organization (IMO) LNG codes in their rules. See *International Maritime Organization (IMO).*
Class of Service: A group of customers with similar characteristics (e.g., residential, commercial, industrial) that are identified for the purpose of setting a rate for service.
Clastic: A rock grain, formed somewhere else and transported into place to be part of another rock.

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Claus Reactor: Equipment in acid gas treatment unit where Claus reaction is developed for sulfur recovery: transforms the H_2S to elemental sulfur forcing the gas to react with oxygen.
Clay: (1) Filtering medium, especially fuller's earth, used in refineries, for the purpose of absorbing the solids or colorizing materials in oils. (2) A fine grain (<0.00015 in. or about 4 μm)—finely crystalline silica sheet minerals. Usually of silicate composition. In oil field terms, the most common clays are smectite (montmorillonite), illite, kaolinite, and chlorite. The characteristic for authigenic clay is to have extremely high surface area-to-volume ratio.
Clay-Bound Water: Water held in or on the surface of a clay and not free to move with other connate fluids.
Clay Extender: A drilling additive to increase the viscosity of water-based muds gelled with bentonite.
Clay Flocculation: Dropping suspended particles out of a fluid by agglomerating them into larger, easier separated particles.
Clay Migration: Movement of clay particles, usually after partial disintegration of the clay matrix due to absorption of water or reaction to other effects such as ions, velocity, and crushing due to overburden.
Clay Swelling: The absorption and modification of the clay matrix by a reactive water.
Clean Alternative Fuel: Any fuel (including methanol, ethanol, or other alcohols [including any mixture thereof containing 85% or more by volume of such alcohol with gasoline or other fuels], reformulated gasoline, diesel, natural gas, liquefied petroleum gases, and hydrogen) or power source (including electricity) used in a clean fuel vehicle that complies with the standards and requirements of the Clean Air Act Amendments of 1990.
Clean Circulation (Drilling): Fluids returning to the surface without cuttings or other solids removed from the well.
Clean Oil: Oil with less than 1% water. Usually within pipeline spec.
Cleanout: Removal of fluids or solids from a well, usually by circulating.
Clean Water Act: An act passed by the US Congress to control water pollution. The Federal Water Pollution Control Act passed in 1972 (Public Law [PL] 92-500). It was amended in 1977 (the Clean Water Act, PL 95-217) and again in 1987 (the Water Quality Act, PL 100-4).
Clear Brine: A brine without suspended solids.
Cleat Fracture (In Coal): A natural fracture along the cleat plane, usually parallel to max stress. Often extensive, especially in thin beds.
Cleveland Open Cup: A test for determining the open flash point and fire point of all petroleum products except fuel oil and products with open flash points below 79°C.
Cleveland Open-Cup Tester: A standard laboratory apparatus used in determining flash and fire points of petroleum products.
CLFP: Choke line friction pressure.
Clinker: Pea- to marble-sized pellets of raw cement prior to grinding.

Clintoptolite: A common zeolite mineral with sensitivity to some surfactants.
ClO_2: See *Chlorine dioxide*.
Closed-Chamber Testing: Testing the well in a chamber open at the bottom but closed at the surface. Fluid entering the wellbore is equal to the fluid production minus the gas volume charge. A material balance approach.
Closed-In: Descriptive of a well that is capable of producing, but is not producing at the time.
Close In: To shut-in a well.
Closing Ratio: The ratio between the pressure in the hole and the operating-piston pressure needed to close the rams on a given BOP design against a particular wellhead pressure.
Closure (Fracture): The pressure at which a fracture closes. Related to the closure forces in a formation.
Cloud Point: The temperature at which a noticeable cloud of crystals or other solid materials appears when a sample is cooled under prescribed conditions.
Cloud Point (Paraffin): The first appearance of microsized paraffin crystals in suspension in the oil.
Cloud Test: The method (ASTM D97) for determining the temperature, known as cloud point, at which paraffin wax or other solid substances begin to crystallize out or separate from solution when an oil is chilled under specified conditions.
Cluster Perforating: Grouping the perforations in small groups usually to generate multiple, regularly spaced fractures using hydraulic diversion or ball sealers.
CLW (SSSV): Control line to well communication.
CMC: See *Carboxymethyl cellulose*.
CMHEC: See *Carboxymethyl, hydroxyethyl cellulose*.
CMHPG: Carboxymethyl, hydroxypropyl cellulose.
CMIT–IAxOA: Combination mechanical integrity test–inner annulus by outer annulus.
CMIT–TxIA: Combination mechanical integrity test–tubing × inner annulus.
CMIT–TxIAxOA: Combination mechanical integrity test–tubing × inner annulus by outer annulus.
CMP (Depth): Common midpoint.
CMS: Carboxymethyl starch.
Cmt: Cement.
CMTD: Cable mounted tension device.
CNG: See *Compressed natural gas*.
CNL: Compensated neutron log. Radioactive neutron source bombards the formation with high-energy neutrons, which are slowed and captured by atoms of the formation. The low-energy neutrons are reflected back to the tool and counted. The amount of neutrons returning is inversely proportional to the porosity of the formation.
CNS: Central North Sea.

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CO: See *Carbon monoxide*.
CO: Circulate out, mud logging term.
CO_2: See *Carbon dioxide*.
CO_2 Injection: Secondary recovery technique for oil. The carbon dioxide gas is injected and alternated with water. CO_2 lowers the viscosity of most oils but may trigger severe asphaltene and scale precipitates.
Coagulant: A chemical that causes very fine particles to clump (floc) together into larger particles. This makes it easier to separate the solids from the liquids by settling, skimming, draining, or filtering.
Coagulation: (1) The clumping together of very fine particles into larger particles (floc) caused by the use of chemicals (coagulants). The chemicals neutralize the electrical charges of the fine particles, allowing them to come closer and form larger clumps. This clumping together makes it easier to separate the solids from the water by settling, skimming, draining, or filtering. (2) Coagulation and coalescence are both words that are used to describe what happens when small particles in a dispersion combine together to form large ones. One example is what happens to milk (a nice disperse emulsion) if it is left at the back of the fridge too long. Coagulation is used when the particles that are combining are more or less solids, and coalescence is usually restricted to droplets of liquid. (3) Forming a larger mass from smaller ones by collision and sticking together.
Coal: (1) A readily combustible black or brownish-black rock whose composition, including inherent moisture, consists of more than 50% by weight and more than 70% by volume of carbonaceous material. It is formed from plant remains that have been compacted, hardened, chemically altered, and metamorphosed by heat and pressure over geologic time. (2) Sedimentary rock, often highly naturally fractured, composed of thermally modified plant remains.
Coal Bed Methane: (1) A methane-rich, sulfur-free natural gas contained within underground coal beds. (2) Natural gas generated and trapped in coal seams. (3) Natural gas, primarily methane, that occurs naturally in the fractures and matrix of coal beds. (4) Natural gas formed during the coalification process and trapped within and adsorbed to the coal.
Coalescence: The combination of bubbles or droplets in an emulsion to form larger bubbles or drops that will separate easier.
Coal Gas: (1) A mixture of hydrogen, carbon monoxide, and methane, produced by distilling coal, that was once used for heating and lighting. (2) Usually methane that is adsorbed and absorbed to the high surface area of the coal.
Coal Gasification: The chemical conversion of coal to a gas.
Coal Liquefaction: Chemical conversion of coal to a liquid hydrocarbon.
Coarse: API designation of sand-type particles larger than 2000 μm.
Coating: A liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film (NACE).
Coating Holiday: A break in an otherwise continuous coating.

Coating (Process): The process of applying a thin layer of a material in the form of a fluid or powder upon a substance.
Coating (Product): A thin layer of a material applied by a coating process.
COC: See *Cleveland open cup.*
Coccolith: A marine, single-celled (1 to 5+ μm) animal that is a component of chalks.
COD: See *Chemical oxygen demand*.
COD: See *Cost of development/BOE*.
Code of Federal Regulations: A publication of the US Government that contains all of the proposed and finalized federal regulations, including environmental regulations.
COE: Controllable operating expense.
COFCAW: A tertiary recovery mechanist consisting of combustion and water flooding.
Cofiring: The process of burning natural gas simultaneously with another fuel. Cofiring can reduce sulfur dioxide (SO_2) and nitrogen oxide (NOx) emissions.
Cogellant: A substance that acts in conjunction with a conventional soap to thicken a grease.
COGEN: See *Cogeneration*.
Cogeneration: (1) Production of electrical or mechanical energy and heat or other power. (2) The simultaneous production of electrical energy from the combustion of a single fuel source via two means: gas turbines and steam turbines. See *Combined-cycle gas turbine*. (3) The simultaneous production of electricity and steam from a single process, which requires up to one-third less fuel than separate production.
Coherence (Seismic): A seismic comparison method. Reverse method is incoherence.
Cohesion: (1) A force that holds fluids and sand grains together. The force is generated by attraction at the molecular level. Cohesion is often used to describe sand grains stuck together by a low-viscosity fluid such as oil or water, although this is better explained as adhesion. (2) Cohesion just means "sticking together" and cohesive forces are the forces that enable something to stick to itself. For example, if you glue two objects together and then break them apart, a cohesive *failure* is where the glue itself breaks, as opposed to an *adhesive failure* where the break is at the join between the glue and one of the objects.
Coiled Tubing: (1) Used to carry production equipment to the bottom of the well. (2) A continuous reeled tube from 1 in. diameter to >3.5 in. diameter. The tubing is injected into a well via a coiled tubing unit (CTU) and can be used to unload wells with liquid, foams or gases, logging, fracturing, etc.
Coiled Tubing Completion: A completion where CT and associated CT-mounted hardware is used as the primary completion flow path.
Coiled Tubing Connector: A mechanical device used to join strings of CT or attach a BHA to the CT.

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Coiled Tubing Drilling: Where CT is used as the primary drill string with a mud (less commonly an electric) motor to rotate the bit. Often used in underbalanced drilling.
Coiled Tubing Injector Head: The hydraulic powered chain-driven unit that snubs or strips coiled tubing into or out of a well.
Coiled Tubing Unit: The CT, reel, injector head, power pack, control unit, and pressure control equipment used in a coiled tubing job.
Coke: (1) A generally insoluble hydrocarbon that has been oxidized to the point of a solid, often hard mass. (2) Hard carbon and other crude oil impurities that can form inside furnace tubes. (3) The solid residue remaining after the destructive distillation of crude petroleum or residual fractions. Used commercially as domestic and industrial fuel and, when purified, in various metallurgical and industrial processes.
Coke Oven Gas: The mixture of permanent gases produced by the carbonization of coal in a coke oven at temperatures in excess of 1000°C.
Cold Box: Vessel containing equipment working at low temperature with the purpose of providing a common thermal insulation. The material used for insulation is normally expanded perlite, which surrounds the contained equipment and fills the entire vessel. The atmosphere inside the vessel is also controlled so that there is neither moisture nor aggressive compounds.
Cold Finger Test: A device with a chilled probe that measures the temperature at which paraffin will precipitate of an oil solution.
Cold Settling: Process for removing petroleum wax from cylinder stock and high viscosity distillate by chilling a naphtha solution of the oil and allowing the wax to crystallize out of the solution and settle to the bottom of the pans.
Cold Test: The temperature at which an oil becomes solid. Generally considered to be 5°F lower than the pour point.
Cold Treating: The treating of an emulsion with chemicals to break an emulsion without resorting to the application of heat.
Coleman Equation: Equations for deliquification of a well at operating pressures less than 1000 psi.
Coliform: A group of bacteria found in the intestines of warm-blooded animals (including humans) and also in plants, soil, air, and water. Fecal coliforms are a specific class of bacteria that only inhabit the intestines of warm-blooded animals. The presence of coliform bacteria is an indication that the water is polluted and may contain pathogenic (disease-causing) organisms. The major species are *Escherichia coli (E. coli)*, found in the intestines of man, and *Aerobactor aerogenes* normally found on grain and plants.
Collapse Chimneys: A type of karst (geologic time sinkhole).
Collapse Pressure: External hydrostatic pressure that will cause the onset of pipe yielding. Heavily influenced by tension loads on the pipe.
Collapse Rating: The collapse pressure derated by a safety factor. Takes into account the effects of axial load. The formulas are only good for round pipe.

Collar: The connection or coupling on jointed pipe. It the strict sense, it is the section with female × female connections.
Collar Lock: A profile that can be set by wire line in the space in an API-type coupling.
Collar Log: A magnetic inflection log, run on wire line that is principally used to locate the depth of threaded pipe connections and other masses of metal.
Collar Stop: A wire line set plug without a profile. It is set in a coupling and grips with packer-like slips.
Collection System: A network of pipes, manholes, cleanouts, traps, siphons, lift stations, and other structures used to collect all wastewater and wastewater-carried wastes of an area and transport them to a treatment plant or disposal system. The collection system includes land, wastewater lines and appurtenances, pumping stations, and general property.
Collet: A mechanical device used for holding or locking where segmented keys or fingers are pushed into a recess to hold, anchor, or grasp the tool.
Collet Connector (Coiled Tubing): A type of connector that utilizes a collet-type device for attaching a BHA to coiled tubing.
Collet Lock: A type of lock used in a profile.
Collider: An explosive charge in a tool designed to sever very heavy BHA tools such as drill string collars and stabilizers. It latterly uses a focused explosive to blow the string apart. A tool of last resort.
Collision: When the drill bit in a new-drill well contacts an existing wellbore.
Colloid: (1) A substance with particle size so fine that it exists as a stable dispersion rather than settling out. (2) Very small solids (particulate or insoluble material in a finely divided form) that remains dispersed in a liquid for a long time due to their small size and electrical charge. (3) If the size of a particle is of the order 10 nm–1 μm (10^{-8}–10^{-6} m), then a mixture of these particles with a continuous phase (e.g., tiny particles of dust in air or polymer in water) will have properties that are intermediate between those of a true solution and a mixture of largish particles in a substance. Three key things to remember about colloids are as follows:

About the same size as a wavelength of light.
Largely unaffected by gravity.
A large proportion of the molecules in a colloidal particle are at or near the particle surface.

Colloidal Suspension: A dispersion of fine particles, held by charge or other force in a stable suspension.
Colorimetric: A means of measuring unknown concentrations of water quality indicators in a sample by comparing the sample's color, after the addition of specific reagents, with the color of known concentrations.
Combination Log: A single assembly of various logging tools.

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Combination Trap: A trap that has both structural and stratigraphic character.
Combined-Cycle Gas Turbine: This is the combination of simple gas turbines with a heat recovery steam generator (HRSG) and a steam turbine in a power generation plant. Gas is combined with air and burned, with the expanded gas turning the blades of the gas turbines to power an electricity generator (the Brayton thermodynamic cycle). The hot exhaust gases are passed to the HRSG, in which water is converted to steam that is used in a single steam turbine to power another generator (the Rankine thermodynamic cycle). Also called "combined cycle generation."
Combined Heat and Power: The simultaneous generation of two forms of energy from a single fuel source. Electrical energy is produced via gas turbines and heat energy (steam) is produced via a heat recovery steam generator. See *Combined-cycle gas turbine*.
Combined Sewer: A sewer designed to carry both sanitary wastewaters and storm or surface water runoff.
Combined Sewer Overflow: Wastewater that flows out of a sewer (or lift station) as a result of flows exceeding the hydraulic capacity of the sewer. CSOs usually occur during periods of heavy precipitation or high levels of runoff from snowmelt or other runoff sources.
Combined Wastewater: A mixture of storm or surface runoff and other wastewater such as domestic or industrial wastewater.
Combustible Limits (Fuel Gas): The range of gas concentration in air where the fuel gas or combustible gas will ignite.
Combustion: Chemical process of oxidation that occurs at a rate fast enough to produce heat and usually a flame.
Combustion Air: Air required to provide for the complete combustion of fuel and usually consisting of primary air, secondary air, and excess air.
Combustion Shock: Abnormal burning of fuel in an internal combustion engineer.
Commercial Consumption: Gas used by nonmanufacturing establishments or agencies primarily engaged in the sale of goods or services. Included are such establishments as hotels, restaurants, wholesale and retail stores, and other service enterprises; gas used by local, state, and federal agencies engaged in nonmanufacturing activities.
Commercial Field: (1) A hydrocarbon field that, under existing economic and operating conditions, is judged to be capable of generating enough revenues to exceed the costs of development. (2) An oil or natural gas field that, under existing economic and operating conditions, is judged to be capable of generating enough revenues to exceed the costs of development. (3) An oil and/or gas field judged to be capable of producing enough net income to make it worth developing.
Commercial Production Level: Varies with the well—an indicator of the minimum flow rate and type of fluids that can justify completing or continuing to operate the well.

Commercial Well: A well of sufficient net production that it could be expected to pay out in a reasonable time and yield a profit from the operation. A shallow 50-barrel-a-day well in a readily accessible location onshore could be a commercial well. Such a well in virtually any offshore area where enormously expensive producing facilities and pipelines would have to be constructed would not be considered commercial.
Commingle: Mixing production. In a well, when two or more zones are mixed to assist in economic production. In a flow line, when multiple crude source streams are mixed.
Commingling: (1) Producing oil and gas from two or more reservoirs at different depths. (2) Producing oil and gas from two or more reservoirs at different depths or where product of two or more fields is transported via a common pipeline.
Comminution: A mechanical treatment process that cuts large pieces of wastes into smaller pieces so they won't plug pipes or damage equipment (shredding).
Comminutor: A device used to reduce the size of the solid chunks in wastewater by shredding (comminuting). The shredding action is like many scissors cutting or chopping to shreds all the large solid material in the wastewater.
Committed Gas Contract: A source-specific natural gas sales contract that commits the seller to deliver natural gas, from specific described reserves or sources.
Commodity Charge: Throughput or usage charge; a fee paid to the pipeline operator, based on the number of decatherms moved by the pipeline for the shipper. At the local market, it is referred to as the gas portion of the end user's bill charged at the burner tip; the component of rates charged to customers that reflects the volume of gas actually transported by a utility or the cost of gas actually purchased by the utility.
Common Carrier: A facility obligated by law to provide service to all potential users without discrimination, with services to be prorated among users in the event capacity is not sufficient to meet all requests. In the United States, interstate oil pipelines are common carriers, but interstate natural gas pipelines are not (they are open access contract carriers).
Common Carrier (Petroleum): Those engaged in the transport of petroleum products.
Common Process: A common way of working that generates and/or protects value; sets out baseline expectations, to materially impact performance; is enduring and globally consistent; and helps advance the capacity of the global organization.
Communication: Ability to circulate or pass fluids from one chamber in a well to another.
Comonomer: A monomer that is polymerized along with one or more other monomers to make a copolymer. All the different comonomers used in a copolymerization are incorporated into each chain.
Compaction: A crushing of the matrix structure as overburden loads press down on the rock, reducing the pore space. During production of the well,

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the load on the matrix increases as the pore-filling fluids are removed. These loads may reduce the porosity of the rock, expelling fluids from the rocks (compaction recovery of fluids). Permeability may be decreased in compaction, first by closing natural (unpropped fractures) and then by reduction of matrix perm in severe cases.

Compaction Drive: A drive mechanism in a weak zone that displaces fluid by reducing the overall volume of the formation.

Company Man (Drilling): The operating company representative on location.

Company-Used Gas: Natural gas consumed by a gas distribution or gas transmission company or the gas department of a combination utility, for example, fuel for compressor stations.

Compartmentalization: Separate compartments or smaller reservoirs in a larger, common reservoir that may not be in communication.

Compartments: Segregated flow units of a main reservoir that have a poor flow connection or no flow connection to the main reservoir.

Compatible Brine: A brine that does not create formation damage or permeability reduction when introduced into a formation.

Compensated Formation Density Log: A dual spacing formation density log, using two detectors at different distances from the source.

Compensated Log: A well log that is designed to correct for an effect associated with the borehole.

Complement: The number of officers and crew employed upon a vessel for its safe navigation and operation.

Completed Well: (1) A well that has been mechanically completed for production or service use. There may be more than one completed zone in the well. See *Active well*. (2) A well that has been drilled, cased, and cemented and is ready to produce hydrocarbons.

Completing a Well: The process by which a finished well is either sealed off or prepared for production by fitting a wellhead.

Completion: (1) To finish a well so that it is ready to produce oil or gas. After reaching total depth (TD), casing is run and cemented, casing is perforated opposite the producing zone, tubing is run, and control and flow valves are installed at the wellhead. Well completions vary according to the kind of well, depth, and the formation from which the well is to produce. (2) The procedure by which a successful well is readied for production. (3) The installation of permanent wellhead equipment for the production of oil and gas.

Completion Bore Protector (Subsea): A removable sleeve that covers the internals of the subsea tree during drilling operations.

Completion Fluid: A brine-, oil-, or gas-based fluid that is used as isolation (kill, separation, inhibition functions, etc.) fluid during the completion of a well. Commonly seawater, NaCl brine, formation water, KCl brine, $CaCl_2$ brine, etc. Oil-based fluids are common where formation sensitivities with shales, clays, minerals, etc., prevent use of aqueous fluids.

Completion Funds: Completion funds are formed to invest in well completions, to finance the completing and equipping of a potentially productive well. After a well is drilled into a productive formation, there remain the costs of setting pipe (casing the well); perforating, testing, acidizing, or fracturing the formation; and running production tubing and installing pumping equipment, separators, stock tanks, etc. The operator who drills the well may not have the financial resources to complete the well, so they may sell part or all of their interests to a completion fund. Completion funds are not as risky an investment as drilling funds, but are less certain than income funds and royalty funds.
Completion Interval: The pay zone exposed to the wellbore. This may or may not be the entire pay.
Completion Technical Limits: The maximum production or flow capacity possible by the best completion attainable.
Complex Fracturing: Opening up secondary natural fractures that may be orthogonal to the planar fracture. Also, networked fractures and shear fracturing.
Complex Grease: A composition in which the thickener is a combination of a conventional metallic soap (salt of a metallic element and a fatty acid having a particular type of structure) and a complexing agent. The complexing agent may be either organic and may or may not involve another metallic constituent.
Complex Well: A well design with engineering or application challenges that are out of the ordinary.
Compliance: The act of meeting specified conditions or requirements.
Compliant Expansion: A term used in expandable nomenclature signifying expansion that fits itself to non-gauge boreholes.
Compliant Piled Tower: A bottom-founded structure viable for installation in water depths to 3000 ft.
Composite Bridge Plug: A bridge plug made mainly of plastic and composite materials.
Composite Log: Several logs spliced or overlayed to form a single group log record.
Composite (Proportional) Sample: A composite sample is a collection of individual samples obtained at regular intervals, usually every 1 or 2 h during a 24-h time span. Each individual sample is combined with the others in proportion to the rate of flow when the sample was collected. The resulting mixture (composite sample) forms a representative sample and is analyzed to determine the average conditions during the sampling period.
Compounded Oil: A mineral oil to which has been added vegetable oil, animal oil, or a similar chemical substance to impart special properties.
Compressed Natural Gas: (1) Natural gas that has been compressed under high pressures (typically between 3000 and 3600 pounds per square inch [psi]) and held in a container; expands when released for use as a fuel. (2) Natural gas compressed to a volume and density that is practical as a portable fuel supply (even when compressed, natural gas is not a liquid).

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(3) Natural gas in its gaseous state that has been compressed. (4) Is natural gas that is under pressure. The pressure reduces the volume occupied for the gas so it can be contained in a smaller vessel.

Compressibility: The volume change of a material when pressure is applied.

Compressibility Factor: The ratio of the actual volume of a gas divided by the volume that would be predicted by the ideal gas law, usually referred to as the "Z" factor.

Compression: (1) The act or process of contracting a volume of gas into a smaller space. (2) Natural gas is compressed during transportation and storage. The standard pressure that gas volumes are measured at is 14.7 psi. When being transported through pipelines, and when being stored, gas is compressed to save space.

Compressional Wave: A P wave.

Compression–Ignition Engine: A diesel engine; an engine in which the air and fuel are ignited by the heat produced on the compression stroke.

Compression Ratio: (1) The relationship of absolute outlet pressure at a compressor to absolute inlet pressure. (2) The ratio of the absolute outlet pressure of a compressor to the absolute inlet pressure.

Compression-Set Packer: A retrievable packer where the slips are set and the seal energized by setting tubing string weighed down on the packer. Releases by picking up the string. Useful where annular pressure could unseat a tension-set packer.

Compressor: (1) A type of pump that increases the pressure of gas. Commonly used as a production rate increaser by increasing the gas pressure delivered from low-pressure gas wells to enter the pipeline. The intake into the compressor lowers the wellhead pressure, creating a larger drawdown. (2) An engine used to increase the pressure of natural gas so that it will flow more easily through a pipeline. (3) Thermodynamic machine that increases the pressure of a gas flow using mechanical energy. (4) Device for mechanically increasing the pressure of a refrigerant vapor. (5) A mechanical device used to raise the pressure of a gas. Compressors can be of three types: axial, centrifugal, or reciprocating. The usual means of providing the required power are electrical motors, steam turbines, or gas turbines.

Compressor Station: (1) A booster station associated with a gas pipeline that uses compressors to increase the gas pressure. When gas turbines are used to provide compressor power, stations can use some of the gas moving through the line as fuel. (2) Stations located along natural gas pipelines that recompress gas to ensure an even flow.

Compton Scattering: A gamma-ray reaction in which the gamma ray, after colliding with an electron, shifts some energy to the electron. The higher the energy loss by Compton scattering in a zone, the higher the electron concentration or density. The basis for the density log.

CONCAWE: Conservation of Clean Air and Water in Europe.

Concentric Completion: A multiple completion in which the upper zone flows to the surface through the annulus formed by the casing and the deeper zone tubing. Usually used only in sweet, dry gas upper completions.
Concentric Operations: Any operation where a smaller tubing is inserted through a larger tubing string. Normally done with the wellhead in place. Often done with the well under pressure.
Concentric Tubing: One string inside another.
Concentric Tubing Workover: A workover using a small-diameter tubing inside the existing tubing. Usually done with a hydraulic workover rig or coiled tubing. Commonly used with a positive surface well pressure and seals on the smaller tubing in a live-well workover.
Concession: (1) A geographic area that is licensed or leased to a company for a given period for exploration and development under specified terms and conditions. (2) Usually used in foreign operations and refers to a large block of acreage granted to the operator by the host government for a certain time and under certain government conditions that allows the operator to conduct exploratory and/or development operations. The concession agreement assures the holder of certain rights under the law.
Concession (Lease): A grant of access for a defined area and time period that transfers certain rights to hydrocarbons that may be discovered from the host country to an enterprise. The enterprise is generally responsible for exploration, development, production, and sale of hydrocarbons that may be discovered. Typically granted under a legislated fiscal system where the host country collects taxes, fees, and sometimes royalty on profits earned (SPE).
Concrete Gravity Rigid Platform Rig: A rigid offshore drilling platform built of steel-reinforced concrete and used to drill development wells. The platform is floated to the drilling site in a vertical position. At the site, one of more tall caissons that serve as the foundation of the platform is flooded so that the platform comes to rest on bottom. Because of the enormous weight of the platform, the force of gravity alone keeps it in place.
Concurrent Method: A well pressure control operation in which circulation is started immediately and mud density is brought up in steps until the well has been completely circulated to the kill weight fluid.
Condensate: (1) The part of the hydrocarbon stream that is a vapor in the formation and condenses to a liquid after being cooled. Normally the volatile condensate has a composition of C5–C8 and an API gravity of >40. (2) A hydrocarbon liquid that forms by precipitation from a gas. When the liquid precipitates in the reservoir during pressure depletion, the liquid is referred to as retrograde condensate. Surface production of hydrocarbon liquids through primary separation facilities is referred to as condensate when it comes from a gas reservoir. Natural gas condensates consist primarily of pentanes (C_5H_{12}) and heavier components; there will be some propane and butane dissolved within the mixture. (3) Liquids condensed

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from a gas stream, made up of a range of heavier hydrocarbons. For gas fields, condensate typically refers to the hydrocarbon liquid separated from the well stream fluid, which can be stabilized, stored, and exported as a high-value liquid product. (4) Hydrocarbons, usually produced with natural gas, which are liquid at normal pressure and temperature. (5) A highly gaseous liquid coming from gas condensate wells, from which the gas is separated, the liquid remaining being shipped with crude oil in pipelines to refineries. (6) Any liquid material coming from the condensers in a refinery. (7) Hydrocarbons that are in the gaseous state under reservoir conditions and that become liquid when temperature or pressure is reduced. A mixture of pentanes and higher hydrocarbons. (8) A natural gas liquid with a low vapor pressure, compared with natural gasoline and liquefied petroleum gas. It is produced from a deep well where the temperature and pressure are high. Gas condenses as it rises up the wellbore and reaches the surface as condensate. Similarly, condensate separates out naturally in pipelines or in a separation plant by the normal process of condensation. (9) Liquid hydrocarbons produced with natural gas that are separated from it by cooling, expansion, and various other means (also called "distillate"). (10) Liquid formed by condensation of a vapor. In steam heating, water condensed from steam; in air-conditioning, water extracted from air, as by condensation on the cooling coil.

Condensate Banking: A relative permeability effect where condensate, usually hydrocarbon, drops out of the vapor phase around the wellbore when the pressure drops below the dew point in response to drawdown or depletion. Gas rates can be severely reduced by the permeability reduction.

Condensate Return Pump: Pump used to transfer condensate from one point in a system to another receiver; usually installed with a receiver tank and a float valve; the pump being controlled by tank level.

Condensation: Change of state of a vapor into a liquid by extracting heat from the vapor.

Condensation Polymerization: Also known as step-growth polymerization. A way of making polymers in which every polymer chain grows continuously through the course of the reaction, remaining quite small until almost all the monomer has reacted.

Condensed Water: Water condensed from gas as it is produced. Usually freshwater.

Condenser: Heat exchanger in which vapor is liquefied by the rejection of heat to a heat sink.

Condensing Unit: Machine specifically designed to condense refrigerant vapor to a liquid by compressing the vapor in a positive-displacement compressor and rejecting heat to a cooling medium. The unit consists usually of one or more positive-displacement compressors, motors, condensers, liquid receivers (when required), and necessary accessories, mounted on a common base.

Conditioned Air: Air treated to control its temperature, relative humidity, purity, pressure, and movement.

Condition the Mud: Circulate the well to remove cuttings and gelled mud prior to running the casing.
Conductance: The reciprocal of resistance in direct current logging measurements. Measured in siemens (formerly mhos).
Conduction Heat Transfer: Heat transfer when two solids are in contact and heat passes between them—heat transport by direct transfer of energy from one particle to another.
Conductive Concrete: A highly conductive cement- and coke-based material used as an impressed current anode.
Conductivity (Fracture Flow): The permeability of the pack times its width. Expressed in md-ft.
Conductor: A substance that offers little resistance to the flow of electrical currents. Insulated copper wire is the most common form of conductor.
Conductor Pipe: The first string of casing run, usually to keep rocks or dirt out of the wellbore. It is usually not cemented in place. It may be jetted in, driven in, drilled in, or installed in an excavated hole.
Conduit Body: The part of a conduit system, at the junction of two or more sections of the system, that allows access through a removable cover. Most commonly known as conduits, LBs, LLs, and LRs.
Confined Aquifer: An aquifer under greater than atmospheric pressure, bounded above and below by relatively impermeable formations.
Confined Space: Confined space means a space is threefold; it is large enough and so configured that an employee can bodily enter and perform assigned work; it has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and it is not designed for continuous employee occupancy.
Confined Space Permit: A written form that assures that actual or potential hazards in a confined space are eliminated or managed prior to entry.
Confining Bed: A rock layer that through either low permeability or different modulus serves as a boundary for an event such as fluid flow or fracturing.
Confining Layer: A geologic formation exhibiting low permeability that inhibits the flow of water.
Confining Pressure: Various Earth forces acting on the formation. Includes overburden.
Confirmation Well or Delineation Well: (1) A secondary well, after a field discovery well, drilled to help determine field extent, volume, or potential rate. (2) Well or wells drilled to prove the formation or resources discovered in the initial or discovery well.
Confirmed Nomination: Verification by a pipeline company that a change in a customer's level of transportation service will be matched by a change in supplier quantities.
Conformity: A surface separating younger from older rocks with no indication of erosion or other disturbance.
Confusion Block: See *Impression block*.

C

Conglomerate: Poorly sorted collection of sediments, generally formed in a very high-energy environment. Similar to sandstones but have much larger grains (pebbles grade 4–64 mm). The space between the grains may be partly or completely filled with sand grains.
Coning: (1) The movement of a water upward or gas downward toward a decrease in pressure caused by producing hydrocarbons in a zone with no vertical permeability boundaries. (2) A condition that may be established in a sludge hopper during sludge withdrawal when part of the sludge moves toward the outlet while the remainder tends to stay in place. Development of a cone or channel of moving liquid surrounded by relatively stationary sludge.
Connate Water: The natural brine occupying the pore spaces. Usually, this water is at equilibrium with the minerals in the formation.
Connection Gas: The small amount of gas that enters the wellbore when circulation is stopped to make a connection. The gas only enters the wellbore in this case when the static fluid pressure is less than the pore pressure.
Consequence (Risk): Outcome of an event.
Conservation: Regulation of oil and/or gas production from a reservoir in order to prolong its life and hopefully recover a larger quantity of the oil or gas in place; reinjection of associated gas for future use. Also, environmental protection and preservation.
Consignee: The entity to whom cargo is consigned as stated on the bills of lading.
Consignor: The entity named in the bill of lading as the one from whom the goods have been received for shipment.
Consistency: A fluid's ability to deform and flow and its general cohesion to itself.
Consistometer: A device with rotating paddles, used to check the pumpability and set time of cement slurries.
Consolidated: An approximate level of rock strength where sufficient cementation is present to allow the rock to remain intact during drilling and production. Often the unconfined compressive strength is >1000–1500 psi.
Consolidated Soil: When a soil is subjected to an increase in pressure due to loading at the ground surface, a readjustment in the soil structure occurs. The volume of space between the soil particles decreases and the soil tends to settle or consolidate over time.
Consortium: (1) A group of unrelated companies acting together in a specific venture. (2) A group of unrelated companies working on a specific venture.
Constant Choke-Pressure Kill Method: A method of killing a well where the choke is adjusted to maintain a constant casing pressure as the water kick rises in the annulus. The method should not be used with a gas kick (will not keep a constant BHP).
Constituent: An essential part or component of a system or group: examples are an ingredient of a chemical system or a component of an alloy.

Construction General Permit: The SPDES permit that regulates construction activities that disturb one or more acres. Coded GP-0-10-001.
Consumer: The ultimate end user of natural gas at their "burner tip" as contrasted to a "customer" who may purchase natural gas for resale.
Contact: The depth of the interface between the oil and water, oil and gas, or water and gas.
Contact Angle: The angle of intersection of two fluids on a given surface. Describes wetting and non-wetting behaviors.
Contact Stabilization: Contact stabilization is a modification of the conventional activated sludge process. In contact stabilization, two aeration tanks are used. One tank is for separate reaeration of the return sludge (typically for at least 4 h) before it is permitted to flow into the other aeration tank to be mixed with the primary effluent requiring treatment.
Contact Tank: A detention tank provided primarily to ensure sufficient time for the disinfection process to take place.
Contaminant (Cementing): Placing a material in a cement slurry (usually already in a wellbore) that purposely prevents the cement form setting so that it can be circulated out of the wellbore.
Contamination: The introduction into water of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the water unfit for its next intended use.
Content (Fuel): The heat value per unit of fuel expressed in British thermal units (Btu) as determined from tests of fuel samples. Examples: Btu per pound of coal, per gallon of oil, per cubic foot of gas (AGA).
Continental Margin: (1) The separation of emerging continents from deep sea basins. (2) A zone separating the emergent continents from the deep sea bottoms.
Continental Offshore Stratigraphic Test: These tests under the direction of the Minerals Management Service are wells deliberately drilled to provide geological information pertinent to competitive bidding for offshore tracts.
Continental Shelf: (1) The edge of a continental mass that lies under the sea in comparatively shallow water (up to a water depth of about 800 ft). (2) A broad, gently sloping, shallow feature extending from the shore to the continental slope. (3) The shallow area out from shore to a water depth of about 450 ft.
Continental Slope: A relatively steep, narrow feature paralleling the continental shelf; the region in which the steepest descent of the ocean bottom occurs.
Contingency String (Casing Design): An "extra" string in a casing design that can be used in the event of failure to get an upper string to the correct depth.
Contingent Resources: The hydrocarbons that are estimated to be potentially recoverable from known accumulations, but which are not currently considered to be commercially recoverable.

C

Continuity: Measurement of a formation being present over a large area.
Continuous Flow Gas Lift: A lift system that uses continuous injection of gas into the liquid column.
Continuous Load: A load whose maximum current continues for three hours or more.
Continuous Phase: The external phase in an emulsion.
Continuous Process: A treatment process in which water is treated continuously (as opposed to batch treatment) in a tank or reactor. The water being treated continuously flows into the tank at one end, is treated as it flows through the tank, and flows out the opposite end as treated water.
Contour: A curve connecting points of equal value on a map.
Contracted Reserves: (1) Natural gas reserves dedicated to fulfill gas contracts. (2) Reserves of hydrocarbon dedicated to fill a specific contract.
Contractor: Contractor is the person, firm, or company whose tender has been accepted by the company and includes the contractor's personnel representative, successors, and permitted assigns.
Contract Price: Price agreed between sellers and buyers.
Contract Term: The term of effectiveness of a contract.
Control Gas: That part of the gas stream used to actuate or operate equipment (may be rendered unusable for sale due to pressure drop).
Control Head: An extension of a retrievable tool that is used to set and release the tool.
Control Line: A small-diameter line, usually attached to the outside of tubing, which controls the ScSSV or other downhole tools.
Convection: Transfer of heat by a fluid moving by natural variations in density.
Convection Heat Transfer: Heat transfer by gas, steam, or liquid circulation. Heat transport by moving particles and the thermal energy they carry to a new location.
Convective Mixing: Mixing created by heat transfer.
Convector: A heating unit, usually wall mounted, which relies on convection for delivery of heated air.
Conventional Crude Oil: (1) Petroleum found in liquid form, flowing naturally or capable of being pumped without further processing or dilution.
Conventional Energy Sources: Oil, gas, coal. The source of the energy may also have bearing on the definition. Unconventional hydrocarbon energy sources include shale oil (both mature and immature), shale gas, and tight gas (ultralow permeability, usually less than 0.001 millidarcy).
Conventional Gas: (1) Natural gas occurring in nature, as opposed to synthetic gas; (2) gas produced under present-day technology at a cost not greater than the current market value. (3) Natural gas in a normal media, capable of flowing without other influences.
Conventional Resource: Any area where natural gas can be drilled and extracted vertically.

Conventional Treatment: The common treatment processes such as preliminary treatment, sedimentation, flotation, trickling filter, rotating biological contactor, activated sludge, and chlorination wastewater treatment processes used by POTWs.
Converted Vehicle: A vehicle originally designed to operate on gasoline that has been modified or altered to operate on an alternative fuel.
Conveyance: Is a transfer of ownership of a property from one party to another.
Conveyance (Well Work): The wire line, slickline, tubing, or coiled tubing used to convey tools or equipment in a well.
Cooling Coil: Coil that uses refrigerant or secondary coolant to provide cooling or cooling with dehumidification.
Cooling Load: Amount of cooling per unit time required by the conditioned space.
Cooling Tower: Heat transfer device, often towerlike, in which atmospheric air cools warm water, generally by direct contact (evaporation).
Cooling Water: Water used for condensing a refrigerant.
Cooperative Fuel Research Engine: A standard test engine used in determining the octane number of motor fuels.
COPAS (Accounting): Council of petroleum accounting and shipping.
Copolymer: (1) A mixture of two or more polymers that polymerize at the same time and with some degree to linking to yield results unlike either polymer used alone. (2) A polymer manufactured from two or more different monomers. An example is butadiene–styrene. (3) A polymer that is made up of more than one monomer unit. A copolymer has each of its comonomers in every chain. There are a number of different types of copolymer that describe the nature of the arrangement of the comonomers within the polymer chain. For the two monomer units A and B, we can have

Block	…AAAAAABBBBBB…
Alternating	…ABABABABAB…
Statistical (or random)	…ABAAABBABBAABBB…

Copper Strip Corrosion: A method of testing petroleum products for their corrosive effect on copper and its alloys. Also used as a method of indicating the amount of free or unreacted sulfur in a product.
Core: A sample of the formation, taken with a core barrel.
Core Analysis: Lab work on a core sample that may yield permeability, porosity, pore size distribution, grain size, density, etc.
Core Barrel: A barrel in the drilling BHA with a coring head designed to receive a rock core cut as part of core sampling operations.
Core Customer: Buyer that can purchase natural gas from only one supplier, with no access to alternate fuel sources; usually describing a residential or small commercial user but may apply to a large industrial and electric utility user as well. Usually pays a higher rate for assured service.
Core Diameter (Coiled Tubing Reel): The diameter of the core of the CT reel.

C

Core Sample: (1) A solid column of rock, usually from 2 to 4 in. in diameter, taken from the bottom of a wellbore as a sample of an underground formation. Cores are also taken in geological studies of an area to determine the oil and gas prospects.
Coring: Taking rock samples from a well by means of a special tool—a "core barrel."
Corkscrew: Compressional deformation of tubulars to the point where the tubing resembles a corkscrew. The condition may be temporary if the metal is not yielded past the elastic recovery point. Tubulars that are corkscrewed may be pumped through but will stick most diameters of tool strings.
Correlate: To compare logging and core or other information and account for discrepancies.
Corridor: A strip of land or water through which a concession is obtained to run pipelines, electrical power, etc.
Corrosion: (1) The deteriorating chemical reaction of a metal with the fluids with which it is in contact. (2) The gradual decomposition or destruction of a material by chemical action, often due to an electrochemical reaction. Corrosion may be caused by (1) stray current electrolysis, (2) galvanic corrosion caused by dissimilar metals, or (3) differential-concentration cells. Corrosion starts at the surface of a material and moves inward.
Corrosion Coupon: A representative piece of metal cut to a specific size and shape that is immersed in a test bath placed in the flow stream to enable an estimation of the active corrosion occurring in a given set of conditions.
Corrosion–Erosion: Eroding away of a protective film of corrosion product by the action of a process stream, exposing fresh metal that then corrodes.
Corrosion Fatigue: Fatigue-type cracking of metal caused by repeated stresses in a corrosive environment.
Corrosion Film: First products of corrosion films that may form a tight barrier film and reduce further corrosion.
Corrosion Inhibition: Corrosion can be defined as the unwanted production of a salt from a metal. Adding acid or oxygen is a good way to do this. The main way of slowing corrosion down (inhibition) is by providing an impermeable coating to stop the chemical reaction from occurring in the first place or by providing a more easily attacked metal that will be consumed first (a "sacrificial anode").
Corrosion Inhibitor: (1) A chemical substance or combination of substances that, when present in the environment, prevents or reduces corrosion (NACE). (2) Substance that slows the rate of corrosion.
Corrosion Potential (E_{corr}): Potential of a corroding surface in an electrolyte relative to a reference electrode under open-circuit conditions.
Corrosion-Resistant Alloy: Alloy intended to be resistant to general and localized corrosion of oil field environments.

Corrosion-Resistant Ring Groove: A ring groove lined with material resistant to metal-loss corrosion.
Corrosive: A chemical that can cause burns to skin, eyes, or the respiratory system.
Corrosive Gas: (1) A gas that attacks metal or other specified targets. Most commonly CO_2 and H_2S. Usually in association with water or water vapor. Oxygen can be described as a corrosive gas in some cases. (2) In water, dissolved oxygen reacts readily with metals at the anode of a corrosion cell, accelerating the rate of corrosion until a film of oxidation products such as rust forms. At the cathode where hydrogen gas may form a coating on the cathode and slow the corrosion rate, oxygen reacts rapidly with hydrogen gas forming water and again increases the rate of corrosion.
Cost: See *Continental offshore stratigraphic test*.
Cost & Freight: Basis for sale of a cargo, in which the price reflects both the cost of the cargo and the cost of freight to its agreed destination. Title and risk of loss or damage to the oil pass from the seller to the buyer when the oil passes the ship's rail at the load port.
Cost, Insurance, and Freight Contract: In an LNG CIF contract, the buyer takes ownership of the LNG either as the LNG is loaded onto the vessel or on the voyage to the receiving terminal. Payment is made at the time ownership transfers but the seller remains responsible for the transportation and insures the cargo on behalf of the buyer. See Ex-ship contract and free on board contract.
Cost of Capital: The weighted average cost of financing investment projects, primarily through debt and/or equity financing.
Cost of Development (BOE): The unit cost ($/BOE) required to develop a project. Calculated by taking the total unescalated net development investment including seismic, technical data, drilling and completion costs, and costs of incremental surface facilities divided by incremental net proved developed reserves.
Cost Well: A well drilled on the continental margin to provide data for offshore leases.
Coulomb: An amp(ere) of current is what you get on 1 C worth of electric charge flows past a point in 1 s—that is, 1 A = 1 C/s. One mole of electrons has a charge of 96,500 C, which is called a farad.
Counterbalance Weights: The rotating weights on a beam lift pump jack that offset the weight of the rod string.
Coupling: The connection point of jointed pipe. It may be a steel shell with female threads to which the pins are connected or a formed female connection (box) on the end of tubing.
Coupon: A test strip of metal used in corrosion and erosion testing.
Covalent Bond: The combination of two of more atoms by sharing of electrons. Covalent bonds are generally stronger than other bonds.
Coventurer: A person or company joined with others in a particular venture.
CP: See *Contract price*.

C

CP (Casing): See *Casing point*.
CPS: Central power station.
CPT: See *Compliant piled tower*.
CPT (Corrosion): Critical pitting temperature.
CQG: Crystal quartz gauge.
Cr: See *Chrome*.
CRA: See *Corrosion-resistant alloy*.
Crack a Valve: To barely open a valve.
Cracking: (1) The refinery process in which large, heavy, complex hydrocarbon molecules are broken down into simpler and lighter molecules in order to derive a variety of fuel products. (2) The process in which large molecules found in crude oil are broken down into smaller molecules. See *Catalytic cracking* and *Thermal cracking*. (3) Process carried out in a refinery reactor in which the large molecules in the charge stock are broken up into smaller, lower-boiling, stable hydrocarbon molecules, which leave the vessel overhead as unfinished cracked gasoline, kerosenes, and gas oils. At the same time, certain unstable or reactive molecules in the charge stock combine to form tar or coke bottoms. The cracking reaction may be carried out with heat and pressure (thermal cracking) or in the presence of a catalyst (catalytic cracking).
Cracking (Refining): Breaking longer-chain hydrocarbon molecules to shorter-chain molecules.
Crane Barge: A large barge, capable of lifting heavy equipment onto offshore platforms. Also known as a "derrick barge."
Crane Vessel: A ship-shape vessel with one crane or semisubmersible vessel with one or two cranes for lifting platform modules and structures at sea. The crane hoisting capacities are substantial and range from 300 to 8000 tons. Cranes allow for moving the hook load vertically and horizontally (in a 360° radius). Nowadays, also frequently used to install heavy equipment on the seabed. In medium water depths, the crane vessel is anchor moored. In deepwater areas, the vessel is dynamically positioned.
Crater (Blowout): A depression formed from a release of gas through loose soil at the surface or sea floor.
Cratering or Sloughing: Collapse of part of the formation into the wellbore during drilling or completions.
Crazing: A network of checks or cracks appearing on the surface.
Creaming Curve: A graph of the hydrocarbons discovered or produced in an area used to determine if new wells are improving with each new well.
Creaming of Emulsions: Density separation state of emulsions, often where color variances are noted.
Creaming Theory: A statistical technique that recognizes that in any exploration province after an initial period in which the largest fields are found, success rates and average field sizes decline as more exploration wells are drilled and knowledge of the area matures.
Creep: (1) The slowest form of mass movement. (2) The slow movement of a solid due to an applied stress. Often very sensitive to time and rate of stress application.

Crest (Flow): The top of the water cone in (usually) a horizontal well. Compare with coning in a vertical well.
Crest (Geology): The top of a pay structure.
Cretaceous: A geological time from 65 to 140 million years ago.
Crevice Corrosion: Intensive localized electrochemical corrosion occurs within crevices when in contact with a corrosive fluid. Will accelerate after start.
Crew: (1) A group of workers on a rig. (2) The company of officers and personnel on board the ship. Though operations are similar to other types of ships, there is more emphasis on crew training for steam turbine plant and LNG cargo handling operations, as well as planned maintenance procedures.
CRI (Solids Handling): Cuttings reinjection.
CRI (Structure): Caisson-retained island.
Criteria Air Contaminants: Emissions of various air pollutants that affect our health and contribute to air pollution problems such as smog. CACs are tracked by Environment Canada.
Critical Buckling Load: The compression load that initiates buckling in the pipe.
Critical Components: Parts identified in a system that need a higher degree of reliability or traceability.
Critical Drawdown: Various. Usually the sand-free rate, but may also include a rate to achieve cleanup in special cases.
Critical Failure: Failure of an equipment unit that causes an immediate cessation of the ability to perform its required function.
Critical (Flow): Supersonic.
Critical Flow Rate (Biofilm): The minimum flow rate that keeps biofilm deposits from forming on the surface of the pipe.
Critical Flow Rate (Corrosion/Erosion): The maximum flow rate that avoids damage to the pipe from corrosion or erosion.
Critical Flow Rate (Liquids Unloading): The minimum flow rate to produce liquids from a well.
Critical Flow Rate (Sand Production): The maximum flow rate that avoids producing sand from the formation.
Critical Point: It is defined by the critical temperature and pressure: it is the end point of liquid and gas equilibrium line in a phase diagram. This point sets a state from which there is no distinction between the behavior of liquid and gas. At any pressure or temperature greater than the critical, transition from liquid to gas or vice versa occurs without any apparent change in state. In practice, the critical point represents the final state in which the fluid behaves as a liquid.
Critical Pressure: (1) For a pure component, the pressure above that separates liquid and gas phases cannot exist; (2) the vapor pressure of a substance at its critical temperature; partial liquefaction can occur below the critical pressure even at the critical temperature.

C

Critical Saturation: The saturation of a fluid at which the fluid will begin to flow as saturation is increased.
Critical Success Factors: Parameters that influence the likelihood of success of a particular method.
Critical Temperature: (1) Temperature that characterizes the critical point of a compound. (2) The temperature above which a fluid cannot be liquefied by increasing pressure. (3) For a pure component, the temperature above which a liquid phase cannot exist.
Critical Velocity (Erosion): Setting a maximum flow rate to minimize erosion corrosion.
Critical Velocity (Unloading): A minimum velocity to lift liquids in gas flow.
Crooked Hole: A wellbore drilled in excess of the maximum allowable dogleg.
Cross-Connection: (1) A connection between a storm drain system and a sanitary collection system. (2) Less frequently used to mean a connection between two sections of a collection system to handle anticipated overloads of one system. (3) A connection between drinking (potable) water and an unapproved water supply.
Cross-Dipole: A log with the receivers located 90° to the emitter.
Cross-Flow: Flow between formations via a connected wellbore. Cross-flow, as seen by downhole cameras, can occur with the wellbore full of fluid and the appearance of a dead well at surface.
Cross-Linked: A polymer gel with a chemical cross-linker added to link the linear gel into a higher viscosity gel.
Crossover (Gravel Packing): A section of the treating string that transfers incoming flow from inside the pipe to the annulus below the crossover and the return flow from inside the tubing to the annulus above the crossover. Straddles a packer.
Crossover Sub: A short section of pipe with the proper threads cut into each end to join two pieces of pipe or equipment that do not have matching connections.
Cross-Plot: Two or more log responses or other variable records plotted on an *X*-, *Y*-axis.
Crosswell Tomography: A map of the acoustic strata record between two wells where the emitter is in one well and the receiver is in the other.
Crown: High point.
Crown Block: The set of pulleys or sheaves at the top of the mast on a rig.
Crown Lands: Government-owned land.
Crown Plugs (Subsea): The plugs above the flow *T* in a subsea wellhead.
Crown Saver: A device that keeps the traveling block from being raised into the crown block.
CRP (Rock Mechanics): Critical reservoir pressure for sanding appearance.
Crude and Crude Oil: A range of principally carbon–hydrogen chain compounds with generally straight carbon chain lengths of C1 (methane) to C60+. The straight-chain materials are alkanes.

Crude Oil: (1) Oil as it comes from the well; unrefined petroleum. (2) The petroleum liquids as they come from the ground; formed from animal and vegetable material that is collected at the bottom of ancient seas. (3) Tarry goop consisting of mixed carbon compounds with a highly variable composition. Not much to look at, but the basis for the chemical industry, modern transport, and many shopping sprees at Harrods. (4) A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface-separating facilities. Depending upon the characteristics of the crude stream, it may also include the following:

- Small amounts of hydrocarbons that exist in gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casinghead) gas in lease separators and are subsequently commingled with the crude stream without being separately measured. Lease condensate recovered as a liquid from natural gas wells in lease or field separation facilities and later mixed into the crude stream is also included.
- Small amounts of nonhydrocarbons produced from oil, such as sulfur and various metals.
- Drip gases and liquid hydrocarbons produced from tar sands, gilsonite, and oil shale.
- Liquids produced at natural gas processing plants are excluded. Crude oil is refined to produce a wide array of petroleum products, including heating oils; gasoline, diesel, and jet fuels; lubricants; asphalt; ethane, propane, and butane; and many other products used for their energy or chemical content.

Crude oil is considered as either domestic or foreign, according to the following:
Crude Oil, Crude Petroleum: A naturally occurring mixture, consisting predominantly of hydrocarbons and/or of sulfur, nitrogen, and/or oxygen derivatives of hydrocarbons, which is capable of being removed from the earth in a liquid state. Basic types of crudes are asphaltic, naphthenic, or paraffinic, depending on the relative proportion of these types of hydrocarbons present.
Crude Oil Equivalent: A conversion of all gas forms to a comparison oil volume. Conversion factors are usually 5.6–6.0 mscf (depending on Btu of the gas) to 1 bbl of oil.
Crude Oil Losses: Represents the volume of crude oil reported by petroleum refineries as being lost in their operations. These losses are due to spills, contamination, fires, etc., as opposed to refinery processing losses.
Crude Oil Production: The volume of crude oil produced from oil reservoirs during given periods of time. The amount of such production for a given period is measured as volumes delivered from lease storage tanks (i.e., the point of custody transfer) to pipelines, trucks, or other media for transport to refineries or terminals with adjustments for (1) net differences between opening and closing lease inventories and (2) basic sediment and water (BS&W).

C

Crude Oil Qualities: Refers to two properties of crude oil, the sulfur content and API gravity, which affect processing complexity and product characteristics.
Crude Oil, Refinery Receipts: Receipts of domestic and foreign crude oil at a refinery. Includes all crude oil in transit except crude oil in transit by pipeline. Foreign crude oil is reported as a receipt only after entry through customs. Crude oil of foreign origin held in bonded storage is excluded.
Crude Wax: Also called petroleum wax or slack wax, crude wax is an unrefined mixture of high-melting hydrocarbons, of the normal straight-chain type, still containing a fairly high percentage of oil.
Crush Zone: The area of the rock adjacent to the perforation tunnel where permeability may be 50% less than initial, undamaged permeability.
Crust: The outermost crust of the Earth.
Cryogenic: The science of producing very low temperatures such as those required for natural gas liquefaction.
Cryogenic Liquid or Cryogens: Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures and have a normal boiling point below –238°F (–150°C). All cryogenic liquids are gases at normal temperatures and pressures. These liquids include methane, oxygen, nitrogen, helium, and hydrogen. Cryogens normally are stored at low pressures.
Cryogenic Recovery: Cryogenic recovery processes are done at temperatures lower than –150°F. The low temperatures allow the plant to recover over 90% of the ethane in the natural gas. Most new gas processing plants use cryogenic recovery technology.
Cryogenics: The production and application of low-temperature phenomena. The cryogenic temperature range is usually from –150°C (–238°F) to absolute zero (–273°C or –460°F), the temperature at which molecular motion essentially ceases. The most important commercial application of cryogenic gas liquefaction techniques is the storage, transportation, and regasification of LNG.
Cryptosporidium: A waterborne intestinal parasite that causes a disease called cryptosporidiosis in infected humans. Symptoms of the disease include diarrhea, cramps, and weight loss. Cryptosporidium contamination is found in most surface waters and some groundwater. Commonly referred to as "crypto."
Crystal: (1) A large number of objects that are all of the same size and shape and are attracted to one another will tend to form repeating 3D structures, instead of lying about randomly. A more complicated crystal will be formed if more than one kind of object is present. You are probably most familiar with crystals of simple covalent solids (like sugar) or ionic solids (like table salt), where the attractive forces between perfectly ordinary molecules and ions line up in an orderly fashion to give structure that we can actually see on the macroscopic scale. It is possible to form crystals even of proteins with molecular weights approaching a million, as each molecule of a protein will have the same molecular weight and 3D shape, and we have all seen "crystals" of oranges stacked in fruit shops. (2) A mineral with a systematic internal arrangement of ions that forms a repeating outward latticework of 3D units.

Crystallization Temperature: The temperature at which the first crystal of salt appears from a brine that is being cooled.
CsCOOH: See *Cesium formate*.
CSDTM: Compensated spectral density log.
CSFs: See *Critical success factors*.
Csg: Casing.
CSO: See *Combined sewer overflow*.
CSS: Cyclic steam stimulation.
cSt (Fluids): A measure of viscosity. See *Centistokes*.
CST (Rock): Capillary suction time.
CT: See *Coiled tubing*.
CTD: See *Coiled tubing drilling*.
CTDESP: Coiled tubing deployed electric submersible pump.
CTE: Coefficient of thermal expansion.
CTL: Coiled tubing logging.
CTMS: See *Custody transfer measuring system*.
CTR: Controlled tension release tool. A release tool for downhole.
CTU: See *Coiled tubing unit*.
Cubic Capacity: The volumetric measurement of the ship's cargo compartments.
Cubic Feet per Day: At standard conditions, the number of cubic feet of natural gas produced from a well over a 24-h period, normally an average figure from a longer period of time. Generally expressed as mcf/d = 1000 ft^3/day, mmcf/d = million ft^3/day, or bcf/d = billion ft^3/day.
Cubic Feet per Second: Rate of flow units of expression.
Cubic Foot: (1) The amount of natural gas required at room temperature at sea level to fill a volume of 1 ft^3. (2) A unit of measurement of gas volume. It is the amount of gas required to fill a volume of 1 ft^3 under stated conditions of temperature, pressure, and water vapor. (3) A unit of measurement for volume. It represents an area one foot long by 1 ft wide by 1 ft deep. Natural gas is measured in cubic feet, but the measurements are usually expressed in terms of Mcf, Bcf, Tcf, or Qcf. (4) The amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure, and water vapor:

- SCF = standard cubic foot (1 ft^3 of gas at standard conditions, i.e., 14.73 psia and 60°F without adjustments for water vapor).
- MCF = 1000 ft^3 (multiply by 1000).
- MMCF = 1 million ft^3 (multiply by 1,000,000).
- BCF = 1 billion ft^3 (multiply by 1,000,000,000).

Note: The aforementioned symbols are the most commonly used symbols in the US gas industry. In certain companies and countries, the metric symbols are used instead. Under this system, 1000 ft^3 is abbreviated to KCF, 1 million ft^3 is abbreviated to MCF, and 1 billion ft^3 is abbreviated to GCF.

C

Cubic Meter: Unit of measurement for gas volume. The amount of gas required to fill the volume of 1 m^3.
Cumulative Effects: Changes to the environment caused by an activity in combination with other past, present, and reasonably foreseeable human activities.
Cumulative Production: (1) Production of oil or gas to date. (2) Production of hydrocarbon to date.
Cup Packer: A packer with elastomer cups that are pushed out during fluid injection as the primary seal. Used for washing perforations and some testing. Only seals during fluid injection.
Curie Point: The temperature above which a mineral loses its magnetism.
Curing Agent: A chemical substance used to initiate the hardening reaction of a resin.
Current: The flow of electricity in a circuit, measured in amperes.
Curtailment: An action by which the customer receives less than the contract quantity of natural gas or services due to a system-wide shortage.
Curvature (Seismic): A seismic comparison method useful in finding karsts.
Cushion Gas: (1) The reservoir pressure necessary to keep gas recoverable. (2) The volume of gas that is required in an underground storage field to maintain minimum field pressure. This cushion gas (or base gas) is not available for withdrawal unless replaced with immiscible injectant to maintain field pressure.
Cushion (Underbalance): A fluid column margin of some type. Usually well control, mud weight, gas column, etc.
Custody: Relates to when the ownership of oil changes. A run ticket is prepared for the receiver and the shipper to record the transaction.
Custody Transfer Measuring System: LNG ships are fitted with high-accuracy liquid-level, temperature, and vapor pressure measuring equipment. The cargo tanks are calibrated by an independent measurer so that the volume of cargo can be determined accurately. The CTMS is accepted by the buyer and the seller of the cargo as the basis for the quantity purchased or sold. Samples of the LNG cargo are taken ashore and analyzed to determine the cargo's chemical composition from which the heating value can be calculated. The heating value is then multiplied by the volume loaded or discharged from the ship to obtain the Btu content of the delivered cargo that is used as the basis for cargo invoices, import duties, and fiscal accounting.
Customer Demand Charge: The component of rates charged to customers that is expected to cover the fixed costs incurred by the pipeline. The other component of rates is the commodity charge. This charge is also referred to as a reservation charge.
Cut: The fraction of a fluid in a mixture of fluids.
Cut and Strip: Cutting the logging cable and threading it through the drill pipe when fishing for logging tools.
Cutback Asphalt: Asphalt that has been softened or liquefied by blending with petroleum distillates.

Cutback Bitumen: A bitumen in which the viscosity has been reduced by the addition of volatile diluents such as white spirits or kerosene.
Cut Fluid: A fluid that has been contaminated by an undesirable fluid.
Cut Lip Guide: A type of cut on the bottom of an overshot that, when rotated, can help center the end of a pipe that is lying against the side of the hole.
Cutoff Tool: Generally a reference to a device that severs the pipe downhole by explosive, chemical, heat, or mechanical action.
Cutrite: Carbide particles in a metal binder. Applied to the cutting surfaces of mills.
Cutting Oil: Oil used to lubricate and cool metal-cutting tools; usually mineral oil blended with other substances to make them water-soluble or water-insoluble, as required.
Cuttings: (1) Chips and small fragments of rock cut by a drill bit and brought to the surface by the flow of drilling mud. (2) Rock chippings cut from the formation by the drill bit and brought to the surface with the mud. Used by geologists to obtain formation data. (3) Chips and small fragments of rocks as the result of drilling that are brought to the surface by the flow of drilling mud as it is circulated. Cuttings are important to geologists, who examine them for information concerning the type of rock being drilled. (4) Chips of rock from the drilling process. They are circulated to the surface by the mud and separated in the screens and shaker. They are useful for identifying and correlating the formation.
CV: See *Check valve*.
CVAR (subsea)**:** Compliant vertical access riser.
CVP: The Group Capital Value Process, essentially the application of the stage gate decision process.
CVT: Chevron Texaco.
CWA: See *Clean water act*, a US law.
CWHE: See *Spiral-wound heat exchanger or coil-wound heat exchanger.*
CWI (Contract): See *Carried working interest*.
CWOP: Complete well on paper exercise.
CWOR: Completion and workover riser.
CWTF: Central water treatment facility.
Cycle Gas: Gas that is separated and reinjected.
Cycle Plant: Similar to a natural gasoline plant in that the liquid hydrocarbons are removed from natural gas. In a cycle plant, the gas is then put back into the ground to maintain pressure on the oil reservoir.
Cycle Stock: Unfinished product taken from a stage of a refinery process and recharged to the process at an earlier period in the operation.
Cycle Time (Drilling): Round trip time for a circulated fluid.
Cycle Time (Plunger): The trip time for a plunger from dropping to recovery.
Cycle Volume: Volume of natural gas that can be withdrawn from underground storage during the winter season and then be replaced during the summer season.

C

Cyclical Aeration: Cycling of air supply to a portion of an aeration tank to promote anoxic conditions suitable for denitrification.
Cycling: A series of operations in petroleum refining or natural gas processing so conducted that the steps are periodically repeated in the same sequence.
Cyclohexane: The cyclic form of hexane; used as a raw material in the manufacture of nylon.
Cyclone: A device that separates cuttings by centrifugal motion of the fluids.
Cyclonite: Another name for RDX explosive.

D

D&A: Dry and abandoned.
D&C: Drilling and completion.
D10/D95: A formation-sizing criterion that shows impact of fines.
D40/D90: A sorting criterion useful in screen selection.
DA: See *Development agreement*.
Daily Average Sendout: Total volume of natural gas delivered during a proscribed period of time, divided by the total number of days in the period.
Daily Contracted Quantity: The average daily quantity of natural gas that is contracted to be supplied and taken.
Daily Drilling Report: The daily report on activities, results, and shows of the past 24 h.
Daisy Chaining: The connection of multiple devices in a serial fashion. Daisy chaining can save on transmission facilities. If a device malfunctions, all of the devices daisy chained behind it are disabled.
Damage (Formation): A general term commonly referring to an obstruction in the flow path.
Damper: Device used to vary the volume of air passing through an outlet, inlet, or duct or generally through a confined cross section by varying the cross-sectional area.
Damper Actuator: Device (motor) that provides the necessary fore to position a damper. Can be electrically, pneumatically, or manually operated.
Damper or Dampener (Flow Line): A device in the line filled with gas that may reduce the surges of pressure pulsation or flow slugging.
Darcy: (1) Is a unit of permeability of rock. A rock of one darcy permeability is one in which fluid centipoise viscosity will flow at a velocity of 1 cm. Since a darcy is too large a unit for most oil-producing rocks, permeabilities used in the oil industry are expressed in units 1000 as large, that is, millidarcies (0.001 darcy). Commercial oil and gas exhibit permeabilities ranging from a few millidarcies to several thousand. (2) A measurement of permeability (ability of fluids to flow through the rock). The relationship is an empirical law that states that the velocity of flow through porous media is directly proportional to the hydraulic gradient, assuming that the flow is laminar and inertia can be neglected.
Dart: A pump-down fluid separation device. May also be used to operate tools downhole by hydraulic forces.
DAS: Data acquisition system.
Data Frac: A small fracture treatment, without proppant, pumped into a well to assess fracture breakdown pressure, fracture extension pressure, fluid loss coefficient, frac fluid efficiency, and fracture closure time.

D

Dateometer: A small calendar disc attached to motors and equipment to indicate the year in which the last maintenance service was performed.
Datum: A relative comparison point, such as the kelly bushing, sea level, or mud line.
Daughter: An atom that results from the radioactive decay of a parent atom.
Daylight Tour: Day working shift.
DB: Dump bailer.
DB&B: Double block and bleed.
DBP: See *Disinfection by-product*.
DC: Depth correction.
DC: See *Direct current*.
DC (Drilling): Drill collar.
DCF (Accounting): Discounted cash flow.
DCQ: See *Daily contracted quantity*.
DCS: Distributed control system.
DCS (Pipe): Depth control sub.
DCU: See *Dry completion unit*.
DD: Draw down.
DD&A: Depletion depreciation and amortization.
DDB: Drive down bailer.
DDCV: Deep draft caisson vessel.
DDDC: See *Dedicated design day capacity*.
DDR: Daily drilling report.
DE: Drilling engineer.
Dead Carbon (Shale): Carbon with a type of kerogen content that has low potential to generate hydrocarbons (generally woody carbon).
Dead Freight: Space booked by shipper or charterer on a vessel but not used.
Dead Freight Factor: Percentage of a ship's carrying capacity that is not utilized.
Dead Leg (Pipeline): A section of pipeline that is not in use.
Dead Line (Lift Systems): That part of a wire line or cable that is attached to a fixed anchor point and does not move through a pulley or other mechanical device.
Deadman: Buried anchor.
Dead Oil: Crude oil without gas. May have been degassed mechanically or by gas breakout during storage.
Dead Time: In radioactive logging, the length of time that the system requires to recover after counting an event.
Deadweight: Is the weight in tons that an oil tanker can carry.
Deadweight Tonnage: (1) A common measure of ship carrying capacity. (2) The number of tons (2,240 lb) of cargo, stores, and bunkers that a vessel can transport. (3) The difference in weight between a vessel when it is fully loaded and a vessel when it is empty (in general transportation terms, the net) measured by the water it displaces. This is the most

common, and useful, measurement for shipping as it measures cargo capacity. (4) The difference between the number of tons of water a vessel displaces "light" and the number of tons it displaces when submerged to the "deep load line." A vessel's cargo capacity is less than its total deadweight tonnage (DWT).

Dead Well: A well that will not flow on its own through natural gas lift or by reservoir pressure.

Deaerator: Devices used to separate gases from liquids.

Deal: Managed by CDA, a unique index of the source of released and proprietary well, seismic and other data.

Dealloying (Corrosion): Selective corrosion of one metal in an alloy.

Dean Number: Fluid flow effects in spooled tubing.

Deasphalting: Process for removing asphalt from petroleum fractions, such as reduced crude.

Debottlenecking: (1) Increasing production capacity of existing facilities through the modification of existing equipment to remove throughput restrictions. Debottlenecking generally increases capacity for a fraction of the cost of building new facilities. (2) The process of increasing the production capacity of existing facilities through the modification of existing equipment to remove throughput restrictions. (3) A program, typically in surface facilities and lines, to remove pressure drop causing flow restrictions.

Debutanizer: The fractionating column in a natural gasoline plant in which the butane and lighter components are removed overhead. The gas stream remaining is referred to as debutanized.

Decay Rate: The rate at which a population of radioactive atoms decays into stable daughter atoms. Rate expressed in half-life of the parent isotope.

Decentralizing Arm: A mechanical level that pushes a tool against the side of the well.

Dechlorination: The deliberate removal of chlorine from water. The partial or complete reduction of residual chlorine by any chemical or physical process.

Decision Tree (Risk): A sequence of nodes that are either a decision or an uncertainty and outcomes associated with each mode. The purpose of a decision tree is to define the set of scenarios and the sequence of events that guide the evaluation of risk and return.

Decline Curve: The slope of the production rate vs. cumulative time or volume measurement. The decline of a well predicts how fast it is being depleted.

Decommission: To remove from service.

Decommissioning: The process for removal of a plant or piece of equipment from an operational state.

Decomposition: The breakdown of complex material into simpler substances by biological or chemical action. Also referred to as degradation.

D

Decompression Damage (Gas Effects on Seals): When pressure is dropped rapidly, gas that has permeated the elastomers and some plastics may rupture the surface of a material when the gas expansion caused by the decompression is faster than the gas can pass through the substance. Most severe in weak tensile strength materials.
Deconvolution (Seismic): (Using Werner) an automated profile-based depth estimation method derived from analysis of magnetic anomalies in sheet-like bodies. Polynomials can be simultaneously solved to estimate the depth, dip, horizontal location, and susceptibility (magnetic) of the surface or structure. Basically undoing the effects of a filter.
Dedicated Design Day Capacity: The maximum volume of gas dedicated to a customer's use and based on the maximum number of therms recorded by meter on the most demanding day—typically the coldest day—of the year; expressed as a decimal number. Also known as "premise demand factor."
Dedicated Vehicle: A vehicle designed to operate solely on one alternative fuel.
Deepen: To increase the distance below a specified reference datum.
Deep Investigation: Measurement of formation properties far enough from the wellbore to minimize the effects of the invaded zone.
Deep Marine Chalks: Often massive deposits of coccolith fragments. Usually very high porosity and limited permeability unless fractured.
Deep Penetrating Charge: A perforating charge with a liner shape designed to create a long penetration into the formation but a smaller entrance hole in the pipe. See also *Big hole charge*.
Deep Propagation Log: A log that measures the resistivity of the formation.
Deep Water: More than 300-m water depth.
Deepwater Discovery: An offshore discovery located in at least 600 ft of water.
Deethanizer: The fractionating column in a natural gasoline plant in which ethane and lighter components are removed overhead. The gas stream remaining is de-ethanized.
Deferred Production: Hydrocarbon production that is delayed due to any of several reasons, specifically well repairs, restrictions that curtail production, and regulations.
Deficiency: The additional quantity of oxygen required to satisfy the BOD in a sample.
DE (Filter): Diatomaceous earth filtration unit.
Deflagration: Burning, decomposition, or low-order detonation of explosive.
Deflection: The total change in angle of a wellbore in a given distance.
Deflection (Drilling): The amount of flex exhibited by the drill string.
Deflocculation: Dispersing a clump or a gathering or "flocculated" of particles. Usually accomplished by dispersants or solvent thinners.

Defoamer: A foam-breaking chemical.
Degasser: Any device that helps remove gas from circulated fluid.
Degradation: The conversion or breakdown of a substance to simpler compounds, for example, the degradation of organic matter to carbon dioxide and water.
Degree Days: Measured as the number of degrees above or below a standardized temperature on any given day.
Degrees API: The American Petroleum Institute (API) gravity.
Dehumidification: Removal of water vapor from air.
Dehumidifier: Air cooler or an absorption or adsorption device used for lowering moisture content in air.
Dehydration: The removal of water from a fluid.
Dehydrator: (1) Natural gas processing equipment that removes water vapor. Typically, glycol dehydration units are used to dry gas before it is sent to a gas transmission line. If the gas is to be sent to a cryogenic expander plant or LNG plant, then the gas is typically dehydrated using molecular sieves. (2) A treating vessel designed to remove water from a process stream.
De (Hydraulics): Equivalent hydraulic diameter.
Dehydrogenation: A reaction in which hydrogen atoms are eliminated from a molecule. Dehydrogenation is used to convert ethane, propane, and butane into olefins.
Delayed Coking: A process by which heavier crude oil fractions can be thermally decomposed under conditions of elevated temperatures and pressure to produce a mixture of lighter oils and petroleum coke. The light oils can be processed further in other refinery units to meet product specifications. The coke can be used either as a fuel or in other applications such as the manufacturing of steel or aluminum.
Delayed Gamma Ray: A gamma ray that is emitted from the decay of an excited state in a nuclear reaction.
Delineation Well: (1) A well drilled at a distance from a discovery well to determine the physical extent, reserves, and likely production rate of a new oil or gas field. (2) Drilled at a distance from a discovery well to determine physical extent, reserves, and likely production rate of a new oil or gas field. (3) A secondary well, after a field discovery well, drilled to help determine field extent, volume, or potential rate.
Deliquification: Removal of condensed or produced fluids from a low-rate gas well.
Deliverability: (1) The volume of natural gas that a pipeline or distribution system can supply in a given period, normally during a 24-h period. (2) The tested and proven ability of a well to produce.
Deliverability (LNG Ships): One major aspect of LNG project planning consists of estimating the transportation capacity required, taking into account the time necessary for each function in the chain of events within

D

a typical round voyage of an LNG carrier. A typical delivery calculation for a 137,500 m^3 LNG carrier might be

One-way distance	6,000 nautical miles
Ship "service" speed	19 knots
Sea days (round trips)	26.31
Port days (round trips)	2
Total days in voyage	28.31 say 29
Operating days in year	350
Voyages per year	12.07
Ship capacity (net)	135,000 m^3
Less: heel	3,000 m^3
Discharge quantity	132,000 m^3
Annual delivered quantity	132,000 × 12.07
	= 1,539,103 m^3

LNG specific gravity varies depending on gas composition but is typically about 0.45; therefore, the annual deliverability of the vessel is 0.45 × 1,593,103 716,896 metric tons. If the maximum output of the liquefaction train is 3.3 million metric tons per annum (mmtpa), this would equal a maximum daily production of 10,000 tons over the 330-day annual operating period. The deliverability of a 137,500 m^3 ship is 59,400 metric tons, which means it can cater for a daily production of 2,048 metric tons on this route, or five ships can carry 10,240 tons, slightly more than maximum production.

Deliverability Rate: A measure of the amount of gas that can be delivered (withdrawn) from a storage facility on a daily basis, typically expressed in terms of millions of cubic feet per day (MMcf/day).

Delivered: The physical transfer of natural, synthetic, and/or supplemental gas from facilities operated by the responding company to facilities operated by others or to consumers.

Delivery Point: Designates the point where natural gas is transferred from one party to another.

Delivery Point Operator: The operator responsible for balancing loads and allocating natural gas quantities received at delivery points to parties who have contracted to receive deliveries at the point.

Deltas: Mouth of river deposits, usually fan shaped with significant variation in composition, sorting, and thickness. Quality of the reservoir rock may vary widely.

Delta T: The sonic travel time in microseconds per foot, of a sound wave through the formation. Denser formations (generally better consolidated and cemented) have lower (faster) delta t times.

Demand Charge: A fixed fee, generally paid monthly, to reserve capacity space in a pipeline, storage, or distribution facility.

Demand Forecast: An estimate of the level of energy or capacity that is likely to be needed at some time in the future.

Demonstrated Reserves (American Petroleum Institute): A collective term for the sum of proved and indicated reserves. Proved reserves are estimated with reasonable certainty to be recovered under current economic conditions. Indicated reserves are economic reserves in known productive reservoirs in existing fields expected to respond to improved recovery techniques where (1) an improved technique has been installed but its effect cannot yet be fully evaluated or (2) an improved technique has not been installed but knowledge of reservoir characteristics and the results of a known technique installed in a similar situation are available for use in the estimating procedure.

Demulsibility: The ability of an oil to separate from or shed water as determined by a standard test method. Demulsibility is an important consideration in lubricant maintenance in many circulating lubrication systems.

Demulsifier: A chemical additive, usually a surfactant, that helps break emulsions.

Demurrage: A fee, per day or per hour, agreed to be paid by the charterer or receiver of the cargo, for the detention of a vessel, loading or unloading, beyond the laytime allowed in the charter party.

Dendritic Drainage: A stream system that branches irregularly.

Denitrification: An anoxic process that occurs when nitrite or nitrate ions are reduced to nitrogen gas, and nitrogen bubbles are formed as a result of this process. The bubbles attach to the biological floc in the activated sludge process and float the floc to the surface of the secondary clarifiers. This condition is often the cause of rising sludge observed in secondary clarifiers or gravity thickeners. Also see *Nitrification*.

Densitometer: A device used for reading the density of a flowing fluid or slurry.

Density: (1) To find the density of an object, you measure its mass and its volume, then divide the mass by the volume, giving a density measured in g/cm^3 or kg/dm^3. Since all atoms are about the same size, the densest materials are metals like osmium and gold, which are elements with heavy nuclei, and the least dense are the very first elements in the periodic table, the gases hydrogen and helium. (2) The heaviness of crude oil, indicating the proportion of large, carbon-rich molecules, generally measured in kilograms per cubic meter (kg/m^3) or degrees on the API gravity scale; in Western Canada oil up to 900 kg/m^3 is considered light to medium crude—oil above this density is deemed as heavy oil or bitumen scale. (3) The mass per volume of a substance. Density of freshwater is 8.33 pounds per gallon or 1 g/cc. (4) The weight per unit volume of a substance, which varies with temperature.

Density Contrast (Seismic): Density of one rock relative to another. The contrast can be positive or negative. Gravity anomalies within sedimentary sections can be analyzed as structural or lithologic anomalies.

Density–Depth Function (Seismic): The change in density with increasing depth is often a result of compaction. Age, lithology, and porosity modification are also factors.

Density Log: One of a number of logging techniques that estimate the density of the formation.

D

Department of Energy: The US federal department that manages programs of research, development, and commercialization for various energy technologies and associated environmental, regulatory, and defense programs. DOE announces energy policies and acts as a principal advisor to the President on energy matters.
Departure: The distance from the kelly bushing horizontally to the end of the well.
Departure Curves: Graphs that show influence of a variable on the basic measurement, for example, temperature, hole diameter, mud resistivity, bed thickness, and adjacent bed resistivity.
Depleted Fields: The used up oil reservoirs that are used most often to store natural gas and comprise the majority of storage.
Depleted Storage Field: A subsurface natural geological reservoir, usually a depleted oil or gas field, used for storing natural gas.
Depletion: Reducing the fluid content of a formation by production of that fluid.
Depletion Plan: The primary process for Life of Field resource management. The depletion plan sets out the framework of how resource management underpins efficient exploration of the resource.
Depolymerization: The chemical reaction that results in a polymer chain being broken down into monomer units. For most polymers made by addition polymerization, this is done by heating the polymer above its ceiling temperature in the absence of oxygen. Some polymers, like styrene and vinyl chloride, will be difficult to depolymerize because the bonds between the side groups (the phenyl ring and chlorine in these examples) are weaker than the C–C bonds between ex-monomers, and the polymer will degrade into different species than the starting materials. Other polymers, such as those made by step-growth polymerization, may be more easily depolymerized by undoing the condensation or elimination reaction that caused the monomer units to join. In the lab, this can often be done using a strong acid in harsh conditions, although industrially, there are other tricks that polymer scientists can play.
Deposit: An accumulation of oil or gas capable of being produced commercially.
Deposit Attack: Corrosion occurring under or around a deposit on a surface.
Deposition: The process of settling solid material from a fluid suspension.
Depositional Energy: Relating to the energy of the transport mechanism that carries particles into an area of deposition. Low-energy environments may contain large quantities of fines where high-energy environments are usually marked by larger and more consistent grain sizes.
Depositional Environment: The conditions of sediment transport and deposition at the time the formations were laid down.
Depreciation, Accelerated: See *Depreciation, liberalized*.
Depreciation, Asset Depreciation Range: A system of tax depreciation that enables a corporation to choose any life falling within 20% of the designated class life for determining its annual depreciation charge. ADR requires an

annual election and all depreciation records must be maintained by vintage year (from AGA).

Depreciation, Declining Balance: One of the liberalized methods of computing depreciation (normally used for tax purposes). Under this method, the depreciation rate is stated as a fixed percentage per year, and the annual charge is derived by applying the rate to the net plant balance, which is determined by subtracting the accumulated depreciation reserve (from AGA).

Depreciation, Flow Through: An accounting procedure under which current net income reflects decreases or increases in current taxes on income, arising from the use of liberalized depreciation or accelerated amortization for tax purposes instead of the straight-line method. See *Depreciation, normalized* (from AGA).

Depreciation, Liberalized: This refers to certain approved methods of computing depreciation allowance for federal and/or state income tax purposes. These methods permit relatively larger depreciation charges during the earlier years, in contrast to the straight-line method, under which the annual charges are the same for each year. This is sometimes referred to as accelerated depreciation (from AGA).

Depreciation, Normalized: An accounting method under which net income includes charges or credits equal to the decreases or increases in current taxes on income, arising from the use of liberalized depreciation or accelerated amortization for tax purposes instead of the straight-line method. The contra entries for such charges to net income are suspended in balance sheet accounts. In future years, there is a feedback of these suspended amounts to net income when increases in the then current taxes on income occur because liberalized depreciation or accelerated amortization was used for tax purposes in prior years (From AGA).

Depreciation, Straight Line: A method of computing depreciation under which equal annual amounts are set aside for the ultimate retirement of the property at the end of its service life. For a property with an assumed 25-year life, the annual charge would be 4% per year, usually applied to the cost of the property less estimated net salvage (from AGA).

Depreciation, Sum of the Years: One of the liberalized methods of computing depreciation, normally used for tax purposes. Under this method, the annual deduction is derived by multiplying the cost of the property less estimated net salvage, by the estimated number of years of service life remaining, and dividing the resultant product by the sum of all the digits would be 25 + 24 + 23 + 22 +, etc., + 5 + 4 + 3 + 2 + 1, or 325. A simple way to compute this figure would be to multiply the number of years by the number of years plus one and divide by 2, that is, (25 × 26): 2 = 325. The first year's full depreciation deduction would be 25/325ths, the second year's would be 24/325ths, etc., of the cost of the property (from AGA).

Depreciation, Units of Production: A method of depreciation whereby the asset is depreciated over an estimated life expressed in units of output rather than over an estimated life expressed as a period of time (from AGA).

D

Depropagation: The reaction in which small alkenes are generated from the decomposition of a large alkane radical. This reaction is important in thermal cracking and is responsible for the ceiling temperature, which prohibits chain polymerization above a certain temperature.
Depropanizer: The fractionating column in a natural gasoline plant in which propane and lighter components are removed overhead. The gas stream remaining is depropanized.
Depth Datum: The zero depth datum for well logging.
Depth Migration (Seismic): Data processing used to shift subsurface signals to their proper depth.
Depth of Investigation: The outer limit to which a logging tool can measure properties with a given accuracy.
Deregulated Gas: Natural gas no longer subject to sales and/or price regulation.
Deregulation: The process of removing restrictive regulations on previously regulated power and utility companies.
Derrick: (1) The elongated pyramid of latticed steel mounted over the borehole for drilling and well-servicing purposes. (2) A wooden or steel structure built over a wellsite to provide support for drilling equipment and a tall mast for raising and lowering drill pipe and casing; a drilling rig. (3) The towerlike structure that houses most of the drilling controls. (4) The elevated section of a rig that rises above the substructure and houses the crown block and draw works.
Derrickhand: A member of the crew who works upon in the derrick on the tubing board racking tubing or the drill pipe as it is pulled from the well and unscrewed by the other crew members on the derrick floor.
Derrickman: A person that works in the derrick and assists handling pipe to make up joints into the string or stand them in the derrick when breaking out joints.
Desalting: Removing calcium chloride, magnesium chloride, and sodium chloride from crude petroleum.
Desander/Desilter: Devices that typically use centrifugal flow paths to spin solids out of a drilling or circulating fluid.
Desiccant: Absorbent or adsorbent, liquid or solid, that removes water or water vapor from an airstream.
Desiccant Drying: The use of drying agent to remove moisture from a stream of oil or gas. In certain product pipelines, great effort is made to remove all the water vapor before putting the line into service. To accomplish this, desiccant-dried air or an inert gas is pumped through the line to absorb the moisture that may be present even in the ambient air in the line.
Desorption: The release of materials that have been absorbed or adsorbed in or onto a formation.
Destructive Distillation: Process of distillation in which a hydrocarbon or other organic compound or mixture is heated to a temperature high enough to cause its decomposition.

Desulfurization: (1) Processes by which sulfur and sulfur compounds are removed from gases or petroleum liquid mixtures. (2) Processes by which sulfur and sulfur compounds are removed from gases or petroleum liquid mixtures. (3) A chemical treatment to remove sulfur or sulfur compounds from crude oil.
Detail Log: A log recorded on a larger scale depth than the standard correlation of 1 or 2 in. per 100 ft.
Detectable Limit: The lower limit of analysis for a test of a piece of equipment for a specified measurement.
Detention Time: (1) The theoretical (calculated) time required for a small amount of water to pass through a tank at a given rate of flow. (2) The actual time in hours, minutes, or seconds that a small amount of water is in a settling basin, flocculating basin, or rapid-mix chamber. In storage reservoirs, detention time is the length of time entering water will be held before being drafted for use (several weeks to years, several months being typical).
Detergency: (1) Detergency is the property of surfactants that allows them to clean things for us. The surfactants accumulate on the oil/water interface so that when we scrub the oily stain to break it up, the oil drops do not coalesce. (2) The property of a lubricating oil to reduce or prevent deposits formed under high-temperature conditions or as a result of the action on the oil of acidic contaminants.
Detergent: A detergent is a type of surfactant. Essentially, a detergent is any surfactant that is not a soap.
Deterministic Estimate (Risk): An estimate using a single number value. It does not account for ranges in value or probability of occurrence for the parameter.
Detonating Cord: An explosive wrapped with elastomer in the shape of a cord. Used to link and detonate charges in perforating guns.
Detonation: In a gasoline engine, the phenomenon occurring when the last portion of the fuel–air mixture ignites spontaneously instead of burning in a normal manner. The resulting explosion is known as engine knock.
Detonator: A blasting cap.
Detridal: A grain of a sedimentary formation that was transported from its origin and deposited as a whole grain in the matrix of the rock.
Detritus: The heavy, coarse material carried by wastewater.
Developed Reserves (Reservoir): Developed reserves are expected to be recovered from existing wells including reserves behind pipe. Improved recovery reserves are considered developed only after the necessary equipment has been installed or when the costs to do so are relatively minor. Developed reserves may be subcategorized as producing or nonproducing (SPE).
Development: (1) The phase in which newly discovered or proven oil or gas fields are put into production by drilling and completing production wells. (2) Phase on which a proven oil or gas field is brought into production by drilling production (development) wells. (3) Activities following exploration

including the installation of facilities and the drilling and completion of wells for production purposes.

Development Agreement: One of the range of agreements between governments and petroleum resource developers is the DA or one of its variants—the Development and Fiscal Agreement (DFA) or the Development and Production Sharing Agreement (DPSA).

Development Phase: The phase in which a proven oil or gas field is brought into production by drilling production (development) wells.

Development Well: (1) A production well drilled with intent of producing oil or gas from a proven field. (2) A well drilled in or adjacent to a proven part of a pool to optimize petroleum production. (3) A well drilled within the proved area of an oil or gas reservoir to the depth of a stratigraphic horizon known to be productive. (4) A well drilled in a proven field for the purpose of completing the desired spacing pattern of production. (5) Wells that are drilled after the discovery and appraisal wells to develop the hydrocarbon production potential of the field.

Deviated Well: (1) A well drilled in such a way that its controlled direction departs progressively from the vertical; such wells are drilled in order to reach different parts of a reservoir from a single platform. (2) Horizontal well drilled at an angle (over 80°) to vertical. (3) A well with an inclination other than 0° from vertical. In practice, deviated wells are usually more than about 10° from vertical.

Deviation Angle: Actual term is inclination—the angle from vertical in a section of a well.

Deviation Survey: A record of the deviation angle and the departure usually on a depth unit basis.

Devonian: A geological time between 365 million and 405 million years ago.

Dew Point: (1) The temperature, at a given pressure, at which a vapor will form a first drop of liquid on the subtraction of heat. Further cooling of liquid at its dew point results in condensation of part or all of the vapors as a liquid. (2) The temperature at which vaporized materials start to condense into liquid form. (3) The temperature at which liquids begin to condense from the vapor phase in a gas stream. See also *Bubble point*.

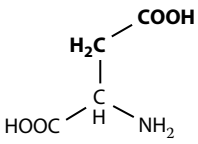
Dewater: To drain or remove water from an enclosure. A structure may be dewatered so that it can be inspected or repaired. Dewater also means draining or removing water from sludge to increase the solid concentration.

Dewaterability: A measure of the ease with which water can be removed from a substance.

Dewatering (Fluids Separation): Separation of liquids and solids in the general sense. Also, removing water from hydrocarbon streams.

Dewaxed Oils: Lubricating oils from which a portion of the wax has been removed.

DF: Derrick floor.
DFIT: Diagnostic fracture injection test.
DFP: Deferred production.
DGLV: Dummy gas lift valve.
DGMK: German Society for Petroleum and Coal Science and Technology.
DG Plug: A plug that is commonly set in the tubing hanger above the tubing or in tubing immediately below the wellhead for wellhead isolation.
DHC: Downhole controller.
DHD: Downhole diagnostics.
DHFC: Downhole flow control.
DHPG: Downhole permanent gauge.
DHSV: Downhole safety valve.
DHTV: May be either downhole TV camera or a televiewer (a sonic caliper tool).
DHV: Downhole video.
DHV™: Down Hole Video, Inc.
Diagenesis: The process of forming a sedimentary rock from the clastic grains. May also be in conjunction with several geochemical processes such as cementation reactions and chemical dissolution.
Diagenetic Porosity: The porosity formed by chemical and bacterial modification after the initial sediments were laid down.
Diagenetic Trap: Where rock changes produces a reservoir rock under a sealing rock.
Diamond Bit or Mill: A shaped bit body with diamonds for abrasive cutting of the formation.
Diamond Drill Bit: Is made by setting man-made diamonds in the tip or the cutting surface of the bit. Diamonds are many times harder than the hardest steel, so diamond bit makes it possible for longer bits to run before a round trip is necessary to change the bits.
Diapir: (1) A mass of rock, usually salt, which has come from a slightly deeper part of the earth's surface by piercing through overlying layers of sediment through a zone of weakness. (2) A salt or other column that pierces upper layers and may form traps of obstructions to flow.
Diatomaceous Earth: Silica particles from diatom beds. Used as a filtering medium and as an additive to cement.
Dibasic: An acid that has *two* acidic hydrogen atoms that can react with a base is dibasic. An example is the amino acid aspartic acid, which contains two carboxylic acid groups with different reactivities.



Aspartic acid (asp, D)
pKa = 3.86

D

Dielectric: A material that does not conduct electricity or has only a low electrical conductivity compared to a metal.
Dielectric Strength: A measure of the insulating value of an electrical insulating medium. The value depends on the extent of the test method used.
Dies: A tool used to shape, form, or finish other parts.
Diesel #1: A diesel fuel, C10–C14+ typically. #1 diesel has paraffins removed for cleaner operation or cold weather use.
Diesel Fuel: (1) A complex mixture of hydrocarbons with a boiling range between approximately 350°F and 650°F. Diesel fuel (simply referred to as "diesel") is composed primarily of paraffins and naphthenic compounds that autoignite from the heat of compression in a diesel engine. Diesel is used mainly by heavy-duty road vehicles, construction equipment, locomotives, and marine and stationary engines. (2) The light oil fuel used in diesel and other compression-ignition engines. (3) Is a middle distillate fuel similar to home heating oil that is used for fuel in trucks, trains, and ship engines.
DIF: Drill-in fluid.
Differential Pressure: The difference in pressure between upstream and downstream of a measurement point.
Differential SP: A curve recorded as a simultaneous SP measurement from two electrodes, each serving as a reference potential for the other.
Differential Sticking: A common method of pipe sticking where the overbalance pressure in the wellbore pushes the tubing against the side of the wellbore in a permeable formation.
Diffused-Air Aeration: A diffused-air-activated sludge plant takes air, compresses it, and then discharges the air below the water surface of the aerator through some type of air diffusion device.
Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
Diffusion: The random scattering of particles due to kinetic energy of the particles. Affected by viscosity, density, and temperature.
Digester: A tank in which sludge is placed to allow decomposition by microorganisms. Digestion may occur under anaerobic (more common) or aerobic conditions.
Dike: A large igneous intrusion that cuts through the sedimentary layers, creating permeability barriers.
DIL: Dual induction log.
Dilatancy (Rock): The ability of a rock to expand through microfractures in consolidated rocks or grain position shifts in unconsolidated rocks.
Dilatant Fluid: A well-dispersed, high solid content liquid that has very high apparent viscosity with any applied shear.
Diluent: The fluid added to a concentrated mixture to reduce the concentration of an internal phase or reduce its viscosity.

Dimer: A dimer is two molecules (of the same type) bonded together (just as monomer is one (mono) unit (mer), a dimer is two units).
Dimple Connector (Coiled Tubing): A connector with shallow holes into the body and threads on the other for attaching a BHA to coiled tubing. The end with shallow holes is slipped into the coiled tubing and a clamp-on device with set screws is used to deform the coiled tubing wall into the dimple.
DIMS: Drilling information management system.
Dip: The angle that the structural surface or bedding plane or fault surface makes with the horizontal. Measured perpendicular to the strike and in the vertical plane.
Dip Log: Dip meter log.
Dip Meter: A log that measures the inclination of the formation beds.
Dipole: If one part of a molecule is more attractive to electrons than another part, it will have a permanent uneven distribution of charge, that is, one end will be slightly positive and one will be slightly negative. There will be an attraction between two molecules of this substance, since they will turn so that the positive end of one is facing the negative end of the other.
Dip Slip Fault: The vertical displacement of a fault along the dip plane.
Dip Tube: A tube from the intake of a pump that extends further into the liquid column of the well, to keep gas out of the pump.
Direct Current: Electrical current that flows in one direction only.
Direct Discharger: A point source that discharges a pollutant(s) to waters of the United States, such as streams, lakes, or oceans. These sources are subject to the National Pollutant Discharge Elimination System (NPDES) program regulations.
Direct Filtration: A method of treating water that consists of the addition of coagulant chemicals, flash mixing, coagulation, minimal flocculation, and filtration. The flocculation facilities may be omitted, but the physical–chemical reactions will occur to some extent. The sedimentation process is omitted. Also see "conventional filtration" and "in-line filtration."
Directional (Deviated) Well: A well drilled at an angle from the vertical by using a slanted drilling rig or by deflecting the drill bit; directional wells are used to drill multiple wells from a common drilling pad or to reach a subsurface location beneath land where drilling cannot be done.
Directional Driller: The specialist that plans and executes the directional drilling plan.
Directional Drilling: (1) A technique whereby a well is deliberately deviated from the vertical in order to reach a particular part of a reservoir. (2) The technique of drilling at an angle from the vertical by deflecting the drill bit. Directional wells are drilled to develop an offshore lease from one drilling platform; to reach a pay zone where drilling cannot be done, such as beneath a shipping lane. (3) Drilling the wellbore in a planned angle of deviation or trajectory.
Directional Permeability: A rock with a higher permeability along a given plane, usually created by natural fracture development, water flow

D

that leaches the pores, depositional environment, or localized reworking of the sediments.

Directional Survey: A measurement of the well path that records the inclination and azimuth of the wellbore using a compass or other device.

Direct Runoff: Water that flows over the ground surface or through the ground directly into streams, rivers, or lakes.

Dirty: High clay content or higher natural radioactivity signature on the gamma-ray log.

Disabled Ship: A vessel impaired so as to be incapable of proceeding on her voyage.

Disaccharide: Just as there are monomers, dimers, trimers, oligomers, and polymers, indicating one, two, three, several, and many identical units joined together in a molecule, the combinations of saccharides (aka sugars) are known as mono-, di-, tri-, oligo-, and polysaccharides. An example of a disaccharide is sucrose, composed of the simple sugars glucose and fructose joined by an ether linkage. An example of a polysaccharide is chitin, a nitrogen-containing polymer of modified glucose units that makes up the exoskeleton of insects.

Disaggregation: When the formation breaks into grains.

Disbond: A formation that comes apart or disaggregates or separation of grains.

Disconformity: A change in the formation that may have been caused by ancient erosional forces. Accounts for variances in formation tops in nearby offset wells in a formation with no pay inclination.

Disconnecting Means: A device that disconnects a group of conductors from their source of supply.

Discontinuous Lenticular Sands: Limited aerial sands.

Discordant: Cutting across surrounding strata.

Discount: An amount agreed between buyer and seller to be subtracted from an existing benchmark.

Discovered Petroleum Initially in Place: That quantity of petroleum that is estimated, on a given date, to be contained in known accumulations, plus those quantities already produced therefrom. Discovered petroleum initially in place may be subdivided into commercial and subcommercial categories, with the estimated potentially recoverable portion being classified as reserves and contingent resources, respectively (SPE).

Discovered (Reserves): The term applied to a petroleum accumulation/reservoir whose existence has been determined by its actual penetration by a well, which has also clearly demonstrated the existence of moveable petroleum by flow to the surface or at least some recovery of a sample of petroleum. Log and/or core data may suffice for proof of existence of moveable petroleum if an analogous reservoir is available for comparison (see also "known accumulation": Petroleum quantities that are discovered are in "known accumulations" or "known reservoirs") (SPE).

Discovery: A find of significant quantities of gas or oil.

Discovery Well: (1) An exploratory well that encounters a new and previously untapped petroleum deposit; a successful wildcat well. A discovery well may also open a new horizon in an established field. (2) The initial well in the field that tests hydrocarbons. (3) An exploratory well that finds hydrocarbons.

Disinfection: The process designed to kill or inactivate most microorganisms in wastewater, including essentially all pathogenic (disease-causing) bacteria. There are several ways to disinfect, with chlorination being the most frequently used in water and wastewater treatment plants.

Disinfection By-Product: A contaminant formed by the reaction of disinfection chemicals (such as chlorine) with other substances in the water being disinfected.

Dispatch: The monitoring and regulation of an electrical or natural gas system to provide coordinated operation; the sequence in which generating resources are called upon to generate power to serve fluctuating loads.

Dispersant: (1) An engine oil additive that helps prevent the formation of sludge, varnish, and other engine deposits by keeping particles suspended in colloidal state (suspension of finely divided particles). (2) Any substance that aids in breaking up a mass of individual particles, bubbles or droplets.

Dispersed: Fluids with materials added to disperse solids or flocs.

Dispersed Phase: The internal phase in an emulsion—that is, the droplets or bubbles.

Dispersion: (1) Two substances mixed together such that one is not dissolved in the other. For example, milk, a dispersion of globules of fat in water; latex paint, a dispersion of polymer particles in water; and smoke, a dispersion of carbon particles in air. (2) An operation as a result of which solid particles or liquid particles are distributed in a fluid. Also applied to a two-phase system in which one phase, known as the "dispersed medium," is distributed throughout the other, known as the "dispersion medium." (3) A mixture of an internal phase of solids, droplets, or bubbles that stay relatively suspended in a continuous fluid.

Dispersion Forces: Since electrons move around, even a molecule with no permanent separation of charge will have negative and positively charged bits from one instant to another. These imperfections generate an overall attractive force even between molecules as unreactive as N_2. Since this explanation is already too complicated for anyone to understand, you may as well call them dispersion forces because they are related to a quantity called the dispersion of a substance, which is the rate of change in refractive index with frequency of transmitted radiation. You can also call them London forces, after Fritz London (1900–1954).

Displacement Efficiency: A measurement of how completely a flooding fluid displaces the saturated fluid in a reservoir.

Displacement Gas: (1) In pipeline transportation, the substitution of a source of natural gas at one point for another source of natural gas at another point. Through displacement, natural gas can be transported by

backhaul or exchange. (2) In natural gas marketing, the substitution of natural gas from one supplier of a customer with natural gas from another competing supplier.

Displacement (Horizontal Well): The distance between the wellhead and the top of a vertical line from the bottom hole location to the wellhead elevation at the surface.

Displacement (Process): The set of actions used to flow a fluid or solids out of a well and replace it with another fluid system.

Displacement (Volume): The volume of a wellbore occupied by fluid. When the swept volume varies from the calculated displacement, part of the wellbore may not be actively swept.

Disposal Well: A well into which fluids such as produced water and some liquid wastes can be injected. It is in a nonhydrocarbon, non-freshwater sand and is not connected to the hydrocarbon bearing formation.

Disposition: The components of petroleum disposition are stock change, crude oil losses, refinery inputs, exports, and products supplied for domestic consumption.

Dissimilar Metals: Different metals that may form an anode–cathode pair in corrosion cell conditions.

Dissociation: The separation of a compound or molecule into pieces, ions, or atoms.

Dissociation Porosity: Secondary porosity that is created when solid materials in sediment dissolve in interstitial solutions.

Dissolved Gas: Natural gas in solution in crude oil in the reservoir.

Dissolved Gas Drive: A reservoir drive mechanism in which dissolved gas from the crude oil breaks out of solution and provides energy to push the hydrocarbons toward the wellbore.

Dissolved Gas–Oil Ratio: The amount of gas contained in the oil (in std ft^3/bbl). This value can change if one fluid is produced faster than the other or if one fluid is reinjected.

Dissolved Gas (Production): The solution gas associated with produced fluids.

Dissolved Oxygen: (1) The oxygen dissolved in sewage, water, or other liquid, usually expressed in milligrams per liter or percent of saturation. It is the test used in BOD determination. (2) DO is the molecular (atmospheric) oxygen dissolved in water or wastewater.

Dissolved Oxygen Molecular (Atmospheric): Oxygen dissolved in water or wastewater, usually abbreviated DO.

Distillate: (1) The product of distillation obtained by condensing the vapors from a refinery still, also known as overhead fractions, as distinguished from the non-vaporizing residual components left in the still. (2) In the distillation of a sample, a portion is evaporated; the part that is condensed afterward is the distillate. (3) The distillate or middle range of petroleum liquids produced during the processing of crude oil. Products include diesel fuel, heating oil, kerosene, and turbine fuel for airplanes. (4) A range of manufactured

products from the refining processes; includes kerosene, diesel, bunker C oil, fuel oil, and heating oil.

Distillate Fuel Oil: A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation. (2) A general classification for one of the overhead fractions produced from crude oil in conventional distillation operations. The so-called light-heating oils, diesel fuels, and gas oils come from this fraction.

Distillation: (1) Separation of two liquid compounds by boiling point. For example, a mixture of two hydrocarbons can be heated so that the lower molecular weight hydrocarbon evaporates—if the vapor is not allowed to escape but taken around the corner and cooled down, it can be extracted as a pure liquid. (2) The first stage in the refining process in which crude oil is heated and unfinished petroleum products are initially separated. (3) The general process of vaporizing liquids, crude oil, or one of its fractions in a closed vessel, collecting and condensing the vapors into liquids. Commercial forms of distillation in petroleum refining are crude, atmospheric, vacuum, rerun, steam, extractive, etc. (4) A process that uses the difference in boiling points of molecules and petroleum fractions to separate the compounds and streams.

Distributed Temperature Log: A log of temperature along the entire length of the interval, well, or flow path.

Distribution: The delivery of a utility (natural gas, electricity, water) to a household or business.

Distribution Company (Gas): A gas utility that obtains the major portion of its natural gas operating revenues from the operation of a retail gas distribution system, a gas distributor.

Distributor: The rotating mechanism that distributes the wastewater evenly over the surface of a trickling filter or other process unit.

Disturbance: In the context of the stormwater program, the term "disturbance" means construction or demolition activity that results in the exposure of soil.

Ditch Gas: Gas removed from the mud at the flow line by mechanical means.

Diurnal: Having a daily cycle or recurring each day.

Diurnal Storage: Daily storage; refers to short-term or peak storage in pipelines or natural gas holders, as opposed to seasonal storage.

Divergence: Separation of groups of data from either other or from a norm.

Diversion (Fluid Treating): A method of limiting the fluid entry into a higher permeability zone and causing the fluid to flow to a lower permeability zone.

Diverter (Acidizing): A material that forces acid to enter another zone by having a higher viscosity or building a filter cake.

D

Diverter (Wellhead): A device in the flow path at the wellhead that forces fluid to go down a pipe to a pit or tank.
Diverting Valve: Three-way valve piped to supply a single source of fluid to either of two outlets.
Diving Support Vessel: A dedicated vessel, most frequently *D.P.*, for assistance of subsea diving and installation work.
Division Order: (1) A statement executed by all parties who claim an interest stipulating how proceeds of production are to be distributed. (2) A list of interest owners and their share of revenues.
DLL: Dual laterolog.
DLS: Dogleg severity.
DMD: Driller's measured depth.
DMO (Seismic): Dip movement offset. The difference in arrival times at various sensors due to the dip of the surface off of which the signals are reflecting.
DMUR: Drilling, milling, and under-reaming.
DNL: Dual porosity compensated neutron log (CNL).
DnV: Det Norske Veritas. A classification and qualification setting business.
DO: See *Dissolved oxygen*.
Dodgy Example: Imagine you have a certain number of Queenslanders, each representing molecules of the same reactant in a chemical reaction. You apply metaphorical kinetic energy (give them car keys) and tell them that they can have $10,000 if they meet you at a certain address in North Sydney. There is a strong incentive for them to meet you there (the reaction Queensland → North Sydney is thermodynamically favored)—but chances are they will get sucked through the Harbour Tunnel and Eastern Distributor to Botany instead (the reaction Queensland → Botany is kinetically favored). If you stop the reaction while they are all in Botany, you will obtain the kinetic product, but if you let them keep the car keys, you should end up with the thermodynamic product eventually. At a certain stage in the reaction, you will have a mixture of the kinetic and thermodynamic products.
DOE: US Department of Energy.
Dog House: A crew or records shack at a lease or on a rig.
Dogleg: A sudden change in the direction of the wellbore. Generally based on degrees per 100 ft.
Dog-Lock: A type of lock used in a profile.
Dolomite: Calcium/magnesium carbonate rock. Dolomite is formed by chemical modification of a limestone.
Dolomite Rhombohedrals: Crystals of dolomite in the pore space. May turn loose when acidized and become migrating fines.
Dome: (1) A roughly symmetrical upfold of the layers of rock in which the beds dip in all directions more or less equally from a common point; any deformation characterized by local uplift and approximately circular in outline; for example, the salt domes of Louisiana and Texas. (2) A symmetrical

upfold of the layers of rock in which the beds dip in all directions more or less equally from a common point; any deformation characterized by a circular local uplift.

Domestic: Residential living facilities. A domestic area will be predominantly residential in occupancy and is sometimes referred to as a "bedroom area" or "bedroom community."

Domestic Production: Production originating inside a specific country of reference.

Doodlebug: Seismograph.

Dope: Pipe thread dope used to lubricate and seal the threaded connection.

DOT (Government): Department of Transportation. A US government agency.

Double Block and Bleed: Two successive plugs, each capable of holding maximum pressure, with a vent between them capable of bleeding off all pressure between the plugs. Also, a valve with two seating surfaces that, in the closed position, blocks flow from both valve ends when the cavity between the seating surfaces is vented through a bleed connection on the body cavity.

Double Board: Working platform for the derrickman on a drilling rig.

Double Grip (Packer): Slips that prevent either upward or downward movement.

Doubles (Pipe): Two joints screwed together.

Doughnut: A hanger, usually screwed onto the end of the top tubing joint and lowered into the slip bowl of the wellhead.

Downcomer: A pipe where the fluid flow path is down. Fluid return pipe.

Down Dip: The direction going down the tilt angle of the formation.

Downflow: Process in which the hydrocarbon stream flows from top to bottom.

Downgradient: In the direction of decreasing static head.

Downhole: (1) A term to describe tools, equipment, and instruments used in the wellbore; also conditions or techniques applying to the wellbore. (2) A general term referring to subsurface equipment, tools, or other items.

Downhole Camera: Any of a variety of downhole cameras, including full-motion video, recording memory camera, and sequence sending cameras. Used to get a better picture of the wellbore or a fish.

Downhole Choke: A flow bean (restriction) set in a profile near the bottom of the well. Used as a flow regulator and to take part of the pressure drop downhole to reduce the potential of hydrates.

Downhole Gauges: Surface reading, downhole located gauges capable of measuring pressure, temperature, and/or flow rate.

Downhole Safety Valve: A valve fitted into the production tubing of a well some distance below the surface. The valve can be closed in an emergency to stop the flow of oil and gas.

Downhole Separation: Removal of a part of the water downhole followed by injection of the water into a disposal zone.

D

Downhole Shutoff: A deliberate shutoff of a zone by a downhole valve or other method, to prevent cross flow.
Downstream: (1) Commercial gas operations that are closer to the end user or "burner tip," as opposed to upstream, which is closer to production. (2) The oil industry term used to refer to all petroleum activities from the processing of refining crude oil into petroleum products to the distribution, marketing, and shipping of the products. Phillips' refining, marketing, and transportation operations (RM&T), as well as Phillips' 50% interest in Chevron Phillips Chemical Company. (3) When referring to the oil and gas industry, this term indicates the refining and marketing sectors of the industry. More generically, the term can be used to refer to any step further along in the process. (4) The processing, refining, and distribution of oil and gas. (5) The transport, refining, and product-making part of the oil business. (5) The direction of the flow of water. In the lower part of a sewer or collection system or in that direction.
Downstream Pipeline: A pipeline receiving natural gas from another pipeline at an interconnection point. See *Upstream pipeline*.
Downstream Sector: The refining and marketing sector of the petroleum industry.
Down Stroke: The recovery stoke downward on a beam pump where the pump is filled with fluid by pushing the open traveling valve through the standing fluid.
D.P.: See *Dynamic positioning.*
DPC (Gas Lift): Casing pressure at depth—the true gas weight at depth.
DP (Offshore Rig): Dynamically positioned.
DP (Perforating): A deep penetrating charge.
DP (Reservoir): Depletion plan.
DPT: Deep propagation log.
DPTA: Diaminopropanoltetraacetic acid, a calcium scale remover, and solvent.
DPU: Downhole power unit.
DRA (Flow): Drag reduction agent.
Draft: (1) The depth of a ship in the water; vertical distance between the waterline and the keel, expressed in feet in the United States, elsewhere in meters; also draught. (2) Pressure difference that causes a current of air or gases to flow through a flue, chimney, heater, or space.
Drag Blocks: Spring-loaded blocks on a packer or other tool that contact the pipe wall, producing resistance to movement. They aid in setting of packers.
Drag (Fluid Flow): The force on a solid surface exerted by a fluid flowing past it.
Drag (Pipe Movement): Resistance to linear motion.
Drawdown: (1) Lowering of the water table due to withdrawal of groundwater from a well. (2) The difference between two pressures. Completion drawdown is the pressure differential from the formation near the wellbore to the wellbore.

Draw Works: The name for the hoisting drum, cable, shaft, clutches, power takeoff, brakes, and other machinery used on the drilling rig. Draw works are located on one side of the derrick floor and serve as a power control center for the hoisting gear and the rotary elements of the drill column.
DRBA: Delaware River Basin Authority.
Dress: To sharpen a bit or replace components of a tool.
Dress Off: To remove rough edges, flares, burrs, etc., from a piece of equipment prior to fishing.
DRGL: Drilling.
Drift Diameter: The published drift diameter for a pipe that describes the diameter of a tool that can pass through the pipe when the pipe is vertical (no doglegs).
Drift (Geological): The rock, sand, and clay moved by a glacier.
Drift (Pipe Gauge): The minimum inside diameter (ID) of tubing through which a standard drift tool will pass.
Drift (Tool): A tool with a set diameter used to check the wellbore for clearance prior to running a tool string or piece of equipment.
Drill: (1) To bore a hole; also see *Drilling*. (2) An implement with cutting edges used to bore holes.
Drillable: Downhole tools and equipment that can be broken up by the bit.
Drill Bit: (1) The part of the drilling tool that actually cuts through the rock. Drill bits bore a hole into soil, sand, or rock by a combination of crushing and shearing actions. Drill bits used for extra-hard rock are studded with thousands of tiny industrial diamonds, the hardest substances known. (2) Is the mechanism that cuts into the ground layers to reach the gas deposit or to cut a core sample. Bits rotate 50–300 revolutions per minute depending upon the hardness of the strata through which it is boring. The diameter of a hole may be up to 24 in. but it is usually 5–8 and 1½ in. (3) The rock-cutting device at the bottom of the drill string. (4) Tool used in drilling to break up rock mechanically in order to penetrate the subsoil. The bit drills a circular hole.
Drill Collar: (1) A heavy, tubular connector between drill pipe and a bit. Originally, the drill collar was a means of attaching the drill bit to the drill pipe and to strengthen the lower end of the drill column, which is subject to extreme compression, torsion, and bending stresses. Now the drill collar is used to concentrate a heavy mass near the lower end of the drill column. Drill collars were once a few feet long and weighed 400 or 500 lb. Today because of the increased bit pressure and rapid rotation, collars are made up in 1000 foot lengths and weigh 50–100 ton. (2) A very heavy wall pipe used to add weight over the bit during drilling. (3) Devices made of extra-heavy steel tubing mounted just above the drill bit to maintain pressure on the bit and keep the drill string in tension.
Drill Cuttings: (1) The small pieces of rock created as a drill bit moves through underground formations while drilling. (2) Chips and small fragments of drilled rock that are brought to the surface by the flow of the drilling mud as it is circulated. (3) The small chips and fines generated by drilling

through a formation with a drill bit. Most of the cuttings are removed from the mud as the fluid passes through the solid control equipment (e.g., shakers, screens, cyclones) at the surface.

Driller: Is the member of the drilling crew who operates a drilling rig; the person in charge of drilling operations and who supervises the drilling crew.

Driller's Console: The control panel.

Driller's Depth: Measured depth or the length of the pipe from top to depth.

Driller's Method: A method of controlling a kick in which the gas is circulated out of the well using the normal weight mud controlled with backpressure of a choke. The heavier mud needed to control the formation without the choke is then circulated into the well.

Drill-In Fluid: The fluid used to drill the pay zone.

Drilling: The action of placing a hole to a depth and location.

Drilling Ahead: Continue with drilling after stopping to check flow or other activity.

Drilling Break: A sudden increase in the rate of penetration (ROP) while drilling. May indicate a higher pressure formation, a change in lithology, a naturally fractured zone, or a poorly consolidated zone.

Drilling Contractor: A person or company whose business is drilling wells. Wells are drilled on several contract specifications: per foot, day rate, or turnkey (i.e., upon completion). Most major oil companies do not own drilling rigs. Exploration and development drilling is contracted. Personnel manning the rigs work for the contractor.

Drilling Contractor/Service Company: A person or a company whose business is drilling wells. Wells are drilled on a per foot basis; others are contracted for a day rate.

Drilling Crew: Composed of a tool pusher, a driller, a derrickhand, and several roughnecks.

Drilling-Delay Rental Clause: The lease clause ensuring that the lessee has no obligation to drill during the primary term. The drilling-delay clause includes "unless" or "or" clauses. The "unless" clause says that the lease terminates unless a well is begun or delay rentals are paid prior to a specified date. The "or" clause states that a lessee must either commence drilling or pay rentals or surrender the lease prior to the due date.

Drilling Efficiency: Average distance drilled per day divided by the total number of days in a measurement cycle.

Drilling Fluid/Mud: A special mixture of clay, water, and chemical additives pumped downhole through the drill pipe and the drill bit. The mud cools the rapidly rotating bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, and serves as a plaster to prevent the wall of the borehole from crumbling or collapsing. It also provides the weight or hydrostatic head to prevent extraneous fluids from entering the wellbore and to control downhole pressures that may be encountered.

Drilling Hook and Swivel: The components below the traveling block to which the elevators are attached.

Drilling Line: (1) Pipes that are made in even sizes from 2 to 48 in. There are larger sizes in use; however, some large gravity loading lines for crude oil tankers are 56 in. Most line pipes are either lap welded or butt welded. Seamless pipe is usually only for drilling wells. Line pipes, especially the large sizes, have beveled weld ends so the joints can be welded together. Large-diameter screw pipe (12 in.) went out of style in the late 1920s, along with the 200-man pipe handling and pipe-laying crews. Gas welding and then electric welding put them out of business. (2) The wire rope used to position tools on the floor. Also used to describe the wire rope on a cable tool rig.
Drilling Mud: (1) A mixture of clays, water, and chemicals pumped in and out of the wellbore during drilling. Drilling mud provides circulation, flushing rock cuttings from the bottom of the wellbore to the surface. It maintains pressure at the bottom of the wellbore and cakes the uncased wellbore wall to provide some protection against cave-ins. (2) A special mixture of clay, water, or refined oil and chemical additives pumped downhole through the drill pipe and drill bit. The mud cools the rapidly rotating bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, serves as a plaster to prevent the wall of the borehole from crumbling or collapsing, and provides the weight or hydrostatic head to prevent extraneous fluids from entering the wellbore and to control downhole pressures that may be encountered. (3) The fluid, water, oil or gas based that is used to establish well control, transport cuttings to the surface, provide fluid loss control, lubricate the string, and cool the bottom hole assembly.
Drilling Out: Drilling out set or green cement from the casing before drilling ahead to make a deeper well.
Drilling Permit: (1) In states that regulate well spacing, a drilling permit is the authorization to drill at a specified location; a well permit. (2) Authorization from a regulatory agency to drill a well.
Drilling Platform: (1) An offshore platform used to drill exploration and development wells but lacking the processing facilities of a production platform. (2) Usually offshore. A platform from which wells can be drilled. It may be permanent (with legs grouted into the seafloor to depths of several hundred feet), anchored, or dynamically positioned.
Drilling Rig: (1) The complete machinery and structures needed for drilling a well. (2) A drilling unit that is not permanently fixed to the seabed, for example, a drillship, a semisubmersible or a jack-up unit. Also means the derrick and its associated machinery. (3) The equipment at the surface used to lift and run the drilling string, provide the rotation, and pump fluids down the string.
Drilling Spool: A section of the BOP that allows side ports for choke and kill lines.
Drilling Table: The turning device on the derrick floor in which the drill string is held and rotated. Also called a rotary table.
Drill Motor: A hydraulic or electric motor on the end of the drill string that turns the bit.

D

Drill Out: Drilling through the cement after a primary cement job as the hole is deepened.
Drill Pipe: (1) A heavy, thick-walled steel pipe used in rotary drilling to turn the drill bit and to provide a conduit for the drilling mud. Joints of drill pipe are about 30 ft long. (2) Heavy, thick-walled, hollow steel pipe used in rotary drilling to turn the drill bit and to provide a conduit for the drilling mud. (3) A heavy wall tubing used for drilling.
Drill Pipe Safety Valve: A full opening valve with threads that match the drill pipe that can be quickly screwed onto the pipe to help control fluid flow up the tubing.
Drillship: (1) A ship fitted with a drilling derrick that is used to drill in waters that are too deep for jack-up rigs and semisubmersible rigs. (2) A ship-shape vessel for drilling and completing wells in medium to deepwater applications. The drilling equipment onboard of the ship enables drilling the well, running the protective casing in the well (preventing collapse of the drilled hole), and installing of the subsea Christmas tree. In medium water depths, the drillship is anchor-moored. In deepwater areas the ship is dynamically positioned.
Drill Stem: Typically, rotating components in a drill string.
Drill-Stem Test: A controlled production of a small amount of fluid from an isolated section of the pay zone into the chamber formed by the drill pipe and a downhole valve. DST's measure pressures, some elements of depletion and gather samples of the produced fluids.
Drill String: The long assembly of drill bit, drill collars, and many lengths of pipe that is turned by the rotate table and cuts through the rock.
Drill String: (1) As the hole gets deeper, pipe is added to the drill bit to allow it to dig further. These lengths of drill pipe form the drill string. (2) All the equipment in a drilling BHA plus the drill pipe.
Drinking Water, Potable Water: Water of a quality based on World Health Organization (WHO).
Drip: Condensate liquid or natural gasoline.
Drip Gas: Natural gasoline or low carbon chain liquids, condensed from the rich gas from a well.
Drip Oil: Natural gasoline or low carbon chain liquids, condensed from the rich gas from a well.
Drive Pipe: The conductor pipe.
DRODB: Drilling, recompletion, and repair database.
Drop Ball: A sized ball dropped or pumped from the surface to shift a tool downhole.
Drop Bar (Perforating): A bar dropped from surface to set off a TCP gun in a near vertical well.
Drop Cable: Cable that provides access to and from a network system. Possibly the cable from a transceiver or an individual line in a multidrop situation. Also the cable from a wall-mounted faceplate or jack to a user's system.

Droplet: A liquid particle of small mass, capable of remaining in suspension in a gas. In some turbulent systems, for example, clouds, its diameter can reach 200 μm.
Droplet Separator: An apparatus for separating liquid particles from a gas stream in which they are suspended.
Dropping Point: (1) The lowest temperature at which a grease is sufficiently fluid to drip as determined by a standard test method, hence an indication of whether a grease will flow from a bearing at operating temperatures. (2) For lubricating greases, the temperature at which the grease passes from a semisolid to a liquid state under prescribed test conditions (ASTM D566).
Dry-Bed Adsorption: A process used to remove water and some of the natural gas liquids from the natural gas. The liquids are adsorbed on the surface of the desiccant such as silica gel.
Dry-Bulb Temperature: Temperature of air indicated by an ordinary thermometer.
Dry-Cleaning Fluid: A petroleum naphtha having narrow, carefully selected boiling points and other properties for dry cleaning.
Dry Completion Unit: A floating facility carrying surface completed wells, that is, the Christmas trees are located above the surface of the sea, on the floater, as opposed to the seabed. The rigid pipes (tubing, casing, etc.) that link the trees to the wells require high tension to avoid buckling. A key feature of a DCU is therefore the need for constant tension to compensate for the floating heave motion. Generally, a DCU also carries basic drilling equipment to allow downhole intervention on a tender assist mode. It can also feature a full drilling capability.
Dry Dock: An enclosed basin into which a ship is taken for underwater cleaning and repairing. It is fitted with watertight entrance gates, which, when closed, permit the dock to be pumped dry.
Dry Gas: (1) Natural gas with so little natural gas liquids that it is nearly all methane. (2) A natural gas from the well free of liquid hydrocarbons; gas that has been treated to remove all liquids; pipeline gas. (3) Natural gas composed mainly of methane with only minor amounts of ethane, propane, and butane and little or no heavier hydrocarbons in the gasoline range. (4) Natural gas, mainly from gas fields rather than oil fields, which does not contain appreciable quantities of the heavier hydrocarbons, such as propane and butane, which condense easily. Methane and ethane are principal components of dry gases.
Dry Gas (in Production): A gas stream without condensate. *Note*: Even dry gas at bottom hole conditions may have up to two barrels of water vapor per million standard cubic feet of gas. Dry gas on the process side has all liquids removed.
Dry Gas (Reserves): Dry gas is a natural gas containing insufficient quantities of hydrocarbons heavier than methane to allow their commercial extraction or to require their removal in order to render the gas suitable for fuel use (also called lean gas) (SPE).

D

Dry Gloss Heating Value (Reactions): The total energy transferred as heat in an ideal combustion reaction at standard temperature and pressure in which all water formed appears as a liquid.

Dry Hole: (1) A well that does not find oil or gas in commercial quantities. Definitions of commercial vary according to the costs of exploration. A shallow well in the old oil patch in the United States might be commercial when it can produce less than 10 barrels of oil per day, while an offshore well might not be commercial unless it produces several thousand barrels of oil per day. (2) A well that has proved to be nonproductive. (3) Any exploratory or development well that does not find commercial quantities of hydrocarbons. (4) A well drilled to a certain depth without finding commercially exploitable hydrocarbons. (5) An unsuccessful well. The well does not contain enough hydrocarbons to warrant completion. (6) A well that does not have or produce commercial deposits of hydrocarbons.

Dry Hole Agreement: An agreement where contributing party agrees to make a cash contribution if the drilling party drills a dry hole. The drilling party generally agrees to provide geological and drilling information whether or not the well is a dry hole.

Drying Oil: An oil capable of conversion from a liquid to a solid in the presence of air.

Dry Measurement Basis: Method of measuring total heating value whereby 1 ft^3 of gas is measured in the absence of water vapor under standard conditions of pressure and temperature.

Dry Natural Gas: Natural gas that remains after (1) the liquefiable hydrocarbon portion has been removed from the gas stream (i.e., gas after lease, field, and/or plant separation) and (2) any volumes of nonhydrocarbon gases have been removed where they occur in sufficient quantity to render the gas unmarketable. (*Note*: Dry natural gas is also known as consumer-grade natural gas. The parameters for measurement are cubic feet at 60°F and 14.73 pounds per square inch absolute.) (3) Is natural gas that has been conditioned and treated and natural gas liquids (ethane and heavier molecules) removed.

Dry Natural Gas Production: The process of producing consumer-grade natural gas. Natural gas withdrawn from reservoirs is reduced by volumes used at the production (lease) site and by processing losses. Volumes used at the production site include (1) the volume returned to reservoirs in cycling, repressuring of oil reservoirs, and conservation operations; (2) gas dioxide, helium, hydrogen sulfide, and nitrogen removed from the gas stream; and (3) gas converted to liquid form, such as lease condensate and plant liquids. Volumes of dry gas withdrawn from gas storage reservoirs are not considered part of production. Dry natural gas production equals marketed production less extraction loss.

Dry (Or Lean) Gas: (1) Gas that has been treated to remove liquids and inert making it suitable for shipping in a pipeline. (2) Natural gas from the well containing no water vapor that will liquefy at ambient temperature and

pressure, that is, the gas is "water dry." Gas is usually priced on a dry basis (see *Pipeline quality gas*). (3) A gas whose water content has been reduced by dehydration. (4) A gas containing little or no hydrocarbons that could be recovered as a liquid condensate.

Dry Point: In the standard distillation test, the temperature when the last drop of liquid evaporates from the bottom of the flask. For solvents and some other products considered to be more indicative of final boiling point than end point, which is the maximum temperature observed on the distillation thermometer when no more vapor can be driven from the flask by heating.

Dry Production Trees: See *Surface (Xmas) trees*.

Dry Sieve Method: A sand particle size distribution obtained by shaking a sample of sand through a series of sieves or screens.

Dry Tree Unit: A motion-stabilized floating vessel that supports vertical steel risers from sea floor wellheads providing well access for drilling or workover operation.

Dry Tree Well: An offshore well with the wellhead and access to the well at the surface.

DS: Drill string.

DS: Directional survey.

DS: Drill site.

DSI: Dipole sonic.

DSL: Diesel.

DST: Drill-stem test.

DSV: See *Diving support vessel*.

DSV: Downhole safety valve.

D/T: Diameter to thickness ratio. A common comparison value in steel pipe.

D/T (Pipe): The outside diameter (OD) to the pipe wall thickness.

DTS: Distributed temperature sensor or survey.

DTU: See *Dry tree unit*.

Dual Completion: (1) A well completed to produce from two separate reservoirs. (2) Two pay zones in the same well that produce up independent flow paths in the same well.

Dual Discovery: An exploratory well that finds petroleum in two separate reservoirs.

Dual-Fuel Burner: Burner designed to burn either gas or oil, but not both simultaneously.

Dual-Fuel Vehicle: A vehicle designed to operate on a combination of alternative fuel, such as liquefied natural gas (LNG) or liquefied petroleum gas (LPG), and conventional fuel, such as gasoline or diesel. These vehicles have two separate fuel systems that inject both fuels simultaneously into the engine combustion chamber.

Dual Induction Log: An induction log with dual and deep measurements of resistivity. Shallow measurements are indicative of severely invaded zone, and the deepest measurements are most reflective of actual formation fluids.

DUB (Perforating): Dynamic underbalance perforating.

D

Duct: Passageway made of suitable material, not necessarily leaktight, used for conveying air or other gas at low pressures.
Ductwork: A system of ducts for distribution and extraction of air.
Dummy Run: A wire line or tubing run into a well with a dummy piece of equipment of the same size, shape, and stiffness of a valuable or unrecoverable piece of equipment to make sure the equipment can be placed.
Dummy Valve: A solid body (nonflowable) gas lift valve that "dummies off" a gas lift mandrel to seal the GLM or pocket.
Dump Bailer: A hollow tube with a flapper or other opening valve at the bottom, run on wire line to place cement or sand in a well.
Dump Flood: Various—usually allowing water to gravity feed into the annulus (without packer) or the tubing and into the formation.
Dune: A deposit of sand produced by wind or running water. The dune may be massive but usually lower energy and permeability varies.
Duplex Pump: A type of pump with two, dual-acting pistons.
Duplex Steel: A corrosion-resistant alloy with chrome and nickel as common components.
Durometer (Rubber): A term used to express hardness, usually of rubbers or elastomers.
Dust: Small solid particles conventionally taken as those particles below 75 μm in diameter that settle out under their own weight but which may remain suspended for some time.
Duster: A dry hole.
Dust Separator: An apparatus for separating solid particles from a gas stream in which they are suspended.
Dutchman: A filler piece used to close a gap in piping or equipment alignment.
DV Tool (Cementing): A stage tool.
DW: Deep water, usually inaccessible by a fixed (nonfloating) platform.
DWD: Deepwater development.
DWOP: Drill well on paper exercise.
DWOP (British Petroleum): Drilling and well operations policy.
DWP: Deep mater production.
DWT: See *Deadweight tonnage*.
Dwt: Deadweight. The total weight of cargo, fuel, freshwater, stores, and crew that a ship can carry when immersed to her load line.
DXV (Subsea): Direct crossover valve.
Dynamic: The head against that a pump works. Friction the head loss by fluid flowing as a result of the disturbances due to the contact between the moving fluid and its container. Loss of the decrease between two points. Static the vertical distance between the free level of the supply and that of the discharge.
Dynamic Event (Propellant Fracturing): Events such as pressure surge or fracturing that occur over a few hundred milliseconds.
Dynamic Flow: Non-steady state flow or flow with changing conditions.

Dynamic Positioning: A station keeping system for floating units that uses thrusters to compensate wind, wave, and current forces in a dynamic controlled mode to keep the unit on a predetermined location and heading at sea.
Dynamic Seal: A seal in a system where motion is expected in the seal or the seal area.
Dynamic Viscosity (Produced Fluid): The viscosity of the fluid in the reservoir at the reservoir conditions. *Note*: Associated gas reduces the viscosity of most oils.
Dynamometer: A recording of the stresses in a rod string of a beam pumping unit.
DZO (Seismic): Demigration to zero offset. An improvement in seismic processing over dip movement offset where signal velocity varies significantly with depth.

E

E&A: Exploration and appraisal.
E&P or E/P: Exploration and production. The "upstream" sector of the oil and gas industry.
E85: A fuel containing a mixture of 85% ethanol and 15% gasoline.
E95: A fuel containing a mixture of 95% ethanol and 5% gasoline.
Easement: Legal right to use the property of others for a specific purpose. For example, a utility company may have a 5 ft easement along the property line of a home. This gives the utility the legal right to install and maintain a sewer line within the easement.
ECAs: See *Export credit agencies*.
Eccentricity: Decentralization of pipe in the hole. A 100% eccentric is against the hole wall.
ECD: See *Equivalent circulating density*.
Echo Meter™: A trademarked, commercial tool that measures the height of a fluid (or solid) level by means of a reflected sound wave.
Economically Recoverable Resource Estimate: An assessment of hydrocarbon potential that takes into account (a) physical and technological constraints on production and (b) the influence of exploration and development costs and market price on industry investment in outer continental shelf (OCS) exploration and production.
Economic Interest: Ownership of part of the well.
Economic Limit: When the revenue from the produced fluids falls below the cost of operations set by the company.
Economizer: Control system that reduces the mechanical heating and cooling requirement. Usually refers to the use of outside air.
Economizer Cycle: Cycle logic that uses the economizer mode in conjunction with mechanical cooling, typically based on return and outside air total heat.
Econoprop™: A trademarked name for an inexpensive lightweight ceramic (man-made) proppant.
Ecorr: Corrosion potential.
ECP: External casing packer.
ECTFE: Thermoplastic fluoropolymer.
eCTU: Electric line coiled tubing unit.
ED (Elastomers): Explosive decompression.
Edge Water: Water at the sides or edges of the hydrocarbon deposit. Often causes problems because the channels that deplete the fastest have the highest

permeability and water production through them can be severe. These respond well to treatment if they can be isolated.
EDP (Subsea): Emergency disconnect package.
EDTA: Ethylenediaminetetraacetic acid.
Eductor: (1) A device that, through flow of a power fluid through a nozzle, creates a low-pressure area useful for moving fluids. (2) A device for mixing two fluids, such as air and water.
EEZ: See *Exclusive economic zone*.
Effective Permeability: The permeability of the formation matrix to a particular fluid when two or more phases are present.
Effective Porosity: (1) Interconnected, drainable porosity. (2) The percent of the total volume of rock that consists of connecting pores or interstices. The part of a rock that is capable of holding a fluid (oil, water, or gas) has the effective porosity.
Effective Shot Density: That number of the open and flowing perforations.
Effective Stress (Fracturing): The principle stress less the fluid pressure.
Effective Wellbore Radius: The theoretical radius of a wellbore that would flow the same rate as a wellbore with a fracture. Effective wellbore radius is a comparison of flow improvement related back to physical radius.
Efficiency: The ratio of actual performance to the theoretical or perfect performance, usually expressed as a percent.
Effluent: (1) Waste liquid, gas, or vapor that results from petroleum and chemical processing. (2) Effluent is (a) a liquid that flows out of a containing space and/or (b) sewage, water, or other liquid partially or completely treated, or in its natural state, as the case may be flowing out of a reservoir, basin or treatment plant, or part thereof. (3) The fluids and solids, perhaps in a mixed stream, produced from a well. (4) Water or other liquid—raw (untreated) or partially or completely treated—flowing from a reservoir, basin, treatment process, or treatment plant.
Effluent Limits: Pollutant limitations developed by a publicly owned treatment works (POTW) for industrial plants discharging to the POTW system. At a minimum, all industrial facilities are required to comply with federal prohibited discharge standards. The industries covered by federal categorical standards must also comply with the appropriate discharge limitations. The POTW may also establish local limits more stringent than or in addition to the federal standards for some or all of its industrial users.
EGM: Electronic gas measurement.
EGMBE: Ethylene glycol monobutyl ether. A mutual solvent.
EGP: External gravel pack.
EIA: See *Environmental impact assessment*.
EIA: See *Energy Information Administration*.
Eight Round: A thread with eight threads per inch.
EIS: See *Environmental impact statement*.
EIT: Engineer in training.

Ejector: A device for conveying a liquid by entraining it in a high-velocity stream of air or water.
EL: Elevation.
EL&P: Exploration, land, and production.
Elastic: Nonpermanent structural deformation during which the amount of deformation (strain) is proportional to the applied stress (load).
Elastic Deformation: Deformation of a body in the elastic range, that is, recovery to the initial shape is possible when the stress or load is removed.
Elasticity: The tendency of a body to return to its original shape and size once the stress is removed.
Elastic Limit: The upper range of elasticity, just before the body is permanently deformed.
Elastomer: (1) A polymer that, when deformed (stretched, twisted, spindled, mutilated, etc.), springs back into its original shape. The elastomer *par excellence* is lightly cross-linked natural rubber. (2) A rubber or plastic material used as a seal. May occur naturally or be synthesized.
Elbow: An "L" shaped fitting in surface piping.
Electricity (Purchased): Electricity purchased for refinery operations that is not produced within the refinery complex.
Electric Line: A wire line with a conductor in the middle and woven electrical braid over the conductor.
Electric Log: (1) An electrical survey made on uncased holes. A special tool is lowered into the hole that ejects an electrical current into the rock and records its resistance to the current. The data from the survey are used by the geologists to determine the nature of the rock and its contents. (2) Typically a resistivity log. (3) Records weak electrical currents that flow in the rock next to the wellbore and shows the thickness and boundaries of the rock layers. These logs help determine the amount of salt water present and the permeability.
Electric Logging: A method of rock and fluid identification or evaluation that began in 1927. The first log was run by Conrad Schlumberger.
Electric Logging Tool: A tool attached to a cable that is lowered into a well to survey the borehole before it is cased. An electrical impulse is emitted that is reflected from the rock strata. The degree of resistance to the current allows geologists to determine the nature of the rock penetrated by the drill and some indication of its permeability, porosity, and content (gas, oil, or water).
Electric Power Sector: An energy-consuming sector that consists of electricity only and combined heat and power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public.
Electric Rig: A drilling rig where the power source is electricity provided by a generator.
Electric Submersible Pump: (1) A downhole artificial lift unit powered by electricity. (2) An electric powered rotating pump capable of lifting very large flow rates (>20,000 bpd).

E

Electric Utility: A corporation, person, agency, authority, or other legal entity or instrumentality aligned with distribution facilities for delivery of electric energy for use primarily by the public. Included are investor-owned electric utilities, municipal and state utilities, federal electric utilities, and rural electric cooperatives. A few entities that are tariff based and corporately aligned with companies that own distribution facilities are also included. (*Note:* Due to the issuance of FERC Order 888 that required traditional electric utilities to functionally unbundle their generation, transmission, and distribution operations, "electric utility" currently has inconsistent interpretations from state to state.)

Electric Utility Consumption: Gas used as fuel in electric utility plants.

Electric Utility Sector: The electric utility sector consists of privately and publicly owned establishments that generate, transmit, distribute, or sell electricity primarily for use by the public and that meet the definition of an electric utility. Nonutility power producers are not included in the electric sector.

Electrolyte: A material that, when dissolved in water, causes or increases the fluids' electrical conductivity.

Electromagnetic Interference: The energy given off by electronic circuits and picked up by other circuits; based on the type of device and operating frequency. Electromagnetic interference effects can be reduced by shielding and other cable designs. Minimum acceptable levels are detailed by the FCC. See also *Radio-frequency interference*.

Electromagnetic Propagation Tool: Measures propagation time and attenuation rate of microwave energy through the formation. Helps distinguish between oil and water.

Electromotive Force: The force that drives electrons and creates an electrical current.

Electromotive Force Series (Corrosion): A list of elements arranged according to their standard electrode potentials.

Electron: A tiny speck of charge, so far impossible to break into smaller pieces, weighing 9.109×10^{-31} kg and having a charge of 1.602×10^{-19} C. An electron is so small that its "size" is a nebulous concept; if it *were* a little round ball, it would be about 10^{-15} m across.

Electronegative: The ability of an atom to attract electrons is its electronegativity. Elements that easily form negatively charged ions, such as fluorine and oxygen, have a high electronegativity. Generally speaking, the top right corner of the periodic table is home to the most electronegative elements, while the bottom left corner is the least electronegative.

Electrostatic Treater: A separation device that uses alternating current charged plates to help break emulsions.

Elevator Bails or Links: The bars that attach the elevators to the hook on the traveling block.

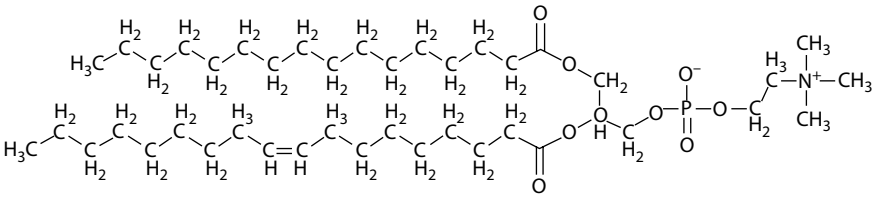
Elevators: The snap-around latches that couple around tubing below the pipe coupling and enable the traveling block on a rig to gab and lift the tubular string.

ELG: Effluent limitation guidelines.
E-Line: See *Electric line*.
ELMD: Electric line measured depth.
Elongation: An increase in length expressed numerically as a percent of initial length.
Elutriation: The washing of digested sludge with either freshwater, plant effluent, or other wastewater. The objective is to remove (wash out) certain soluble organic and inorganic components that consume large amounts of chemicals. This process reduces the demand for conditioning chemicals and improves settling or filtering characteristics of the solids.
EM: Eddy current measurement for wall thickness in corrosion and wear determination.
Embedment: Proppant that has partly or completely sunk into a formation through displacement of the formation around the grain.
Embrittlement: A fatigue state of metal that may be caused by trapping atomic hydrogen in the structure of the steel. Characterized by loss of ductility. May also be caused by work hardening or other factor.
EMCS: Energy monitoring and control system.
Emergency Response Plan: A written plan that identifies various types of anticipated emergencies and the preplanned response to such events.
Emergency Shutdown System: A system, usually independent of the main control system, that is designed to safely shut down an operating system. For example, at "ship shore interface," LNG cargo transfer between ship and shore is accomplished by a series of shore-based articulated loading arms, usually three or four liquid arms and a single vapor arm. The configuration is similar at both the loading and discharge terminals. These arms have flexibility in three directions to allow for relative motion between ship and shore. If this allowable motion is exceeded, alarms sound on the ship and shore. Cargo transfer is automatically stopped, either by the shore pumps shutting down during loading or by the ship's pumps shutting down during unloading.
Emergency Training and Response Action Centers: Two specially designed communications and emergency vehicles operated by the Red Cross and sponsored by Phillips. EmTRAC was developed after the Oklahoma City bombing to provide fast, mobile assistance in emergencies.
EMF: See *Electromotive force*.
EMI: See *Electromagnetic interference*.
Empirical: Observed response, often well proven by experiences but not theoretically derived.
EmTRAC: See *Emergency Training and Response Action Center*.
Emulsification: The phenomenon of fine dispersion of one liquid held in suspension in a second liquid in which it is partly or completely immiscible.
Emulsification Test: Standard laboratory procedure for evaluating the resistance of insulating oils, turbine oils, and other lubricating oils to emulsification.

E

Emulsified Asphalt: An emulsion of asphalt cement and water, containing a small amount of an emulsifying agent.

Emulsifier: (1) An additive that promotes the formation of a stable mixture, or emulsion, of oil and water. (2) An emulsion-stabilizing mechanism, usually either surface-active agent, fines, viscosity, or charge. (3) A compound added to a mixture of two immiscible liquids in order to make it an emulsion, and not just two layers of liquid lying on top of each other. An emulsifier will usually be a molecule where one end is highly soluble in water, and the other is highly soluble in oil. Sodium dodecyl sulfate, the active ingredient in bubble-blowing mixture, is a surfactant. So is lecithin, found in egg yolk:



Emulsion: (1) A dispersion where a liquid is dispersed in another liquid—for example, mayonnaise is an emulsion of water in oil and milk is an emulsion of oil in water. Strictly speaking, a dispersion is only an emulsion if the dispersed blobs of liquid are of colloidal dimensions. (2) Intimate mixture of two or more materials that are immiscible or partially miscible with each other. In most emulsions, one material is aqueous and the other is oil. (3) A physical mixture of two or more immiscible phases. (4) A mixture of two or more liquids that cannot be combined; therefore, one liquid is "suspended" in the other.

Emulsion Stabilizer: A chemical or physical effect that prevents separation of two or more, normally immiscible phases; normally surfactant, electrical charge, liquid or emulsion viscosity, or micron-sized solids at the interface.

EMW: Equivalent mud weight.

Enabling Agreement: Provides the general terms and conditions for the purchase, sale, or exchange of LNG, pipeline gas, and electricity but does not list specific contract details.

Encapsulated Breaker: Breaker in small pill-form particles that stays with the polymer and helps break the mud cake.

Ending Stocks: Primary stocks of crude oil and petroleum products held in storage as of 12 midnight on the last day of the month. Primary stocks include crude oil or petroleum products held in storage at (or in) leases, refineries, natural gas processing plants, pipelines, tank farms, and bulk terminals that can store at least 50,000 barrels of petroleum products or that can receive petroleum products by tanker, barge, or pipeline. Crude oil that is in-transit by water from Alaska or that is stored on federal leases or in the Strategic Petroleum Reserve is included. Primary stocks exclude stocks of foreign origin that are held in bonded warehouse storage.

End of Well Report: A summary of general well data, operation data, geologic data, etc., for a particular well after the final completion step.
Endogenous: A diminished level of respiration in which a microorganism utilizes previously stored nutrients to sustain life.
Endogenous Respiration: The biological process by which living organisms oxidize some of their own cellular mass instead of new organic matter they adsorb or absorb from their environment.
Endothermic: A reaction that absorbs heat.
End Point: (1) In the distillation tests for gasoline and other products, the highest thermometer reading during the distillation, usually that when the sample has been entirely vaporized. Also the final boiling point. (2) Samples are titrated to the end point. This means that a chemical is added, drop by drop, to a sample until a certain color change (e.g., blue to clear) occurs that is called the end point of the titration. In addition to a color change, an end point may be reached by the formation of a precipitate or the reaching of a specified pH. An end point may be detected by the use of an electronic device such as a pH meter.
Endurance Limit: The maximum stress that a material can withstand for an infinitely large number of cycles (NACE definition of the term).
End Users: The ultimate consumers of natural gas, including residential, commercial, industrial, wholesale, cogeneration and utility electric generation customers.
Energy Efficiency: The inverse of energy intensiveness: the ratio of energy outputs from a process to the energy inputs (e.g., miles traveled per gallon of fuel).
Energy Equivalents:

Boe: Barrel of oil (one barrel of oil equals 6000 ft^3 of natural gas)
Mboe: 1000 barrels of oil equivalent
Mmboe: 1 million barrels of oil equivalent
Mmcfe: 1 million ft^3 of natural gas equivalent
Bcfe: 1 billion ft^3 of natural gas equivalent
Tcfe: 1 trillion ft^3 of natural gas equivalent

Energy Information Administration: An agency within the US Department of Energy. EIA provides energy data, forecasts, and analyses.
Engineering, Procurement, and Construction Contract: (1) A legal agreement setting out the terms for all activities required to build a facility to the point that it is ready to undergo preparations for operations as designed. (2) The final contracting phase in the development of the export portion of the LNG chain that defines the terms under which the detailed design, procurement, construction, and commissioning of the facilities will be conducted. Greenfield LNG project development entails a wide variety of design, engineering, fabrication, and construction work far beyond the capabilities of a single contractor. Therefore, an LNG project developer divides the work into

a number of segments, each one being the subject of an engineering, procurement, and construction (EPC) contract. For example, separate EPC contracts are executed for construction of onshore LNG plant and related infrastructure, for the offshore production facilities, and for the pipeline from the offshore location to the plant site. See *Front-end engineering and design contract*. (3) Contract between the owner of a liquefaction plant and an engineering company for the project development and erection.

Engine Oil: Generic term applied to oils used for the bearing lubrication of all types of engines, machines, and shafting and for cylinder lubrication other than steam engines. In internal combustion engineering, synonymous with motor oils and crankcase oils.

Engine Sludge: The insoluble degradation product of lubricating oils and/or fuels formed during their use in internal combustion engines and deposited from the oils outside the combustion space. Water may or may not be present.

Enhanced Oil Recovery: (1) Any method that increases oil production by using techniques or materials that are not part of normal pressure maintenance or water-flooding operations. For example, natural gas can be injected into a reservoir to "enhance" or increase oil production. (2) A process whereby oil is recovered other than by the natural pressure in a reservoir. Refers to a variety of processes to increase the amount of oil removed from a reservoir, typically by injecting a liquid (e.g., water, surfactant) or gas (e.g., nitrogen, carbon dioxide). (3) Recovery of oil or gas from a reservoir by artificially maintaining or enhancing the reservoir pressure by injecting gas, water, or other substances into the reservoir rock. (4) One or more of a variety of processes that seek to improve recovery of hydrocarbons from a reservoir after the primary production phase.

Enhanced Reach: Deviated wells (over 65°) from vertical and reached out horizontally more than twice the vertical depth.

Enriching: Increasing the heat content of natural gas by mixing it with a gas of higher Btu content.

Ensign: Flag carried by a ship to show her nationality.

Enteric: Intestinal.

Enthalpy: Thermodynamic quantity equal to the sum of the internal energy of a system plus the product of the pressure–volume work done on the system.

Entitlement (Reserves/Production): Reserves consistent with the cost recovery plus profit hydrocarbons that are recoverable under the terms of the contract or lease are typically reported by the upstream contractor (SPE).

Entrained Gas: Gas dispersed in a produced fluid.

Entropy: A measure of the number of possible states a group of "somethings can occupy"—the more possible ways the group can be arranged, the higher the entropy. For example, there are fewer possible configurations of students in chairs in a room where the chairs are bolted to the floor than where the chairs can be moved around—the room with fewer possibilities will have less entropy and more order. It is also interesting that the entropy of the universe is

always increasing, so any process that gives one part of the universe (e.g., your bedroom) more order is increasing the disorder in other places (e.g., the air due to the hard work of cleaning your room). On balance, then, it is better for the universe if you don't clean your room; try convincing your parents though.

Environmental Cracking: Brittle fracture of a normally ductile material for which the corrosive effect of the environment is a cause (NACE definition of the term).

Environmental Impact Assessment: An assessment of the impact of an industrial installation or activity on the surrounding environment, conducted before work on that activity has commenced. The original baseline study, a key part of this process, describes the original conditions.

Environmental Impact Statement: A statement required by the National Environmental Policy Act (NEPA) of 1969 or similar state law in relation to any action significantly affecting the environment, including certain exploration and drilling activities.

Environmental Protection Agency, United States: (1) A government agency, established in 1970. Its responsibilities include the regulation of fuels and fuel additives. (2) The US federal agency that administers federal environmental policies, enforces environmental laws and regulations, performs research, and provides information on environmental subjects. The agency also acts as chief advisor to the President on American environmental policy and issues. (3) A federal agency created in 1970 to permit coordinated and effective governmental action, for protection of the environment by the systematic abatement and control of pollution, through integration of research monitoring, standard setting, and enforcement activities. (4) US pollution control enforcer. (5) A regulatory agency established by the US Congress to administer the nation's environmental laws. Also called the US EPA.

Enzyme: (1) A protein that catalyzes a biochemical reaction. For example, chemical engineers make nitrogen (N_2) into ammonia (NH_3) using high temperatures and pressures—generating the power to make fertilizer by this process accounts for about 2% of all anthropogenic greenhouse gas emissions. Bacteria do the same thing at soil temperature and pressure using enzymes to catalyze the reaction. (2) A protein-based (nonliving) material that can serve as a catalyst for many organic reactions. (3) Organic substances (produced by living organisms) that cause or speed up chemical reactions. Organic catalysts and/or biochemical catalysts.

EOB: End of build (horizontal wellbore).

EOC: End of curve.

Eocene: A geologic epoch from 38 to 55 million years.

Eolian: Formed by wind.

Eon: The primary division of geologic time—from oldest to youngest: the Haldean, Archean, Proterozoic, and Phanerozoic.

EOP: See *Extreme overbalanced perforating.*

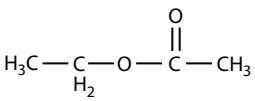
EOR: See *Enhanced oil recovery.*

EOS: See *Equation of state.*

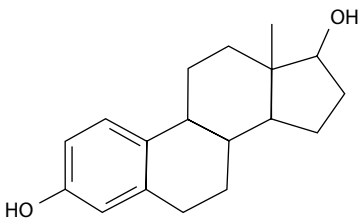
E

EOT: End of tubing.
EOWR: See *End of well report*.
EP: Equalizing prong.
EPA: See *Environmental Protection Agency, United States*.
EPCI: Engineer, procure, construct, install. A form of contracting that provides for turnkey delivery of facilities.
EPCRA: Emergency Planning and Community Right-to-Know Act.
EPM: See *Equivalents per million*.
Epoch: A time division of geologic time next shorter than a period.
Epoxy: A resin formed by the reaction of polyols with epichlorohydrin.
Epoxy Resins: Plastics materials, petrochemically derived, used as surface coatings, laminating adhesives, and in paints.
EPT: See *Electromagnetic propagation tool*.
EQMW: See *Equivalent mud weight*.
Equalizing Basin: A holding basin in which variations in flow and composition of a liquid are averaged. Such basins are used to provide a flow of reasonably uniform volume and composition to a treatment unit. Also called a balancing reservoir.
Equalizing Feature: A part of a plug that allows equalization of the pressures above and below a plug.
Equation of State: A mathematical relationship between pressure, volume, and the temperature of a fluid that permits the prediction of the real volumetric and thermodynamic behavior.
Equity Gas: The proportion of natural gas to which a producing company is entitled as a result of its financial contribution to the project.
Equivalent Circulating Density: The effective fluid density that the formation sees when the friction pressure on the fluids returning to surface is added to the fluid density.
Equivalent Mud Weight: The equivalent mud weight felt by the formation when circulating with a certain mud weight and holding a back pressure. A 10 lb/gal mud in a 10,000 ft well with 1000 psi back pressure would generate an equivalent mud weight of about 11.9 lb/gal.
Equivalents per Million: The epm is equal to the ppm divided by the equivalent weight.
Equivalent Weight: The atomic or formula weight of a material.
Era: A division of geologic time, next shorter than the eon and larger than a period.
ERD: Extended reach drilling.
ERF: Error function.
ERFC(x): Complimentary error function = $1 - \text{erf}(x)$.
Erosion: (1) Progressive loss of material from a solid surface due to mechanical interaction between that surface and a fluid, a multicomponent fluid or solid particles carried within the fluid (NACE). (2) Wear of a material by a slurry of liquid and (usually) solids.

Erosion Corrosion: Corrosion acceleration by passage of a high-velocity flow or impingement of solids. May remove the thin, protective oxide film that protects exposed metal surface.
Erosion/Scour: The removal or dissolution of parts of the seabed by bottom currents, particularly those by storms. Transportation by currents of the removed material can result in significant movement of masses of sand, silt, and mud on the seafloor. This migration of sediment can "strand" drilling platform supports or wellhead plumbing by erosion of the surrounding support sediments.
ERW: See *Extended reach well*.
Escalator Clause: A clause in a gas purchase or sale contract that permits adjustment of the contract price under specified conditions.
ESD or ESDS: See *Emergency shutdown*.
ESP: See *Electric submersible pump.*
ESR: Equilibrium step rate test.
ESS (Sand Control): Expandable sand control screen.
ESS (Seismic): Exploration subsalt.
Established Reserves: The portion of the discovered resource base that is estimated to be recoverable using known technology under present and anticipated economic conditions. Includes proved plus a portion of probable (usually 50%).
Ester: Take a carboxylic acid and an alcohol and remove water, so that you are left with two bits linked by a C(O)–O– group—this is an ester. Many of the most important industrial polymers are esters. For example, ethyl acetate:



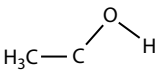
ES (Treating): Electrostatic separator.
Estrogen: A steroid hormone responsible for the development of female characteristics in mammals. The proper name for it is "estradiol," and it looks as shown below:



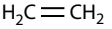
Estuaries: Bodies of water at the lower end of a river that are subject to tidal fluctuations.

E

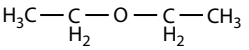
ESV: Emergency shutdown valve.
ES (Wire Line): Equalizing sleeve.
ETBE: *See Ethyl tertiary butyl ether.*
Ethane: (1) A normally gaseous straight-chain hydrocarbon. It is a colorless paraffinic gas that boils at a temperature of –127.48°F. It is extracted from natural gas and refinery gas streams. (2) The saturated hydrocarbon that is primarily extracted from natural gas, but also from recovered refinery gases. The United States and Canada have long been the dominant producers and consumers of ethane. The largest end use for ethane is as a feedstock for ethylene production. (3) A two-carbon chain alkane. A gas under standard conditions of temperature and pressure.
Ethanol: (1) A colorless liquid that burns to produce water and carbon dioxide. The vapors form an explosive mixture with air and may be used as a fuel in the internal combustion engine. It is most easily produced by the fermentation of carbohydrates. Ethanol has replaced MBTE as the source of oxygenates in the gasoline pool. (2) Otherwise known as ethyl alcohol, alcohol, or grain spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5°C in the anhydrous state. However, it forms a binary azeotrope with water, with a boiling point of 78.15°C at a composition of 95.57% by weight ethanol. It is used in the United States as a gasoline octane enhancer and oxygenate (10% concentration). Ethanol can also be used in high concentrations in vehicles optimized for its use. (3) What most people just call alcohol, ethanol is the alcohol with which most people are most familiar. It's a very useful solvent, antiseptic, or cleaner and is also known as a "social lubricant" due to its physiological effects, which can include death.



Ethene: Also known as ethylene, ethene is the simplest monomer for use in addition polymerization reactions. Poly(ethene) (or polyethylene) is well known to you in the form of cling wrap.



Ether: (1) The family name applied to a group of organic chemical compounds composed of carbon, hydrogen, and oxygen, which are characterized by an oxygen atom attached to two carbon atoms (e.g., methyl tertiary butyl ether). (2) A generic term applied to a group of organic chemical compounds composed of carbon, hydrogen, and oxygen, characterized by an oxygen atom attached to two carbon atoms (e.g., methyl tertiary butyl ether). (3) Any carbon compound containing the functional group C–O–C. A commonly used ether is diethyl ether, which used to be used as an anesthetic.



Ethernet (Computer): A local area network protocol standard defined by IEEE 802.3.

Ethylene: (1) An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. (2) Basic chemical used in the manufacture of plastics (such as polyethylene), antifreeze, and synthetic fibers. (3) A colorless, flammable gas, with a faint odor. It is an unsaturated chemical formed by cracking of ethane and other feedstocks in an ethylene plant. It is an important raw material in the manufacture of numerous petrochemicals. (4) A two-carbon chain alkene—double bonds between the carbons and a formula of C_2H_4. A very common starting material for synthesis of various products.

Ethylene Glycol: (1) A colorless, sweet-tasting liquid completely miscible with water and many organic liquids. Ethylene glycol markedly reduces the freezing point of water. It is used primarily as an antifreeze and in the manufacture of polyester fiber and film, as heat-transfer fluid, dehydrating agent for natural gas. (2) Clear, colorless liquid used to depress the freezing point of water for use as a secondary coolant.

Ethylene Oxide: A colorless, flammable, and liquefied gas with a sweet odor. It is primarily used as a chemical intermediate for ethylene glycol and other chemicals such as nonionic surfactants, glycol ethers, ethanolamines, triethylene glycol, and diethylene glycol. It is used as a sterilant and fumigant in the health product and medical fields.

Ethyl Fluid: Gasoline antiknock compound.

Ethyl Tertiary Butyl Ether: (1) A colorless, flammable, oxygenated hydrocarbon blend stock formed by the catalytic etherification of isobutylene with ethanol. (2) An oxygenate blend stock formed by the catalytic etherification of isobutylene with ethanol.

ETP (BP): Engineering technical standards.

EUE or EU: See *External upset*.

Euler Method (Seismic): A profile or map-based depth estimation method based on a concept that magnetic fields of structures are homogeneous functions of depth and location. This is used to satisfy Euler's equation.

EUR: Expected ultimate recovery from a field.

Eutectic (Brine): A mixture of substances having a minimum solidification/melting point.

Eutrophication: (1) Usually, the limiting factor on how many living organisms can grow in a body of water is the supply of nutrient elements such as nitrogen and phosphorus. If these are supplied in overabundance (e.g., by pouring fertilizer into the lake), plants and bacteria can multiply to such an extent that the oxygen consumed in their decomposition can exhaust the oxygen available in the lake, causing a loss of species that like oxygen and the multiplication of anaerobic bacteria that generate nasty chemicals like hydrogen sulfide. This process, as well as the more stately natural accumulation of nutrients over time leading to a more complex and populous community of living things in the lake, is called

eutrophication. (2) The increase in the nutrient levels of a lake or other body of water; this usually causes an increase in the growth of aquatic animal and plant life.

Evaporative Cooling: Sensible cooling obtained by latent heat exchange from water sprays or jets of water.

Evaporator: Part of a refrigerating system in which the refrigerant is evaporated to absorb heat from the contacting heat source.

Evaporite: A formation formed by the evaporation of water from shallow seas. Very low permeability.

Event (Risk): Occurrence of a particular set of circumstances.

Evergreen Clause: A contract clause that extends the contract beyond the initial term, until one of the parties gives a required notice of termination.

EVXT-DB (Subsea): Enhanced vertical tree, dual bore.

EVXT-SB (Subsea): Enhanced vertical tree, single bore.

EVXT™ (Subsea): Enhanced vertical tree.

Excess Capacity: A pipeline that is operating at a point below maximum capacity. If a pipeline has excess capacity, it can receive additional gas.

Excess Cement: The amount of cement over that required to cement the zone. Usually between 30% and 100% depending on hole diameter unknowns and contamination risk.

Exclusive Economic Zone: An area contiguous to the territorial sea of the United States, the Commonwealth of Puerto Rico, the Commonwealth of Northern Mariana Islands, and the US overseas territories and possessions and those extending 200 nautical miles from the coastline.

Exergy Analysis: The evaluation of a thermodynamic process' irreversibility and inefficiency. Exergy analysis is a fundamental design mechanism to increase efficiency and reduce costs.

Exfoliation Corrosion: Localized and subsurface corrosion in zones often parallel to the surface that results in leaving thin layers of uncorroded metal resembling the pages of a book.

Exhaust Air: Air discharged from a space to the outdoors as differentiated from air transferred from one space to an adjacent one.

Exhaust Fan: Fan used to withdraw air from a space by suction.

EXHT™ (Subsea): Enhanced horizontal tree.

Exothermic: Chemical reactions that give off heat.

Expandable Casing: Well construction tubulars run like conventional casing but mechanically enlarged downhole before the cement is set.

Expandable Completions: Wellbore tubulars run like conventional completions but mechanically enlarged downhole once in place. Can include combinations of sand screens, blank pipe, and annular isolation seals used in lieu of gravel packs.

Expandable Hanger: A combination hanger and packer run like conventional hangers for drilling liners and well completions but permanently mechanically expanded once in the well.

Expandables: A class of pipe that can be expanded for cladding corroded or worn casing, saving room in a completion, casing open hole, sealing-off perforations, etc.
Expander: Thermodynamic machine that obtains work from the pressure energy contained in a gaseous fluid: the pressure reduction in the gas flow generates work that can be used to make other machines run. It is also called expansion turbine.
Expanding Cement: Cement with additives that promote volumetric cement expansion.
Expansion Joint: A device in a length of pipe that allows some pipe length expansion or contraction.
Expansion Tank: Partially filled tank, operating at atmospheric pressure, at the top of a water system for the accommodation of volume expansion and due to the contraction of water.
Expectancy: Remaining life.
Expected Value (Risk): The weighted average using probabilities as weights. For decisions involving uncertainty, the concept of expected value provides a rational means for selecting the best course of action and for forecasting portfolio-level performance.
Expendable Gun (Perforating): A gun made up of perforating charges linked together with wire or clips. The debris is not recovered on the wire line run.
Experiment: A controlled environment for the application of common sense. Having observed something interesting in the world of chemistry, we make an educated guess as to what is happening (a "theory"); then say "if this explanation is true, we should see such-and-such an effect if we do such-and-such." Actually doing such and such and seeing what happens is called "doing an experiment."
Exploitation: Development of a producing reservoir.
Exploration: (1) A general term referring to all efforts made in the search for new deposits of oil and gas. (2) The process of searching for minerals preliminary to development. Exploration activities include (a) geophysical surveys, (b) drilling to locate an oil or gas reservoir, and (c) the drilling of additional wells after a discovery to delineate a reservoir. It enables the lessee to determine whether to proceed with development and production.
Exploration Drilling: Drilling carried out to determine whether hydrocarbons are present in a particular area or structure.
Exploration License: A license to explore for oil or gas in a particular area issued to a company by the governing state.
Exploration Phase: (1) The phase of operations in which a company searches for oil or gas by carrying out detailed geological and geophysical surveys, followed up where appropriate by exploratory drilling in the most promising places. (2) The phase of operations that covers the search for oil or gas by carrying out detailed geological and geophysical surveys followed up where appropriate by exploratory drilling.

E

Exploration Rig: A structure used to carry the equipment needed for exploratory drilling. See *Semisubmersible rig.*

Exploration Well: (1) Drilling carried out to determine whether hydrocarbons are present in a particular area or structure. Also known as a "wildcat well." (2) A wildcat or well drilled in a new area with unknown producing potential. (3) A well into an area where petroleum has not been previously found or one targeted for formations above or below known reservoirs. (4) A well that is not a development well, a service well, or a stratigraphic test well. Wells drilled to find the limits of an oil-bearing formation, often referred to as a pool, only partly developed.

Explosimeter: An instrument used to detect explosive atmospheres. When the lower explosive limit of an atmosphere is exceeded, an alarm signal on the instrument is activated. Also called a combustible gas detector.

Explosion: The sudden release or creation of pressure and generation of high temperature as a result of a rapid change in chemical state (usually burning) or a mechanical failure.

Explosion Proof: Term referring to the construction characteristics of a piece of equipment that will not allow sparks or high temperatures to ignite an explosive mixture of air and fuel.

Explosive Cutter: A pipe cutoff tool composed of linear shaped charge that is designed to sever pipe. Works on the same principle as a perforating charge.

Explosive Decompression: A rapid reduction in pressure that may cause trapped gas to try to break out of rubber/elastomer seals and ruin the seals. Common at the surface but uncommon downhole.

Explosive Fracturing: One of the several techniques used to break the rock in the near-well area. It was an early stimulation method. Fractures formed in this method are short. Although still used, its best application is in perf breakdown and overcoming some near-well damage.

Explosive Limits: The low and high range (wt%) of a combustible gas mixed in air that can be ignited at ambient pressure and temperature.

Exponential Decline: Constant percent decline of production rate over time.

Export Credit Agencies: Government agencies whose mission is to facilitate the export sale of goods and services by providing credits that are more attractive than those available commercially and by providing security for credit and political risk that may not be available at an economic cost from private finance sources. ECAs of the United States, Europe, and Japan have been consistent financing sources for LNG projects and include Export–Import Banks of the United States (US ExIm) and Japan Bank for International Cooperation (JBIC), Britain's Export Credit Guarantee Department (ECGD), Germany's Hermes, France's Coface, and Italy's Sace. See *Multilateral institutions.*

Exports: Shipments of goods from within the 50 states and the District of Columbia to US possessions and territories or to foreign countries.

Exposed Guns: A perforating gun with exposed charge capsules.

Exposure Control Plan: A written plan to control workplace hazards from blood-borne pathogens.
Ex Ship: Refers to the delivery basis for most traditional long-term LNG contracts. Agreed price includes cost of freight and insurance for transporting the LNG by tanker to buyers' facilities. Usually contrasted with free on board (FOB).
Ex Ship Contract: In an LNG ex ship contract, ownership of the LNG transfers to the buyer as the LNG is unloaded at the receiving terminal, and payment is due at that time. See *Cost, insurance, and freight contract* and *Free on board contract*.
Extended Reach Well: A well deviated above the pay to reach further from the drill site or further into the pay formation to expose the contact area with the pay zone.
Extension Well: A well drilled on the edge of the existing field that may extend the known area of the field.
External Cage Choke: A choke capable of handling high solid content flow. The external sleeve is moved over a perforated hub with high erosion resistance properties.
External Casing Packer: A rubber bladder over a section of casing that is inflated, usually with cement, to give an annular seal in open hole sections. Frequently used with liners and set at intervals along the open hole.
External Cutter: A mechanical, chemical, or explosive device that is lowered over a pipe to cut from the outside.
External Filter Cake: Filtration control established on the surface of the wellbore by particles large enough to bridge on the entry of the pores.
External Phase: The outside or continuous phase of an emulsion.
External Upset: A pipe connection with a thicker connection body than the pipe body. In an EUE, the thickness is offset to the outside diameter.
Extract, Extract Oil: In solvent refining, the less desirable portion of the oil under process, which is dissolved in and removed by the selective solvent used.
Extraction Loss: (1) The reduction in volume of wet natural gas due to the removal of natural gas liquids, hydrogen sulfide, carbon dioxide, water vapor, and other impurities from the natural gas stream. Also called "shrinkage." (2) The reduction in volume of natural gas due to the removal of natural gas liquid constituents such as ethane, propane, and butane at natural gas processing plants.
Extraction Loss (Produced Fluids): Loss of volume due to removal of gases or liquids during processing.
Extraction Plant: A facility for removal of liquids from gas.
Extractive Distillation: In the distillation process, the separation of different components of mixtures that have similar vapor pressures by flowing a solvent that is selective for some of the components in the feed down the distillation column as the operation proceeds. By this means, the less soluble component passes overhead, while the soluble component is scrubbed from

the vapors. The solvent with the dissolved component is deposited in the bottom of the column and withdrawn for separation.

Extreme Overbalance Perforating: A method of applying a very high pressure surge to the formation at the instant of perforating. Usually in excess of 1.4 psi/ft. Designed to overcome frac initiation pressure and break down each perf with a very short (<1 m) frac.

Extreme Pressure Additive: A chemical compound imparting extreme pressure characteristics to a lubricant with the objective of reducing wear under conditions where rubbing or sliding accompanies high contact pressures, as in heavily loaded gears, particularly of the hypoid type.

Extrusion Gap: Radial gap between the maximum rated casing inside diameter and the minimum outside diameter immediately adjacent to the packing element.

Extrusive Igneous Rock: A description of rock resulting from a magma breached to surface and exposed to atmospheric conditions during cooling.

EZSV™: A drillable bridge plug.

F

F: See *Fahrenheit degrees*.
Fabric Filter: Filter having a textile-based filter medium.
Face and Bypass Damper: A dual damper arrangement at the inlet of a heating or cooling coil that either acts to direct the flow of air through the heating or cooling coil or acts to divert the air around the coil by the way of a bypass air channel or duct. Usually controlled by a damper actuator that is positioned by a temperature controller.
Face Cleat (Coal): A longitudinal fracture in coal.
Face Seal: Allowing a flat, usually polished, face to deform an elastomer and create a seal.
Facies: The set of all characteristics of a sedimentary rock that defines its particular environment and distinguishes it from other facies.
Facultative (Bacteria): (1) Bacteria that can survive either with or without oxygen. (2) Bacteria that can use either molecular (dissolved) oxygen or oxygen obtained from food materials such as sulfate or nitrate ions. In other words, facultative bacteria can live under aerobic or anaerobic conditions. (3) Primitive organisms, mostly plants and generally those free of pigment, which reproduce by dividing into one, two, or three planes. They are single celled, do not require light for their life processes, and can be grown in special cultures out of their native environment.
Facultative Pond: The most common type of pond in current use. The upper portion (supernatant) is aerobic, while the bottom layer is anaerobic. Algae supply most of the oxygen to the supernatant.
Fahrenheit Degrees: A temperature scale according to which water boils at 212° and freezes at 32°. Convert to degree Celsius by the following formula: (F − 32)/1.8 = C.
Failure: When the designed function can no longer be met.
Fairway: The best part of a reservoir. Commonly used in coal pays.
Fall-Off Test: A multifunctional test that can be used to determine fracturing pressure or if the well is fractured.
False Set: An abnormal early thickening of cement that does not affect the length of time that the cement can be pumped.
Fan Coil Unit: As the name implies, this unit is composed of a fan and a heat exchange coil mounted within a common cabinet. Fan coil units can be used for both heating and cooling service.
Fanning Equation (or Friction Factor): $fF = (db/2\rho V^2)\ (\Delta P/L)$, where ρ = density (ppg), V = average fluid velocity (ft/s), and ΔP is pressure loss over length L (ft).

F

Fann Viscometer: A common viscometer for oil-field fluids.
Farmer's Oil: An older term indicating the mineral owners royalty-based "share" of the oil. This was from a time when natural gas had no value.
Farm-In: (1) An outside party paying a concession owner all or a percentage of the drilling costs of a well in order to obtain a working interest in the land or well. (2) When a company acquires an interest in a block by taking over all or part of the financial commitment for drilling an exploration well.
Farm-Out: (1) A concession owner selling a percentage of a lease to an outside operator for drilling a well. (2) Transfer of all or part of the operating rights from a working interest owner to an assignee who assumes all or some of the burden of development in return for an interest in the property. The assignor usually retains an overriding royalty but may retain any type of interest.
Farm-Out Agreement: (1) Farm-out agreement is an agreement to assign an interest in acreage in return for drilling or testing operation on that acreage. (2) An agreement between oil companies whereby the owner of a lease who is not interested in drilling at the time agrees to assign the lease or a portion of it to another company that will earn a share of the production by undertaking exploration.
Fast Gages: Gages with a high sampling rate.
Fast Line (Drilling): End of a braided drilling line affixed to the draw works.
Fast Taper: A steep slope.
Fatigue: A metal failure based on weakening by flexing or cycling. The material often work hardens.
Fatigue Strength: The maximum stress that can be sustained for a specified number of cycles without failure.
Fault: (1) Is a fracture in the Earth's crust accompanied by a shifting of one side of the fracture with respect to the other side; the point at which a geological strata "breaks off" or is sheared off by dropping of a section of the strata by settling. (2) Where rock splits or ruptures with associated movement occuring on either side.
Fault Plane: The plane or direction along which fault movement has occurred.
Fault Trap: (1) Is formed by rock movement along a fault line. (2) A formation that contains oil or gas that is held in place by a displaced, non-permeable rock mass.
FBHP: Flowing bottom hole pressure.
FBP: Formation breakdown pressure. The pressure at which the fracture initiates.
FC: See *Fluorocarbon*.
FCD: Fracture capacity. A comparison of the conductivity of the fracture to the capacity of the formation.
FCP: See *Final circulating pressure*.
FCP: See *Fracture closure pressure*.
FCS (Fracturing): Fracture closure stress.
FCTA (Brine): The first crystal to appear.
FCV: Formation control valve.

FDC: Formation density log.
FDCNL: Formation density compensated neutron log.
FDP: Field development plan.
FE: Facility engineer.
$FeCO_3$: Iron carbonate scale. Also see *Iron scales*.
Federal Energy Regulatory Commission: (1) The chief energy regulatory body of the US government and therefore responsible for regulating LNG facilities in the United States. The FERC is considered an independent regulatory agency responsible primarily to congress but is housed in the US Department of Energy. (2) The federal agency that regulates interstate gas pipelines and interstate gas sales under the Natural Gas Act. The FERC is considered an independent regulatory agency responsible primarily to congress, but it is housed in the Department of Energy.
FEED: See *Front-end engineering and design contract*.
Feeder: Circuit conductors between the service and the final branch circuit over current device.
Feed Gas: See *Feedstock gas*.
Feed In: Influx into the wellbore.
Feed Preparation Unit: A fractionation unit in a refinery, the primary purpose of which is to prepare one or more close-boiling point cuts to be used as feed for subsequent processing.
Feedstock: Crude oil, natural gas liquids, natural gas, or other materials used as raw ingredients for making gasoline, other refined products, or chemicals.
Feedstock Gas (Feed Gas): (1) Dry natural gas used as raw material for LNG, petrochemical, and gas-to-liquids (GTL) plants. (2) Gas received in the liquefaction plant for processing and transformation into LNG.
Fee Land (Contract): Land where mineral and surface rights are controlled. Usually private lands, rather than public or government.
Fee Simple Owner: The landowner of a tract of land that holds the right to use, occupy, and enjoy the surface of the land, and the air space above it (surface rights), plus all rights to minerals beneath it (mineral rights).
Feet of Pay: The thickness of a pay zone or formation, usually the gross (total) thickness.
Feldspar: A silicate mineral, often modified and sometimes part of the movable particles in a formation.
Female Connection: A coupling with threads on the inside.
FeOH: See *Iron hydroxide*.
FEPM: Fluoroelastomers (Aflas™).
FERC: See *Federal Energy Regulatory Commission*.
FERC Blanket Certificate: Authorization from FERC to the interstate pipeline to offer a service to the public without individual certification or approval filings.
FERC Order 497—A 1988 FERC Order: Having to do with the activities of marketing affiliates of interstate pipeline companies. Among other things, it establishes guidelines for sharing of certain insider information.

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It requires disclosure of certain information regarding shared personnel and affiliate transactions.

FERC Order 636: A 1992 order that unbundled US pipeline services, requiring pipelines to cease their merchant function and instead become solely a transporter of gas.

FERC Order 637—2000 FERC Order: That required changes in FERC regulation of interstate pipelines, changes designed to encourage greater comparability between primary pipeline capacity and the secondary capacity (capacity release) market.

Fermentation: The process in which an organic substance is converted into another organic substance and carbon dioxide to generate energy by a (micro)organism in the absence of oxygen. "Fermentation" comes from the Latin word for yeast, a kind of single-celled fungus. The most common fermentation reaction is the one by which glucose is converted into ethanol and carbon dioxide. This series of reactions is made use of by humans when they use yeasts to make alcoholic drinks. It is easy to go wrong and make some different kinds of alcohol (e.g., butanol), depending on the microorganisms involved, which is one reason you occasionally hear of deaths from drinking illicitly produced alcohol.

Ferric Iron: Valence state +3 iron in solution. A very common catalyst in oil-field emulsion and sludge formation. Precipitates at iron hydroxide when the pH exceeds 1.8–2.2 (depending on sour conditions).

Ferrite: Body-centered cubic crystalline phases common to iron-based alloys.

Ferrous Iron: Valence state +2 iron in solution. In oil-field operations, most solution iron is ferrous until oxygen is encountered. Precipitates at iron hydroxide when the pH exceeds 7 or when oxidized to ferric by contact with oxygen.

FeSx: One of the several forms of iron sulfide.

FF: Formation factor.

FFI (Logging): Proportion of moveable fluids occupying the effective porosity.

FFKM: Perfluoroelastomers (Kalrez™, Chemraz™, etc.).

FFM: Full field model.

Fg: Fracture gradient.

FGLR: Formation GLR.

FGOR: Flowing gas/oil ratio.

Fiber Cement: Cement with small hairlike fibers that build strength or help control fluid loss.

Fiber Optics: A technology that uses light as a digital information carrier. Fiber-optic cables are direct replacement for conventional cables and wire pairs. They occupy far less physical space and are immune to electrical interference.

Field: (1) One or more reservoirs grouped by or related to the same general geologic structural feature or stratigraphic condition. (2) An area consisting of a single reservoir or multiple reservoirs all grouped on or related to the same individual geological structural feature and/or stratigraphic condition.

There may be two or more reservoirs in a field that are separated vertically by intervening impervious strata, or laterally by local geologic barriers, or by both. (3) A geographical area under which a producing or prospective oil and/or natural gas reservoir lies. (4) The surface area above one or more underground petroleum pools sharing the same or related infrastructure. (5) The geographical area encompassing a group of one or more underground petroleum pools sharing the same or related infrastructure.

Field Butanes: A raw mix of natural gas liquids; the product of gas processing plants in the field. Raw mix streams are sent to fractionating plants where the various components—butane, propane, hexane, and others—are separated. Some refineries are capable of using field butanes at 10%–15% of charge stock.

Field Capacity: The percentage of water remaining in the soil 2 or 3 days after gravity drainage has ceased from saturated conditions.

Field Gathering Systems: Consist of pipelines that move oil from the wellhead to storage tanks and treatment facilities where the oil is measured and tested.

Field Natural Gas: Natural gas extracted from a production well prior to entering the first stage of processing, such as dehydration.

Field Potential: (1) The producing capacity of a field during a 24 h period. (2) Estimate of the producing capacity of a field during a 24 h period.

Field Production: Represents crude oil production on leases, natural gas liquids production at natural gas processing plants, new supply of other hydrocarbons/oxygenates and motor gasoline blending components, and fuel ethanol blended into finished motor gasoline.

Field Rules: The spacing and production rules in a field or unit.

Field Weld: A weld repair made in the field. Usually derates the equipment pressure or tensile rating.

Filamentous: A situation in which organisms grow in a threadlike fashion, intertwining with one another to form a mat-like structure.

Filamentous Bacteria: Organisms that grow in a thread or filamentous form. Common types are Thiothrix and actinomycetes. A common cause of sludge bulking in the activated sludge process.

Filiform Corrosion: Corrosion occurring under a coating in a pattern of filaments. May resemble threads.

Filler: An inert powder that can be incorporated in a bitumen enamel in order to improve one or more of its useful properties without changing its quality.

Film Strength: (1) The property of a lubricant that enables it to maintain an unbroken film over lubricated surfaces under operating conditions, thus avoiding scuffing or scoring of bearing surfaces. (2) The ability of a film of lubricant to resist rupture due to load, speed, and temperature (also called lubricity).

Filter: An apparatus for separating solid or liquid particles from a gas stream in which they are suspended.

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Filter Cake: The layer of solids stranded on the face of permeable formations by liquids driven into the rock by pressure differential toward the formation. When sized correctly, the filter cake may completely stop losses.
Filter Cake Lift-Off: The act of lifting off part of the mud filter cake, at the most permeable sections of the rock, in response to flow produced by draw down.
Filter Cake Lift-Off Pressure (Drilling): The inward differential pressure difference that will result in part of the filter cake being removed from the face of the formation (usually over the most permeable and higher-pressured sections).
Filter Media: The material used to make up a filter bed. Common filter media are DE, sand, various fibers, etc.
Filter Press: (1) Usually at DE filter. (2) In petroleum refining, the equipment used to separate wax and oil in paraffin-wax distillates. It consists of a series of canvas-covered plates separated by narrow iron rings. The distillate is run into a narrow bore extending the length of the press and is forced into the spaces between the plates formed by the rings. The oil penetrates the canvas covering the plates and drips into a trough beneath the press, the wax remaining in the plates. (3) A mechanically operated device for separating solids from water.
Filtrate: The liquid that leaks off into the formation during fluid loss.
Filtrate Reducers: Materials that reduce the fluid loss from a wellbore fluid. May include bentonite clays, lignite.
Filtration Level: The general statement of the largest size particles in a fluid after passing through a filter.
Final Circulating Pressure: Drill pipe pressure required to circulate at the selected kill rate.
Final Set: A reference to one of many expectations when cement is sufficiently set to bear some type or level of weight.
Final Strength: The strength of cement when the strength development with time curve ceases to change significantly.
Finding and Development Costs: Capital costs from acquisition, exploration, drilling, and completion costs of proved reserves.
Fines Control: Any process designed to minimize movement of otherwise mobile fines, typical size <44 μm.
Fines Migration: Movement of small particles (usually <5 μm) through the rock pores.
Finger Board (Drilling): Steel fingers mounted to the derrick into which the derrickman stores the pipe that is standing in the derrick.
Fingering: Movement of one fluid through another.
Finned-Tube Radiator: Wall-mounted heater with numerous fins bonded to a tube, usually carrying steam or hot water.
FIP: Free in pipe. LPG is sometimes sold on this basis.
Firebox: Combustion chamber in a furnace.
Fire Damper: Device that interrupts airflow automatically through part of an air system to restrict passage of flame. Installed in fire-rated wall or floor

and closes automatically in the event of fire to maintain the integrity of the fire-rated separation.

Fire Flood: A tertiary recovery method involving injection of air into the formation and igniting the oil. Under the right conditions, the heat produced from combustion of the heavy ends that are trapped on the sand grains lowers the oil viscosity and liberates light ends.

Fire Point: The lowest temperature at which, under standard test conditions (ASTM D92), a petroleum product vaporizes rapidly enough to form above its surface an air–vapor mixture that burns continuously when ignited by a small flame. Generally applies for all petroleum products except fuel oils and those having an open-cup flash point below 175°F.

Fire Stat: A temperature sensing device that is either mounted within a duct or within an air handling unit and that is used to sense a high-temperature condition. Typically, a fire stat will be interlocked with an alarm or an air handling system, such that a shutdown or alarm is initiated if a high temperature is sensed.

Firm Energy (Contract): Energy sales guaranteed to be delivered under terms defined by contract.

Firm Transportation: A fixed obligation where the transporter is obligated to provide a specified capacity without interruption.

Fischer Assay: An assay method for organics in rock by pyrolysis (burning).

Fish: A lost piece of equipment in the well.

Fisheries Legacy Trust Company: Formed in 2007 by Oil & Gas UK, Scottish Fishermen's Federation (SFF), and National Federation of Fishermen's Organisations (NFFO) to enhance the safety of fishermen by ensuring the provision in perpetuity of information relating to oil and gas seabed structures and equipment in UK waters.

Fisheyes: Lumps of undispersed polymer in suspension in the pill.

Fish Hook: An upward turning horizontal well—usually over 90°.

Fishing: Retrieving objects from the borehole, such as a broken drill string, or tools.

Fishing Magnet: A magnet, usually run on wire line, used to recover lighter metal components from the well.

Fishing Neck: A piece of equipment on most downhole tools that is designed for simple, nonrotating attachment when retrieving.

Fishing Tools: The tools that can capture a lost item (a fish) in a well.

Fishtail Bit: A drag bit with no moving parts, rotated like a conventional metal drilling bit.

Fissile (Rock): A fissile rock tends to break along a plane or planes that are roughly parallel to the bedding planes.

FIT (Fracturing): Frac isolation tools.

FIT (Operations): See *Formation integrity test*.

FIV: Formation isolation valve. A downhole valve that is operated by pressure cycling or other remote method.

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Five-Spot Pattern: A well placement pattern that looks like the 5-spot side on a dice cube.
Fixed: The addition of chemicals that prevent the variables from changing their form or concentration until the laboratory analyses can be performed.
Fixed Choke: A nonadjustable choke that uses a flow bean for regulation.
Fixed Film Process: Biological process where the microbes are attached to medium such as rock or plastic.
Fixed Price Contract: Contract in which a specific price is agreed for commodities.
Fixed Roof Tanks: The refinery tanks used to store diesel, kerosene, catalytic cracker feedstock, and residual fuel oil.
Fixed Spray Nozzle: Cone-shaped spray nozzle used to distribute wastewater over the filter medial similar to a lawn sprinkling system. A deflector or steel ball is mounted within the cone to spread the flow of wastewater through the cone, causing a spraying action. See also *Distributor.*
FKM: Fluoroelastomers (Viton™, Fluorel™, etc.).
Flag: Marking the pipe or wire line with a paint stripe.
Flame Polish: Insertion of sharp-edged glass into a flame and rotating it until the glass melts slightly and smoothes the edge. Routinely done to glassware in the laboratory.
Flame Safeguard Control: System for sensing the presence or absence of flame and for indicating, alarming, or initiating control action.
Flammability Limit: The flammability limit of a fuel is the concentration of fuel (by volume) that must be present in air for an ignition to occur when an ignition source is present.
Flammable Liquid: (1) Any liquid having a flash point below 37.8°C, except any liquid mixture having one or more components with a flash point at or above the upper limit that makes up 99% or more of the total volume of the mixture. (2) Liquid with a flash point below 100°F. At that temperature, vapors from the substance can be ignited by a flame, spark, or other sources of ignition.
Flange: A common, high-pressure wellhead connection, using bolt attached flange plates and metal-to-metal seals.
Flanged Up: Completed.
Flapper Valve: A one-way, flow-actuated valve common in safety valves, coiled tubing, and fluid loss devices.
Flare: (1) A burner on a remote line used for disposal of hydrocarbons during cleanup, for emergency shut downs, and for disposal of small-volume waste streams of mixed gases that cannot easily or safely be separated. (2) A flame used to burn off unwanted natural gas; a "flare stack" is the steel structure on a processing facility from which gas is flared. (3) An open flame used to burn off unwanted natural gas. (4) To burn unwanted gas through a pipe or stack. (Under conservation laws, the flaring of natural gas is illegal.) (5) The flame from a flare; the pipe or the stack itself.

Flared: Gas disposed off by burning in flares usually at the production sites or at gas processing plants.
Flare Stack: The steel structure on an offshore rig or at a processing facility from which gas is flared.
Flaring: Flaring is the burning of natural gas that cannot be processed or sold. Flaring disposes off gas, and it releases emissions into the atmosphere. Today, it is an important safety measure at natural gas facilities.
Flaring/Venting: The controlled burning (flare) or release (vent) of natural gas that can't be processed for sale or use because of technical or economic reasons.
Flashing: Vaporization of water or light ends as pressure is released during production or processing.
Flash Liberation: A sudden pressure drop that causes hydrocarbon light ends to go from a liquid to a gas.
Flash (Pipe): The weld seam on or in a welded pipe.
Flash Point: (1) An ignition temperature (given in °F) that liquid will put off enough vapors to be ignited. (2) The temperature under very specific conditions at which a combustible liquid will give off sufficient vapor to form a flammable mixture with air in a standardized vessel. Related to the volatility of the liquid. (3) The lowest temperature under closely specified conditions at which a combustible material will give off sufficient vapor to form a flammable mixture with air in a standardized vessel. Flash point tests are used to assess the volatility of petroleum products. (4) The minimum temperature (corrected to a barometric pressure of 760 mm Hg) at which a liquid gives off a vapor in sufficient concentration to ignite under specified conditions of test. (5) The lowest temperature at which vapors from an oil will ignite momentarily on application of a flame under standard test conditions. In the range of 90°F–150°F, flash point is significant in determining safety conditions for the storage, handling, and use of petroleum products.
Flash Set: A rapid, usually unplanned, thickening of cement.
Flash Tank: Container where the separation of gas and liquid phases is achieved after pressure reduction in fluid flow. Both phases appear when pressure is decreased as a consequence of the Joule–Thomson effect.
Flash Vapors: Gas vapors released from a stream of natural gas liquids as a result of an increase in temperature or a decrease in pressure.
FLC (Completions): Fluid loss control.
FLC (Operations): Field lifting cost.
FL (Drilling/Completions): See *Fluid loss*.
Flexible-Fuel Vehicle: A vehicle with the ability to operate on alternative fuels (such as M85 or E85), 100% traditional fuels, or a mixture of alternative fuel and traditional fuels.
Flexicoking: A thermal cracking process that converts heavy hydrocarbons such as crude oil, tar sands bitumen, and distillation residues into light hydrocarbons. Feedstocks can be any pumpable hydrocarbons including those containing high concentrations of sulfur and metals.

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Flexing: Pressuring and depressuring the tubing (ballooning) to remove plugs or knock scale and other debris loose from the tubing wall.
Flights: Scrapers, made from redwood or plastic in rectangular tanks and metal in circular tanks, which move the settled sludge to the hopper. In rectangular tanks, these same scrapers return on the surface of the tank and move the accumulated scum to its collection point.
Flint: A variety of chert.
Floatables: Litter, debris, and other larger materials that enter stormwater runoff and are carried by flow to become water pollutants.
Float Collar: A short piece of casing run one to two joints above the end of casing. The collar contains a backpressure or check valve that stops cement from reentering the well after displacement into the annulus. It is useful to prevent channels in the cement until the cement is set.
Float (Control): A device used to measure the elevation of the surface of water. The float rests on the surface of the water and rises or falls with it. The elevation of the water surface is measured by a rod, chain, rope, or tape attached to the float.
Floating Offshore Drilling Rig: A type of mobile offshore drilling unit that floats and is not in contact with the seafloor (except with anchors) when it is in the drilling mode. Floating units include barge rigs, drill ships, and semi-submersibles.
Floating Production, Drilling, Storage, and Offloading System: For a description, refer to the FPSO, add the capability to drill, complete, and work over wells from this facility. Generally this term applies to systems receiving the production stream from several subsea completed wells and where the unit is capable of intervention on (or drilling of) one well while production continues to flow from the others. The group has patented a concept to accommodate dry trees on board the FPDSO. See also *Tension leg deck*.
Floating Production, Storage, and Offloading Vessel: (1) A floating tank system designed to receive oil or gas produced from a nearby platform, process it, and store it until the oil or gas can be offloaded or sent through a pipeline. They are typically used in deeper waters and often in conjunction with subsea facilities. (2) A floating facility installed above or close to an offshore oil and gas field to receive, process, store, and export hydrocarbons. It consists of a floater (a newly built or converted tanker) permanently moored on site. The cargo capacity of the vessel is used as buffer storage for the oil produced. The process facilities (topsides) and accommodation are installed on the floater. The mooring configuration may be of the spread mooring type or a single-point mooring system, generally a turret. The high-pressure mixture of produced fluids is delivered to the process facilities mounted on the deck of the tanker, where the oil, gas, and water are separated. The water is discharged overboard after treatment to eliminate hydrocarbons. The stabilized crude oil is stored in the cargo tanks and subsequently transferred into shuttle tankers either via a buoy or by laying in tandem to the FPSO. The gas is used for enhancing the liquid production through gas lift and

for energy production onboard the vessel. The remainder is either flared, or compressed and transported by pipeline to shore, or reinjected into the reservoir. (3) This operation, based on a tanker, is used as a semipermanent storage and loading facility for crude oil production in offshore fields. (4) An alternative to pipelines. (4) A floating offshore oil production vessel that has facilities for producing, treating, and sorting oil from several producing wells and that puts (offloads) the treated oil into a tanker ship for transport to refineries on land. Some floating production and system offloaders are also capable of drilling; in this case, they are termed floating production, drilling, storage, and system offloaders (FPDSOs).

Floating Roof: Special type of steel-tank roof that floats upon the surface of the oil in the tank, thereby eliminating tank breathing and reducing evaporation losses.

Floating Roof Tank: Is a storage tank with a flat roof that floats on the surface of the oil thus reducing evaporation to the minimum. The roof rests on a series of pontoons whose buoyancy supports the roof proper, a floater. This is used for storage of high-volatile components such as gasoline, naphtha, and benzene.

Floating Storage and Regasification Unit: A floating vessel that has the capability to be permanently moored at a site where it receives LNG from carriers and stores and re-gasifies the LNG at a rate required by natural gas users.

Float Shoe: Same function as a float collar but run on the end of the casing.

Float Valve: The primary, bottom hole valve in the float collar or shoe that allows the casing to self-fill while running and allows the cement to pass into the annulus but helps prevent cementing U-tubing after the job. Drillable and subject to erosion wear.

Floc: Groups or "clumps" of bacteria that have come together and formed a cluster. Found in aeration tanks and secondary clarifiers.

Flocculants: Materials used to increase viscosity. They cause colloidal particles to group into bunches or flocs.

Flocculated: An action resulting in the gathering of fine particles to form larger particles.

Flocculation: (1) The process of gathering small, colloidal particles together into larger, denser, and more readily settleable clusters. (2) Attraction, gelation, and dropout of suspended particles from a liquid.

Floc Point: The temperature at which a flocculant collection of wax crystals first appears when a solution of Freon in oil is cooled under prescribed conditions.

Flood: Injection of gas or water into a reservoir to drive oil toward a producing well or set of wells.

Flood Plain: Reservoirs that occur along ancient rivers where the rivers overflowed. Deposits are mostly silt and mud.

Floorhand: A helper on the drilling floor.

FL (Operations): See *Flow line*.

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Flow: Very simply, a movement of a fluid.
Flow After Flow: A multipoint flow test measuring skin at each flow rate. When plotted, the intersection of the best fit line with the *y*-axis (skin) at zero flow rate yields the mechanical skin.
Flow-Assisted Corrosion: Corrosion that is accelerated by the effects of erosion removing the initial corrosion films.
Flow Assurance: A science field dealing with the prevention of scales, hydrates, asphaltene and paraffin deposits, and other problems that could stop flow of fluid from the subsurface, wellhead, or pipeline.
Flow Back: Flowing a well back after a treatment.
Flow Bean: A flow restriction common in downhole chokes, surface chokes, and some SSSVs.
Flow Control Valve: One that shuts automatically when the circulating pump stops, thereby preventing gravity circulation.
Flow Coupling: A thicker body piece of tubing above and sometimes below a tubing profile or other tool to control erosion by fluid flow.
Flow Cross: A four-way connection. In a wellhead, a flow cross connects the master valve and the swab valve with two, normally horizontal, connections to the wing valves.
Flow Divider (Screen): A device on the entrance to a screen to route the incoming flow more evenly across the face of the screen.
Flow Efficiency: Ideal drawdown/actual drawdown.
Flowing Pressure: The pressure at some datum (usually surface, FSP, or bottom hole, FBHP) measured while the well is flowing.
Flowing Well: (1) A well that flows to the surface by produced gas expansion and does not use any method of artificial lift. (2) A well capable of producing oil or gas by its own energy without the aid of a mechanical pump. Normally, a pump is put on the well after the pressure reduction inhibits the rate of production.
Flowline: (1) The flow connection from the wellhead to the separation facility, pipeline, or storage unit. (2) Pipeline carrying reservoir fluid on the seabed from wells to risers. (3) Pipe, usually buried, through which oil or gas travels from the well to a processing facility. (4) The pipe connection between the well and the separators or tank battery.
Flow Loop: A test loop of pipe in which flow characteristics are measured.
Flow Path: The subsurface course that fluids would follow as they move in a reservoir or between reservoirs.
Flow Profile: What the flow looks like across the cross section of the pipe.
Flow Recording: A record of a flow measurement past any selected point. Usually consists of time, velocity, and amount (in gallons) with maximum and minimum rates as well as the total amount over a given time period.
Flow Regime: Flow condition (e.g., mist, slug, churn) of a multiphase process stream.
Flow Test: A flow test designed to prove that hydrocarbon exists in the reservoir and will flow to surface. May also indicate productivity or other characteristics such as interference or boundaries.

Flow T or Tee: A three-way connection. In a wellhead, a flow cross connects the master valve and the swab valve with the wing valve.
Flow Tubes: Tubes with a diameter slightly larger than the braded wire line or slick line that are used in the "stuffing box" on a wire line intervention to isolate the well pressure and fluid from the atmosphere. They work in combination with oil or wire line grease injection to form a hydraulic seal.
Flow Wetted: Any piece of a tool or the well that is wetted by the produced fluid flow.
FLTC: See *Fisheries Legacy Trust Company*.
Flue: Passage through which flue gases pass from a combustion chamber to the outside atmosphere.
Fluid: Substances that are transported through a pipeline in liquid and/or gaseous phase.
Fluid Coking: A thermal cracking process utilizing the fluidized-solids technique to remove carbon (coke) for continuous conversion of heavy, low-grade oils into lighter products.
Fluid Conductivity: The constant of proportionality in the Darcy law relating the rate of flow of a fluid through a cross section of porous medium in response to a hydraulic gradient. Fluid conductivity is a function of the intrinsic permeability of a porous medium and the kinematic viscosity of the fluid that flows through it. Fluid conductivity has units of length per time (cm/s).
Fluid Contact: Depth of the contact point in a specific well between immiscible phases.
Fluid Density: The mass per volume density of a fluid.
Fluid Invasion: The distance outward from the wellbore to the leading edge of the lost fluids. Varies with the permeability of the zone.
Fluidize: Add sufficient fluid in an unconsolidated sand matrix to break cohesive bonds and lubricate grain by grain movement of sands.
Fluid Loss: The rate of loss of liquids to the formations from the fluid being circulated through the wellbore.
Fluid Loss Coefficient: A measurement of fluid loss expressed in $cc/min^{1/2}$.
Fluid Packed: Liquid filled.
Fluid Pound (or Rod Pound): A beam lift term where the pump is filled with gas from pump off or too fast of an operating speed (rod speed).
Fluid Pressure Gradient: A measurement in the well of the pressure vs. depth. Useful for spotting liquid levels, leaks, fluid entries, etc.
Fluid Saturation: The fractional or percent amount of pore space that a specific fluid occupies.
FLUORAZ: A high-performance elastomer for seal assemblies.
Fluorescence: If a substance absorbs light at one wavelength and reradiates it at another wavelength almost immediately, it is *fluorescent*; this is why many materials glow under ultraviolet light. If the substance keeps reradiating light over a period of seconds, minutes, or hours, it is called *phosphorescent*.

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Fluorocarbon: A seal with good resistance to aromatic fluids but susceptible to sour gas.
Fluoroscope: A device that uses a black light for identifying hydrocarbons on cuttings.
Flushed Zone: Part of the rock that has been flushed with a sweep fluid. The area may have little hydrocarbons remaining.
Flush Joint: A nonupset connection in most cases.
Flush Production: The early, higher-rate production that comes from the larger pores, fractures, and vugs that empty quickly. Delivers a small, high-rate flow every time the well is shut in (recharges) and is brought back on line.
Fly Ash: Ash from the burning of coal. Used as an extender in several cements and as a plug component.
Flying Leads (Subsea): Flexible hydraulic hoses connected to control systems in a subsea tree.
FMEA: Failure mode and effects analysis.
FMECA: Failure mode, effects, and criticality analysis.
FMI: Formation micro image, a common fracture detection tool.
FMJ (Control Line): Ferrule metal junction.
F/M Ratio: See *Food to microorganism ratio.*
FMWTR: See *Formation water.*
FN: Fishing neck.
F Nipple: A standard profile. Can accept a plug or other tools.
FO: Full opening.
Foam: A gas in liquid emulsion. Common as a low-density cleanout fluid or a frac fluid with reduced water content.
Foam Breaker: One of several materials that reduce the stability of the bubble skin in a foam and cause the foam to break.
Foam Cement: A cement slurry, foamed with between 40% and 60% nitrogen gas. Has a slurry density of about 7.5–10 lb/gal (0.9–1.2 g/cc).
Foaming: The occurrence of a frothy mixture of air and a petroleum product (lubricant, fuel oil) that can reduce the effectiveness of the product and cause sluggish hydraulic operation, air binding of oil pumps, and overflow of tanks or sumps.
FOB: See *Free on board.*
FOC: Field operations center.
Fog: A general term applied to a suspension of droplets in a gas. In meteorology, it refers to a suspension of water droplets resulting in the visibility of less than 1 km.
Fold: A bend-like disruption in rock strata such that the angle of the formation is significantly changed.
Food to Microorganism Ratio: A measure of the organic loading to an aeration tank.
Foot Wall: The side of the fault that protrudes underneath the upper formation.
Forced-Draft Burner: Burner that has a fan capable of supplying all necessary air for proper combustion with positive pressure in the firebox.

Forced-Draft Venting: When the burner fan provides the pressure required for the combustion gases to overcome the resistance in the boiler, breaching, and chimney. The boiler is pressurized.
Force Main: A pipe that carries wastewater under pressure from the discharge side of a pump to a point of gravity flow downstream.
Force Majeure: A term commonly used in contracts to describe an event or effect that cannot be reasonably controlled.
Formaldehyde: An older biocide, now rarely used.
Formate: One of several low-damage, low-toxicity, normally high-cost brine for special applications. May be one of several formation compounds.
Formation: Any distinct, mappable layer.
Formation Breakdown: Initiating a fracture in the formation.
Formation Competency: The breakdown (fracturing) pressure of a formation.
Formation Damage: (1) An obstruction to flow. Usually a reduction of permeability. (2) The reduction in permeability in reservoir rock due to the infiltration of drilling or treating fluids into the area adjacent to the wellbore.
Formation Evaluation: The analysis of formation character or properties, usually by remote logs.
Formation Gas/Oil Ratio: Quantity of oil dissolved in one stock tank barrel of oil at current reservoir pressure and temperature.
Formation Integrity: The ability to resist breakup. Often taken as the fracturing point.
Formation Integrity Test: A test of the fracture initiation pressure.
Formation Pressure: (1) The pressure of the fluid in the formation. The initial reservoir pressure is the pressure at discovery. (2) The pressure at the bottom of a well when it is shut in at the wellhead.
Formation Resistivity: A measurement of the electrical resistivity of a formation. The measurement will be significantly affected by the type of fluid and the salinity of water-based fluids within the pores of the rock.
Formation Sensitivity: The tendency of a formation to react with fluids, usually filtrates from injected fluids.
Formation Volume Factor: The number of barrels of reservoir oil that shrinks to one stock tank (surface) barrel after gas breakout and light end vaporization.
Formation Water: (1) The connate water. (2) Saltwater underlying gas and oil in the formation.
Formic Acid: An organic acid used in higher-temperature wells for shallow damage removal.
Forward Contract: A commitment to buy (long) or sell (short) an underlying asset at a specified date at a price (known as the exercise or forward price) specified at the origination of the contract.
Forward Haul: A natural gas transportation service that requires movement of gas from a point of receipt to a point of delivery such that the contractual direction of movement on the pipeline is in the same direction as the flow of the gas.

F

FoRxo Log: A focused resistivity log that uses a pad contact with the borehole wall.
Fossil: The silicate replaced replica of an animal or plant.
Fossil Energy: Energy derived from crude oil, natural gas, or coal.
Fossil Fuel: (1) Coal, natural gas, or oil. (2) Any naturally occurring organic fuel formed in the Earth's crust, such as petroleum, coal, or natural gas. (3) A fossil fuel is a fuel such as coal, oil, or natural gas that was formed through the decomposition of ancient plant and animal life. Fossil fuels are generally burnt to release the energy stored in the chemical bonds of the hydrocarbons. A side effect of this combustion is the release of gases such as carbon dioxide, which has been linked to global warming through the greenhouse effect. Fossil fuel reserves are also finite and some of them (particularly oil reserves) are likely to run out within our lifetime. (4) Is an energy source formed in the Earth's crust from decayed organic material. The common fossil fuels are petroleum, coal, and natural gas.
Fouling: Accumulation of deposits on a surface.
Four-Ball Method: Either of two lubricant test procedures—the four-ball wear method and the four-ball extreme pressure method. The test methods evaluate the antiwear properties of lubricants under different test conditions.
Four-Point Test: A flow test in which the flow rate is measured at four drawdowns to estimate how skin changes at each rate. Useful for identifying non-Darcy skin or turbulent skin.
FPC: See *Free point constant*.
FPDSO: See *Floating production, drilling, storage, and offloading system*.
FPH: Feet per hour.
FPIT: See *Free point indicator tool*.
FPP: See *Fracture propagation pressure*.
FPSO: See *Floating production, storage, and offloading.*
FPU: Floating production unit.
FPWD: Formation pressure while drilling.
FRA: Formation rate analyzer, a well performance test method.
Frac Ball: A technique for isolating multiple fracs using a short downhole settable ring or restriction and dropping a hard rubber ball between frac jobs. Two or more ring/ball sets can be used to stage frac a long zone.
Frac Fluid: The fluid used in a fracturing treatment, may include pre- and posttreatment fluids.
Fracing: The process of pumping fluids into a productive formation at high rates of injection to hydraulically break the rock. The "fractures" that are created in the rock act as flow channels for the oil and gas to the well.
Frac Plug: A flow-through plug set after pumping a frac (between stages) in a multi-fraced well and sealed with a ball dropped from surface as the next frac stage is started.
Fractional Distillation: Separation of the components of a liquid mixture by vaporizing it and collecting the fractions, which condense in different temperature ranges.

Fractionating Column: A tall tower, fitted with perforated trays, in which fractional distillation of crude oil or its products is carried out.
Fractionation: (1) The process for breaking natural gas liquids into component parts—methane, ethane, propane, butane, pentane, and heavier hydrocarbons. (2) Separation of a mixture of hydrocarbons into fractions with different boiling point ranges by heating crude oil in a column that is cooler at the top than at the bottom—"fractions" are removed from the column at different heights where the temperature is different. (3) The process of separating a fluid mixture into its primary constituents, e.g., separating a natural gas condensate into ethane, propane, butanes, and heavier components. (4) The process to separate a mixed hydrocarbon stream by distillation, making use of the difference in boiling points of the components to be separated. The lower boiling point components are recovered from the top of the fractionation column and the heavier boiling point components from the bottom. This process is used in LPG processing systems to separate products such as propane and butane. (5) The process of separating natural gas into component parts or fractions such as propane, butane, and ethane.
Fractions: Refiner's term for the portions of oils containing a number of hydrocarbon compounds but within certain boiling ranges, separated from other portions in fractional distillation. They are distinguished from pure compounds that have specified boiling temperatures.
Fracture Acidizing: Creating a fracture in a carbonate and etching the face of the fracture to preserve flow capacity down the fracture.
Fracture Breakdown Pressure: The pressure needed to initiate a fracture.
Fracture Closure Pressure: The Earth's stresses acting to try to close a hydraulic fracture offset by the pore pressure. A measurement of the pressure at which the fractured formation closes. Generally determined by the change in slope of the pressure reading as leak off gradually lessens the volume of fluid that is holding the fracture open, until the fracture walls meet and the pressure reverts to a decline to pore pressure.
Fracture Effective Length: Normally the propped part of the fracture that will support improved flow.
Fracture Extension Pressure: The pressure necessary to extend the fracture once initiated. The fracture extension pressure may rise slightly with increasing fracture length and/or height because of friction pressure drop down the length of the fracture. Fracture roughness, fracture width, and fluid viscosity also have influence on extension pressure.
Fracture Finder™ Log: An acoustic log that helps determine if fractures are present.
Fracture Fluid Efficiency: A measurement, derived from a data frac, of the efficiency of a particular fluid in creating fracture area on a particular formation at a set of conditions.
Fracture Fluids: The fluids used to fracture a well. Generally, a fracture fluid is a water-based fluid with less than 0.5% total additives, most of which are common in food or household use.

F

Fracture Gradient: The gradient needed to initiate a fracture.
Fracture Half Length: The length of one wind of a fracture from the wellbore to the tip.
Fracture Initiation Pressure: The pressure necessary to start a fracture from the wellbore.
Fracture Network: The groupings of fractures, possibly interconnected, that form an enhanced flow unit.
Fracture Packing: A sand control technique coupling fracture treating (usually a tip screen-out fracture) with a screen and gravel packing of the wellbore.
Fracture Pad: The initial part of the fracture fluid that creates the fracture width and controls the initial fluid loss but contains no proppant.
Fracture Porosity: The porosity attributed to the natural fractures, commonly less than 2%–4%.
Fracture Propagation Pressure: Same as fracture extension pressure.
Fracture Proppant Pack Density: The loading of proppant per square foot after the fracture has been placed. Commonly between 4 and 16 lb/ft^2 of fracture face.
Fracture Width: The width of a fracture at the wellbore. Hydraulic frac width is generated by frac fluid viscosity and/or pump rate (i.e., horsepower).
Fracturing: (1) A stimulation method involving injection of fluid into the well at a high enough pressure to break the rock. Fracturing "failure" of the rock is a tensile failure as the wellbore is enlarged by pressure. (2) Refers to a method used by producers to extract more natural gas from a well by opening up rock formations using hydraulic or explosive force. Advanced fracturing techniques are enhancing producers' ability to find and recover natural gas, as well as extending the longevity of older wells. (3) The pumping of a media, typically water, sand, and chemical additives, into a reservoir with a controlled force to fracture reservoir rock, resulting in a greater flow of natural gas or oil from the reservoir. (4) A method of breaking down a formation by pumping fluid at very high pressure. The objective is to increase production rates from a reservoir.
Fracturing Fluids: The fluids used to fracture a well. Generally, a fracture fluid is a water-based fluid with less than 0.5% total additives, most of which are common in food or household use.
Fragipan: Dense layer of soil containing silt and sand but no organic matter and little clay. May have extreme hardness due to compaction.
Fragmental Source Sedimentary (Rock): Lithification of rock fragments.
Frangible Valve: Purposely breakable valve, usually a flapper in a fluid loss device.
FRC: Fire-retardant clothing.
Freeboard: The vertical distance between the normal water surface elevation in a tank, channel, etc., and the top of the side walls of the same structure.
Free Gas: Gas that is not dissolved in the liquid.

Free on Board: Refers to the costs associated with delivery, inspection, and loading involved in putting crude oil, refined products, or LNG on a tanker at sellers' facilities that are included in agreed price. The buyer pays all additional costs to transport and unload the cargo.

Free on Board Contract: In an LNG FOB contract, the buyer lifts the LNG from the liquefaction plant and is responsible for transporting the LNG to the receiving terminal. The buyer is responsible for the shipping, either owning the LNG ships or chartering them from a ship owner. In an FOB contract, the seller requires assurance that the shipping protocols provide a safe and reliable offtake for the LNG to prevent disruption to the sale and purchase agreement (SPA). See *Cost, insurance, and freight (CIF) contract, Ex ship contract* and *Sale and purchase agreement*.

Free Oxygen: Molecular oxygen available for respiration by organisms. Molecular oxygen is the oxygen molecule that is not combined with another element to form a compound.

Free Point: A technique for estimating the highest free point in a string of stuck pipe. It is based on a differential stretch calculation with amount of pull and the FPC.

Free Point and Back-Off: Free point analysis followed by downhole unscrewing of a pipe coupling above the stuck point.

Free Point Constant: (1) A calculation used in the stuck pipe calculation to correct for pipe wall thickness and diameter. (2) Used in stuck pipe depth calculations.

Free Point Indicator Tool: A tool with strain gages that is run on wire line and moved along the stuck pipe with successive pipe pulls until the stuck point is located.

Free Product: A contaminant in the unweathered phase, where no dissolution or biodegradation has occurred.

Free Radical: A member of the socialist party not caught by McCarthy's inquisition. Also a molecule that has an odd number of electrons. The "unpaired" electron feels lonely and wants to find a friend. If it finds something that might be willing to give it an electron, it reacts very quickly with it. Molecules such as other radicals and alkenes turn out to be good things for radicals to attack. The reaction of radicals with the double bonds in alkenes is how some of us earn our living.

Free Water: (1) The excess water that separates from a cement slurry on standing. (2) The first water that separates from the crude oil in the first stage of the separator (free water knockout).

Free Water Knockout: The first stage of separation in a crude that contains a large amount of water.

Freeze Point (Pipe Movement): The depth at which the pipe is stuck.

Freeze Stat: A temperature sensing device that is either mounted within a duct or within an air handling unit and that is used to sense a potential freezing condition. Typically, a freeze stat will be interlocked with an alarm

or an air handling system, such that a shutdown or alarm is initiated if a low temperature is sensed.

Freezing Point: (1) The temperature where a liquid or solution changes from a liquid to a solid. Clearly, one person's freezing point will be another's melting point. In a solution the freezing point will be reduced by a number that depends on the number of particles in solution

$$\text{delta}(T) = K_f \times (\text{number of solute molecules per liter})$$

where delta(T) is the reduction in freezing point and K_f is called the "cryoscopic constant" and varies from one solvent to another. (2) The temperature at which a substance freezes by standard test procedure (ASTM D1015). Used in determining the degree of purity of high-purity hydrocarbon compounds.

Freight: Charge made for the transportation of a cargo.

Frequency: The number of times per second a signal regenerates itself at a peak amplitude. It can be expressed in hertz (Hz), kilohertz (Hz), megahertz (MHz), etc.

Frequency Domain (Seismic): Where the independent variable is distance and the dependent variables are strength of the signal and frequency of the signal. (A domain is a mathematical function with dependent and independent variables.)

Fresh Air Makeup: Volume of outside air introduced into a space.

Fresh Feed Input: Represents input of material (crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and oxygenates or finished products) to processing units at a refinery that is being processed (input) into a particular unit for the first time.

Examples:

1. Unfinished oils coming out of a crude oil distillation unit that are input into a catalytic cracking unit are considered fresh feed to the catalytic cracking unit.
2. Unfinished oils coming out of a catalytic cracking unit being looped back into the same catalytic cracking unit to be reprocessed are not considered fresh feed.

Freshwater: Water with less than about 600 ppm total dissolved solids. Suitable for drinking.

Fretting Corrosion: Deterioration at interfaces of two metals accelerated by their relative motion.

Friable Sand: A sand with an unconfined compressive strength of 300–1000 psi. Crushable with forceps.

Friction: The resistance to an object's passage through a fluid (or a fluid's passage past a stationary object). Affected by viscous resistance, density, and wall contact (vessel radii).

Friction Coefficient: A dimensionless value expressing the roughness of the pipe.

Friction Lock (Coiled Tubing): A state where the wall drag or friction is high enough to prevent further movement of the pipe.
Friction Reducer: A material, usually a polymer, that reduces the friction of flowing fluid in a conduit.
Front-End Costs: Money paid or costs at the start of a project (engineering, legal, contracts, etc.), before on-site activities begin.
Front-End Engineering and Design Contract: (1) A legal agreement setting out the terms for all activities required to define the design of a facility to a level of definition necessary for the starting point of an EPC contract. (2) Generally, the second contracting phase for the development of the export facilities in the LNG chain that provides greater definition than the prior conceptual design phase. In an LNG project, the single most important function of the FEED contract is to provide the maximum possible definition for the work ultimately to be performed by the engineering, procurement, and construction (EPC) contractor. This enables potential EPC contractors to submit bids on a lump-sum basis, with the least possibility that the contract cost will change through undefined work or through claims for unanticipated changes in the work. Clear definition of contract costs is important not only for cost control purposes but also for purposes of project financing—LNG project lenders will normally limit their lending commitment to a specific percentage of forecast project costs, and cost overruns will have to be covered by the borrower's equity investment. (3) A study used to analyze the various technical options for new field developments with the objective to define the facilities required. (4) The stage of design between concept evaluation and detailed design during which the chosen concept is developed such that most key decisions can be taken. Output of FEED includes estimate of total installed cost and schedule. (5) See *Engineering, procurement, and construction contract*.
FrontSim™: 3D streamline model.
Froth: A foam with very high internal gas volume, usually 90%+ gas. High viscosity and often very stable.
FRP: Fiber-reinforced pipe.
FRP: Failure to release packer.
FRUCOS: Final report until change of status.
FSN: Failure to set in nipple/side pocket.
FSP: Failure to set packer.
FSRU: See *Floating storage and regasification unit*.
FSV (Completions): Formation saver valve. A check valve that prevents fluids from reaching the formation.
FTC (SSSV): Fail to close on demand.
FTH: Failure to hold in nipple/side pocket.
FTHP: Flowing tubing head pressure.
FTO (SSSV): Failure to open on command.
FTP: Flowing tubing pressure.
FTR: Failure to release from nipple/side pocket.

F

Fuel Ethanol: (1) An anhydrous denatured aliphatic alcohol intended for gasoline blending as described in Oxygenates definition. (2) Blends of up to 10% by volume anhydrous ethanol (200 proof) (commonly referred to as the "gasohol waiver").
Fuel Gas: (1) A process stream internal to a facility that is used to provide energy for operating the facility. (2) Gas used as fuel in a liquefaction plant. It typically involves processing waste streams to LNG that are not profitable. It is used in gas turbines, boilers, and reaction furnaces.
Fuel Loss: A proportion of natural gas received by a pipeline or local distribution company that is retained to compensate for lost and unaccounted for natural gas.
Fuel Oil: (1) One of the many refined petroleum oils such as heating oil and diesel. (2) The heavy distillate from the oil refining process that is used primarily for heating, for fueling industrial processes, for fueling locomotives and ships, and for fueling power generation systems. (3) Any liquid or liquefiable petroleum product burned for the generation of heat in a furnace or firebox or for the generation of power in an engine, exclusive of oils with a flash point below 100°F and oils burned in cotton- or wool-wick burners.
Fuels Solvent Deasphalting: A refining process for removing asphalt compounds from petroleum fractions, such as reduced crude oil. The recovered stream from this process is used to produce fuel products.
Fuel-Switching Capability: The ability of an end user to readily change fuel.
Full Cycle Economics: Economic analysis that includes all costs of field development including seismic expense, lease cost, and construction, drilling, completion, and development costs.
Fuller's Earth: A clay having a high natural adsorption capacity, used in refineries to filter and decolorize oils.
Full Gage Hole: A wellbore drilled with a full gage bit (maintained initial diameter).
Fume Hood: Fume collection device mounted over a closed table or shelf serving to conduct unwanted gases away from the area enclosed.
Fumes: Very small airborne particles, usually less than one micrometer in size, from burning or melting materials.
Functional Group: An atom or group of atoms that has similar chemical behavior, no matter what the rest of the molecule looks like. For example, the hydroxy (OH) group in all alcohols has similar reactivity, as does the thio (SH) group in all thiols.
Fungi: (1) Neither plants nor animals, fungi are eukaryotes (organisms whose cells have nuclei) that are incapable of making their own food by photosynthesis and survive by breaking down chemical compounds made by plants and bacteria to waste products, just like we do. (2) Small, non-chlorophyll-bearing plants, without roots, stems, or leaves, which tend to overpower bacteria at low pH and dissolved oxygen concentrations. They generally have a filamentous-type structure and are therefore not welcome in a secondary process clarifier.

Funnel Viscosity: A viscosity measurement based on the number of seconds that it takes for 1 L of fluid to flow through a Marsh funnel.
Furan: An organic resin, formed by polymerization reaction of furfuryl, used in consolidation, zone shutoff, and water control.
Furnace: Part of a boiler or warm air heating system in which energy is converted to heat, as by burning fuel or by converting electrical energy.
Fusible Plug or Link: An emergency shutdown device activated by fire or thermal overload (*Note*: fusible links below the ignition point in a wellhead may not be activated [melted]).
Fusible Vent: A pressure relief valve that opens when temperature increases sufficiently to melt an activation linkage.
FV: See *Flapper valve*.
FVF: See *Formation volume factor*.
FW: See *Freshwater*.
FWHP: Flowing wellhead pressure.
FWHT: Flowing wellhead temperature.
FWKO: See *Free water knockout*.
FWS: Fish and wildlife service.

G

G: See *Gas*.
G: The acceleration of gravity measured in ft/s^2 or m/s^2. (1 G = 32 f/s^2 or 9.8 m/s^2.)
G&G: Geology and geophysics. See *Geology* and *Geophysics*.
Gage: A device for measuring a variable physical magnitude.
Gage Carrier: A downhole tool that houses gages.
Gage Diameter: The OD of a bit or tool used downhole.
Gage (Drilling): The diameter of the bit of the hole drilled by the bit when there are no washouts.
Gage Hole: A drilled hole with no washouts; the same diameter as the bit.
Gage Joint: An older well design process of using a single joint of the heaviest wall casing in the well just below the wellhead. (*Note*: this restricts access of full-bore tools to all points below the joint.)
Gage Pressure: (1) Pressure read by a gage that is set to zero at atmospheric pressure. (2) The pressure generally shown by measuring devices. This is the pressure in excess of that exerted by the atmosphere.
Gage Ring: A short, wire line-run tool that checks the id of a wellbore.
Gage (Screens): A rating where each gage point equals 0.001 in. A 12-gage screen has 0.012 in. openings (about 300 µm).
Gaging Nipple: A small opening in the top of a tank, allowing gaging of the contents.
Galena: Lead sulfide, PbS. A mud weighting additive for high mud weights.
Galling: Thread damage from lack of lubrication or mismatched metals.
Galvanic: Corrosion between two dissimilar metals—couplings, centralizers, pumps, packers, profiles—usually severe metal loss on one metal near contact point. May see galvanic loss on a single metal with current.
Galvanic Anode: Sacrificial anode.
Galvanic Series: A ranking of metals from the easiest corrodible (magnesium) to the most difficult.
Galvanometer: A sensitive ammeter.
Gamma-Ray Index: A clayiness index determined from the difference between the radioactivity level of the zone of interest and that of clean rock compared to the difference between the radioactivity level in clay shale and that in the clean rock.
Gamma-Ray Log: Uses a scintillation crystal and a photomultiplier tube to measure naturally occurring and artificially induced gamma-ray radiation. The gamma-ray radiation is a signature of the formations in a well—very

useful in depth control. Used in open hole or pipe and also used to spot changes in radiation (NORM scale) and radioactive tracers.

Gamma (Seismic): Unit of magnetic survey map. 1 gamma = 1 nanotesla or 1 gamma = 10^{-5} gauss.

Gang Pusher (Rig): Supervisor.

Gang (Rig): Crew.

GAP®: See *Gravity actuated pipe*.

GAP™: General allocation program.

Gap Test (Perforating): A test of the sensitivity of the perforating charge to firing from a detonating cord. May be used to spot changes in charge explosive or differences in loading.

Gardner's Equation (Seismic): Empirically derived equation that describes the general relationship in rock between bulk densities (r) and acoustic velocities (v): $r = 0.23–0.25$.

Gas: "Any fluid, combustible or noncombustible, which is produced in a natural state from the Earth and which maintains a gaseous or rarified state at ordinary temperature and pressure conditions" (Code of Federal Regulations, Title 30, Mineral Resources, Chap. II, Geological Survey, 221.2).

Gas Anchor: A gas separation device, usually a perforated pipe section, in a beam lift well that helps break gas out of the liquids, preventing gas entry and resultant gas lock of the pump.

Gas and Water Injection: To enhance the crude oil recovery by maintaining sufficiently high reservoir pressure throughout the production life, it is becoming usual to inject water and/or gas to replace the produced volumes. This reinjection performed above reservoir pressure requires heavy-duty pumps and compressors consuming large amounts of energy. The associated production gas is normally used as fuel.

Gas Buster: A device that helps knock out gas from circulated well fluid.

Gas Cap: (1) A free gas phase within a reservoir that overlies an oil zone. (2) The portion of an oil-producing reservoir occupied by free gas, in a free state above an oil zone. (3) A zone of free gas above an oil deposit. The gas cap occurs where the oil is oversaturated with gas (past the solubility limit). When a gas cap is not present at discovery, the oil is above the bubble point.

Gas Cap Drive: A reservoir drive mechanism in which gas expansion in the gas cap pushes the oil toward the wellbore.

Gas Condensate: The liquids, generally straight-chain alkanes in the C2 to C6+ range, that can condense from gas when the temperature and pressure drop sufficiently low.

Gas/Condensate Ratio: For a gas condensate reservoir, the ratio of gas to condensate is reported in scf/bbl. The inverse ratio (condensate/gas ratio [CGR]) is also used and is reported in bbl/mscf.

Gas Condensate Reservoir: A reservoir initially containing natural gas that will precipitate hydrocarbon liquid (retrograde condensate) during pressure depletion. To increase the recovery of the condensate, gas may be recycled in early years and produced at a later date.

Gas Condensate Well: A gas well that produces from a gas reservoir containing considerable quantities of liquid hydrocarbons in the pentane and heavier range generally described as "condensate."
Gas Coning: Gas from a fee gas cap that goes downward toward the top perforations in response to a drawdown.
Gas Cut: Liquids with free gas. Usually refers to drilling or completion liquids. May indicate a kick if the gas is present in large enough quantities.
Gas Cycling: Process in which produced gas is reinjected into the reservoir after removal of condensate in order to maintain reservoir pressure and prevent condensate from "condensing" in the reservoir (retrograde condensation) and becoming difficult to recover.
Gas Day: In the United States, a period of 24 consecutive hours, beginning at 9 am. Central time.
Gas Distribution Line: A gas pipeline, normally operating at pressures of 60 pounds per square inch (psi) or less, which transports gas from high-pressure transmission lines to end users.
Gas Drive: Flooding an oil reservoir from the top of the reservoir or an updip location, to push the oil toward a producing well.
Gas Effect (on Logs): A difference in porosities caused by the compressibility of gas in porosities estimated by the formation density log and the neutron density log.
Gas Field: (1) A field or group of reservoirs of hydrocarbons containing natural gas but insignificant quantities of oil. (2) A field containing natural gas but no oil.
Gas Formation Volume Factor: The volume of reservoir gas resulting in one standard cubic foot.
Gas Gatherer: The entity that contracts with the producer to take the gas from the wellhead to the plant or market.
Gas Gathering System: (1) A system for collecting gas production from different sources for delivery by pipeline to a central point such as a platform or processing facility. The gas sources could be individual wells, smaller gathering systems, field facilities, and platforms. (2) Central collection point for offshore gas fields. Production is then piped to a central processing system onshore.
Gas Gravity: Ratio of the gas density to the density of air. Equal to the ratio of molecular weight of gas to that of air (28.97).
Gas Grid: (1) The system of pipelines that run from the wellhead to the city gate. (2) The network of gas transmission and distribution pipelines in a region or country, through which gas is transported to industrial, commercial, and domestic users.
Gas Hydrate: Immense deposits of natural gas tied up in clathrate structures with water. Found extensively. See also *Hydrate*.
Gasification: The conversion of soluble and suspended organic materials into gas during anaerobic decomposition. In clarifiers the resulting gas bubbles can become attached to the settled sludge and cause large clumps of

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sludge to rise and float on the water surface. In anaerobic sludge digesters, this gas is collected for fuel or disposed off using a waste gas burner. (2) The production of gas from liquid or solid fuels.

Gas Imbalance: A discrepancy between a transporter's receipt and deliveries of natural gas for a shipper.

Gas Injection: (1) An enhanced recovery technique in which natural gas is injected under pressure into a producing reservoir through an injection well to drive oil to the wellbore and the surface. (2) Associated gas is pumped back into a reservoir to maintain reservoir pressure. In this way, the rate of production of crude oil also can be increased. (3) The process whereby separated associated gas is pumped back into a reservoir for conservation purposes or to maintain the reservoir pressure. (4) The technique of injecting gas into a reservoir. It may be done for pressure maintenance, oil viscosity reduction, light end stripping, or storage.

Gas-In-Place: The original amount of gas in the reservoir before production.

Gasket: Any of several replaceable seals in equipment or tools.

Gas Kick (Drilling): An unexpected and unwanted entry of gas into the wellbore during drilling or well operations.

Gas Lift: (1) One of several methods of artificial lift. A mechanical process using the continuous or intermittent injection of a gas into the production conduit (tubing or casing) to aerate or displace the produced fluids. This creates a reduction of the bottom-hole pressure of the well, increasing or sustaining the flow rate of the well. (2) It is becoming normal practice on FPSOs, particularly for heavy crudes, to facilitate the flow of live crude from the wells by injecting gas either at Xmas tree level or downhole to lower the back pressure on the wells. In fact, the lift gas is the associated gas from the field, which is treated, compressed, and recirculated into the flow system. (3) Gas from same or nearby field is mixed with oil in tubing to lessen the weight of liquid column. (4) One of the artificial lift methods that uses gas injected down the annulus and interspersed into the flowing fluids in the tubing to lessen the density and to assist in vertical flow by gas expansion.

Gas Lift Dummy: A solid body insert that replaces and blanks off a gas lift mandrel pocket designed for a valve.

Gas Lift Mandrel: A section of pipe used in the tubing into which a gas lift valve can be inserted. The mandrel will allow communication with the annulus gas lift supply through the valve.

Gas Lift Side Pocket Mandrel: A type of gas lift mandrel that allows full-bore passage. The valve "pocket" is on the side of the pipe.

Gas Lift Valve: A pressure-operated valve, placed in gas lift mandrels at designed points in the well. The gas lift supply gas is routed through the valves into the tubing. The top valves close and the lower valves open as the static liquid level drops in the well (the well is unloaded).

Gas Lift Valve–Injection Pressure-Operated Valve (Gas Lift): Gas lift valves where injection gas enters the valve and acts on the effective bellows area,

overcoming the precharge in the valve and opening the valve (the retracting bellows lifts the needle off the seat) to allow gas lift gas flow from the gas-filled annulus through the seat and the reverse-flow check valve and into the tubing.

Gas Lift Valve–Production Pressure-Operated Valve (Gas Lift): Production fluid enters the valve and acts on the effective bellows area, compressing the bellows against the precharge pressure, lifting the needle off the seat and opening the valve. The injection gas then flows through the seat, through the reverse-flow check valve, and into the tubing.

Gas Liquefaction: The process of cooling gas to –162°C, reducing its volume by 600-fold over the gas volume at standard conditions.

Gas Lock (Facilities): A gas retention device that permits gaging the tank without loosing gas to the atmosphere.

Gas Lock (Pump): A pump filled with gas that it cannot expel and where no further fluid will enter the pump. Common in beam lift pumps that pump off or are used in high GOR wells.

Gasohol: A blend of finished motor gasoline containing alcohol (generally ethanol but sometimes methanol) at a concentration of 10% or less by volume. Data on gasohol that has at least 2.7% oxygen, by weight, and is intended for sale inside carbon monoxide nonattainment areas are included in data on oxygenated gasoline. See *Oxygenates*.

Gas Oil: (1) A liquid petroleum distillate having a viscosity intermediate between that of kerosene and lubricating oil. It derives its name from having originally been used in the manufacture of illuminating gas. It is now used to produce distillate fuel oils and gasoline. (2) A fraction derived in refining petroleum with a boiling range between kerosene and lubricating oil. It derives its name from having originally been used in the manufacture of illuminating gas. Now supplies distillate-type fuel oils and diesel fuel, also cracked to produce gasoline.

Gas/Oil Contact: The changing contact of the gas cap and the oil below in the rock.

Gas Oil (Diesel): A distillate, intermediate in character between kerosene and the light lubricating oils. It is used as a heating oil and as a fuel in diesel engines.

Gas/Oil Ratio: (1) The number of standard cubic feet of gas produced per barrel of crude oil or other hydrocarbon liquid. In some parts of the world, the units are cubic meters of gas per cubic meter of liquid produced. (2) May refer to a solution gas/oil ratio or total gas/oil ratio. (3) The volume of gas at atmospheric pressure produced per unit of oil produced.

Gasoline: (1) The light fuel used to spark-ignition engines in cars, motorcycles, etc. Modern gasolines are blends of petroleum liquids that are produced in several different processes and that generally contain additives. (2) A refined petroleum naphtha that by its composition is suitable for fuel in a reciprocating-type internal combustion engine. ASTM D439 specifies three grades for various types of motor vehicle operations. Straight-run gasoline

is the product of distillation; cracked gasoline that of a cracking process. (3) A light hydrocarbon mixture having C4–C9 carbon atom hydrocarbons, which are used as fuel for internal combustion engines. (4) Normally C7–C10 fuel, with a flash point of −40.

Gasoline (Petrol): A light petroleum product with a boiling range between the approximate limits of 30°C and 200°C. Used as a fuel in spark-ignition engines. It is also known as mogas.

Gasoline Blending Components: Naphthas that will be used for blending or compounding into finished aviation or motor gasoline (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene, and xylene). Excludes oxygenates (alcohols, ethers), butane, and pentanes plus.

Gas Permeation: Invasion of gas into a solid, usually an elastomer, but sometimes referring to a metal.

Gas Pipeline: A transmission system for natural gas or other gaseous material.

Gas Processing: The separation of oil and gas and the removal of impurities and natural gas liquids (NGL) from natural gas.

Gas Processing Plant: A facility that extracts liquefiable hydrocarbons or sulfur from natural gas and/or fractionates a liquid stream.

Gas Reserves: Those quantities of gas that are anticipated to be commercially recovered from known accumulations from a given date forward.

Gas Reservoir: A geological formation containing a single gaseous phase. When produced, the surface equipment may or may not contain condensed liquid, depending on the temperature, pressure, and composition of the single reservoir phase.

Gas Revenue: The product of gas volume times gas price; gross cash flow from sales of gas.

Gas Saturation: The fraction of the porosity in a zone that is occupied by free gas.

Gas Sendout: The total natural gas produced or purchased (including exchange gas receipts), or the net natural gas withdrawn from underground storage within a specified time interval, measured at the point of production, purchase, or withdrawal, adjusted for changes in local storage quantity.

Gas Show: Any indication of gas in the drilling fluid or cuttings that indicates gas production from a reservoir that has been drilled.

Gas Spiking: Adding gas to an injected fluid or treatment to reduce the injected water volume and provide energy for flowing the well back after the treatment.

Gas-to-Liquids: (1) A processing technology that converts natural gas into high-value commodity liquid fuels and blending agents, petrochemical feedstocks, and chemicals by changing its chemical structure. GTL produces products that can be easily traded as commodities on world markets. (2) A process, based on Fischer–Tropsch technology, which polymerizes several gas molecules into a longer-chain hydrocarbon molecule that can exist in liquid phase at ambient conditions. This process is being developed as a competitor to LNG for commercialization of remote gas reserves. (3) The

conversion of natural gas to a liquid form so that it can be transported easily. Typically, the liquid is converted back to natural gas prior to consumption. (4) A conversion of gas to a liquefied state by compression and cooling. Also, a conversion of gas by chemical methods to an easily transportable liquid hydrocarbon of a more stable, longer chain.

Gas Treatment: (1) Removal of gas phase impurities, such as sulfur compounds, carbon dioxide, and water vapor from natural gas. (2) Removal of impurities, condensate, hydrogen sulfide, and NGLs from natural gas.

Gas Turbine: Heat engine with an air compressor, a combustion chamber, and an exhaust gases expansion turbine. It produces mechanical energy (work) from chemical energy provided by burning fuel. After the combustion, gases expand in the turbine blades transmitting the mechanical energy to the shaft. Part of this mechanical energy is used to move combustion air compressor, and another part remains available to move other external machines, such as electrical generators or gas compressors.

Gas Turbine Power Plant: A power plant in which the prime mover is a gas turbine. A gas turbine typically consists of an axial-flow compressor that feeds compressed air into one or more combustion chambers where liquid or gaseous fuel is burned. The resulting hot gases are expanded through the turbine, causing it to rotate. The rotating turbine shaft drives the compressors as well as the generator, producing electricity.

Gas Well: (1) A well drilled and completed that primarily produces natural gas. (2) A well completed for the production of natural gas from one or more gas zones or reservoirs. Such wells contain no completions for the production of crude oil. (3) A well that produces natural gas that is not associated with crude oil.

Gate: A movable barrier for the control of liquid flow. There are two types: Sluice gates have a guaranteed maximum leakage rate. Slide gates are not guaranteed to stop the flow of water and are generally used when leakage does not matter or where suspended solids in the liquid would tend to stop the leakage.

Gate Valve: A valve with a sliding bar—common in the oilfield as tree valves.

Gathering: The process of collecting natural gas flowing from numerous wells and bringing it together into pooling areas where it is received into transmission pipelines.

Gathering Agreement (Contract): An agreement detailing the conditions for entry of the producer's gas into the gathering system.

Gathering Line: (1) Network-like pipeline that transports natural gas from individual wellheads to a compressor station, treating or processing plant, or main trunk transmission line. Gathering lines are generally relatively short in length and smaller in diameter than the gas sales line. (2) Pipeline that moves natural gas or petroleum from wells to processing or transmission facilities. (3) The flow line from the well to the separator or tank battery.

Gathering Lines, Systems: The piping networks installed in oil or gas fields to transport petroleum to a processing plant or bulk shipping point.

G

Gathering Stations: Receive oil through a gathering system from the producer's tanks.
Gather (Seismic): A display of the input data in a stacking process designed to show all the seismic traces corresponding to the same depth.
GC: Gathering center.
G/C: See *Gas condensate*.
GCI: Gas cap injection.
GCV: Gas control valve.
GD: See *Gravity drainage*.
Gear Reducer: A pump or motor speed reducer.
Geiger–Müller Counter: Radioactive measuring device.
Gel: A fluid with a higher than normal viscosity created by a gallant material such as polymer.
Gel Strength: The ability of a fluid to suspend solids.
Gel Strength (Drilling): The shear stress measured at low shear rate after the mud has set for a period of time.
Geochemistry: (1) The science of chemistry applied to rocks and minerals; geoeconomists analyze the contents of subsurface rocks for the presence of organic matter associated with oil deposits. (2) The branch of chemistry dealing with the specialized reactions of downhole fluids and formations.
Geographic Information System: (1) A computer program that combines mapping with detailed information about the physical locations of structures such as pipes, valves, and manholes within geographic areas. The system is used to help operators and maintenance personnel locate utility system features or structures and to assist with the scheduling and performance of maintenance activities. (2) A computer system capable of assembling, storing, manipulating, and displaying geographically referenced information.
Geologic Cross Section: Vertical cross section (vertical is depth and horizontal is lateral distance) between two points through a rock section.
Geologist: (1) A person trained in the study of the Earth's crust; petroleum geologists search for traps that could contain petroleum and recommend drilling locations. (2) Scientist who studies the origin, history, composition, and structure of the Earth and its life as recorded in rocks and other solid matter.
Geology: (1) The science of the history of the Earth and its life as recorded in rocks. (2) The science that involves the study of the Earth and its origin, composition, structure, and history. Geology is the key to finding new sources of useful Earth materials and to understanding Earth processes that affect our lives. (3) The science that deals with the study of the planet Earth.
Geophones: (1) Are sensitive sound-detecting instruments used in conducting seismic surveys. A series of geophones is placed on the ground at intervals to detect and transmit to the amplifier-recording system the

reflected sound waves created by explosions set off in the course of seismic exploration work. (2) An instrument that detects vibrations passing through the Earth's crust.

Geophysicist: Usually a professional involved with application of physics to geology, for example, seismic interpreter.

Geophysics: (1) The science that deals with the relations between the physical features of the Earth and forces that produce them. Geophysics includes the study of seismology and magnetism. (2) The science of the physical properties of the Earth.

Geopressured: Overpressured zone.

Geosteering: Using the formation data generated by a measurement while drilling system to assist in drilling a wellbore to a specific target in the formation.

Geothermal Energy: The heat of the Earth, usually from produced natural steam, heat recovered from circulated water, or direct heat-to-energy conversion (ongoing research).

Geothermal Gradient: The gradient reflecting the amount of temperature rise as the well depth increases. Normally about 1.1°F–1.8°F per 100 ft of true vertical depth increase.

Geothermal Wells: The wells that produce geothermal energy (heat).

Geronimo Line (Rig): A safety slide or a line from the derrickman's platform to the ground, used in an emergency.

G-Function: Dimensionless function used in shut-in time normalized to pumping time. It is used to analyze pressure-dependant leak off.

GGE: Gasoline gallon equivalent.

GHG: See *Greenhouse gases*.

GHV: See *Higher heating value*.

GI: See *Gas injection*.

Giardia: A waterborne intestinal parasite that causes a disease called giardiasis in infected humans. Symptoms of the disease include diarrhea, cramps, and weight loss. Giardia contamination is found in most surface waters and some groundwater.

Gigajoule: A joule is an international unit of energy defined as the energy produced from one watt flowing for one second. A very small unit of energy, there are 3.6 million joules in a kilowatt-hour. For gas, one gigajoule 960 ft^3 under standard temperature and pressure conditions. Roughly, 1 gigajoule (GJ) = 1,000 ft^3; 1 terajoule (TJ) = 1,000,000 ft^3; 1 petajoule (PJ) = 1,000,000,000 ft^3; and 1 exajoule (Ej) = 1,000,000,000,000 ft^3. (2) 1,000,000,000 Js.

Gigawatt: A unit of electric power equal to 1,000,000,000 W, 1,000,000 kW, or 1,000 MW—enough power to supply the needs of a medium-sized city.

Gigawatt-Hour: 1,000,000,000 W-h.

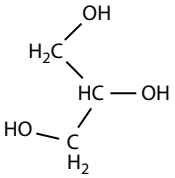
GIIP: Gas initially in place.

Gilsonite: An asphaltic drilling fluid loss additive.

G

Girbitol Process: A process for removing hydrogen sulfide, carbon dioxide, and/or organic gases from petroleum gases and liquids.
GIS: (1) See *Geographic information system*. (2) Global information system.
Giulio Natta: Nobel Prize-winning chemist (1903–1979) who did a vast quantity of work on the catalysts allowing high-density poly(ethene) and poly(propene) to be produced. Most of his work was done in Milan, Italy, for the Montecatini corporation, making him one of the most successful industrial chemists of the twentieth century.
GIV: Gas injection valve.
GJ: See *Gigajoule*.
Glacial Drift: General term for debris and stones transported by glaciers.
GLAD™: Software package, gas lift-assisted design.
Gland: A seal around a moving rod.
Glass Disc: Often a rupture disc to allow a well to flow after it is broken by a dropped bar.
Glass Transition Temperature: The temperature where the molecules of a polymeric solid can begin to move relative to one another, giving a substance that behaves like a rubber, rather than a brittle glass. Alternatively, you can think of it as the temperature where the molecules of a polymeric solid can no longer move relative to one another, giving a substance that behaves like glass, rather than a rubber that can be stretched without breaking. It all depends on which way you are going.
GL (Datum): Ground level.
GL (Lift): See *Gas lift*.
GLL (Subsea): Guidelineless.
GLM: See *Gas lift mandrel*.
Global Warming: (1) A rise in the average global temperature. There is general agreement in the scientific community that average global temperatures have risen about 1°F during the past century. Phillips supports taking actions now that make good environmental and economic sense in their own right—such as energy conservation and improved efficiency. The company also supports further work to improve our understanding of the impact of human activity on climate. (2) The theoretical escalation of global temperatures caused by the greenhouse effect.
Glossary: A set of definitions of words, such as this one. Not all glossaries are self-referential.
GLR: Gas/liquid ratio.
Glucose: A common sugar, one of many with the chemical formula $C_6O_6H_{12}$ but different 3D structures. It is not the simplest of all sugars (which honor belongs to glyceraldehyde, $C_3O_3H_6$), but glucose is the fundamental building block of many biopolymers, including starch and cellulose, and is the starting material for the serious biochemical reactions used to obtain energy in most "higher" organisms.
GLV: See *Gas lift valve*.

Glycerol: Propan-1,2,3-triol, named from the Greek word for "sweet" thanks to its taste. It is the basis for many animal and vegetable fats.



Glycol: A hydrate inhibitor or freeze-up preventer.
Glycol Dehydrator: (1) Field equipment used to remove water from natural gas by using triethylene glycol or diethylene glycol. (2) Equipment for removal of water from natural gas.
Gneiss: A coarse, metamorphic rock with some parallel alignment of granular minerals and alternate bands of flaky or elongate minerals.
GNFT: Gas no-flow test.
Goals: Phillips' corporate goals are a total annual return of 15% on a 5-year rolling average; quality products, superior services, and innovative solutions for our customers; and opportunity, development, and recognition for our employees. See *Mission*, *Values*.
GOC: See *Gas/oil contact*.
Go-Devil: (1) A scraper that is run through the pipeline to clear out loose objects and clean the wall of the line. (2) Various. A wire line cutter, cleanout pig, sleeve, etc. See *Pig*.
Gooseneck (Coiled Tubing): The CT guide arch over the injection head.
GOR: See *Gas/oil ratio*.
GOS: Gulf of Suez.
GPA: See *Graded production acreage*.
GPD: Gallons per day.
GPF: Gas production facility.
GPG: Grains per gallon.
GP/GL (Subsea): Guide post/guideline.
GPM: Gallons per minute.
GPR: Gravel pack replacement.
GPS: Global positioning system.
GR: See *Gamma-ray log*.
Graben: A block of the formation that has slid downward between two faults.
Grab Sample: A single sample of water collected at a particular time and place that represents the composition of the water only at that time and place.
Graded Production Acreage: A term that expresses the producibility of a part of the reservoir for purposes of comparing one producing area to another.
Gradient: Change in pressure or temperature per unit depth.
Gradiomanometer (Well Logging): A device that measures the density of fluids along a fluid column.

G

Gradiometer (Seismic): A device that measures an electric field at multiple points at the same time. The gradient is the difference in measured values per unit of distance between the measuring points.
Grain Density: The density of the rock components, without the effect of porosity.
Grain (Fluid Loss Additive): Literally grain or animal feed that is circulated with mud to act as an identifiable marker.
Grain (Formation): A small piece of the formation composed of a single piece of sand.
Grainstone: An often high-permeability limestone where large grains are in contact. Only high perm if fines are absent.
Grandfather Clause: A clause in a contract that maintains the prior rule or policy where a new rule or policy would otherwise be applicable.
Grand Slam: A combination of logs or a computational procedure for calculating the depth of invasion and the resistivity of both invaded and uncontaminated zones, based on a dual induction-laterolog and a proximity log or microlaterolog.
Granite: Common igneous rock. No effective permeability.
Granite Wash: A sandstone with a large percent of weathered granite grains.
Granting Clause: Defines the rights that are "granted" by the mineral interest owner to the lessee.
Graphite: A soft form of elemental carbon, gray to black in color. It occurs naturally or is synthesized from coal or other carbon sources; widely used as a lubricant alone or added to conventional lubricants.
Grapple: A springlike device, resembling a interlocking finger puzzle that allows a round work piece to slide through the ID when in compression but grips the work piece (or fish) when a tension load is applied. Common in overshot fishing devices.
Gravel: Large, well-sorted, and consistently sized sand used to hold back a soft formation.
Gravel Pack: A sand control completion that uses a larger gravel to stop the formation sand and a screen to stop the gravel.
Gravel Pack Evaluation Tool: Uses porosity, density, and/or tracer tools to determine the presence of gravel and placement of gravel type between the screen and the hole or casing.
Gravel Pack Log: A neutron-type device that evaluates the packing completeness or condition of the gravel pack. The log is useful for estimating voids in the pack.
Gravel Reserve: The amount of gravel above the top perf, after the job, in a well with deviation less than about 50°.
Gravimeter: (1) An instrument that measures differences in the gravitational attraction. Particularly useful in finding salt domes. (2) A device that measures the local gravitational pull. Gravimeters are useful for determining small changes in the gravity. Very useful for detecting salt domes.
Gravitometer: A device that records the specific gravity of a fluid.

Gravity Actuated Pipe: A concept developed by the group, consisting of a bundle of mid-water pipes floating between surface and seabed to minimize pipeline length and temperature problems in deepwater developments. These pipes typically connect a DCU to a floating production facility and carry the flow of gases, oil, water, and control signals over large distances. The bundle is stabilized vertically and horizontally by maintaining tension at each end, created by gravity from suspended masses.
Gravity Anomaly: The difference between theoretical calculated and observed terrestrial gravity; excess gravity is positive and deficiency is negative.
Gravity (API): The specific gravity of a fluid in API units, where freshwater is 10. Lighter gravity crude has higher API numbers.
Gravity Drainage: The movements in a reservoir driven by gravity.
Gravity Flow: Water or wastewater flowing from a higher elevation to a lower elevation due to the force of gravity. The water does not flow due to energy provided by a pump. Wherever possible, wastewater collection systems are designed to use the force of gravity to convey waste liquids and solids.
Gravity Meter: A device that measures gravity changes over a specific area.
Gravity Specific: Gravity of a fluid expressed as a ratio of a standard fluid. For liquids, the standard is freshwater. For gases, the standard is air.
Gravity Structures: Either concrete or hybrid (concrete base and steel legs and superstructure) structures that due to weight rest on seabed or piled into it.
Gravity Survey: An exploration method that uses an instrument to measure the intensity of the Earth's gravity. Areas with unusual readings may indicate traps or structures that could contain hydrocarbons.
Gravity Unit (Seismic): An acceleration unit (gu) used in gravity measurement. 1 milligal = 10 gu.
Gray Shale: An indeterminate description of a shale with lower carbon content than a "black shale."
Graywacke: A sandstone, characterized by angular-shaped grains of quartz and feldspar set in a matrix of fine grains. May have high hardness.
Grease: (1) A lubricating oil thickened with a metallic soap or a specially treated clay to yield a lubricant in solid form. The action of the thickening agent may be likened to that of a sponge that holds the lubricating agent in its interstices. (2) In a collection system, grease is considered to be the residues of fats, detergents, waxes, free fatty acids, calcium and magnesium soaps, mineral oils, and certain other nonfatty materials that tend to separate from water and coagulate as floatables or scums.
Grease Injector: A pressure control method for forming a pressure seal around braded line and electric line. Grease is injected between special tubes in a high-pressure housing. The tubes are slightly larger than the line and the grease seals the remaining area.
Grease Trap: A receptacle designed to collect and retain grease and fatty substances usually found in kitchens or from similar wastes. It is installed

in the drainage system between the kitchen or other point of production of the waste and the building wastewater collection line. Commonly used to control grease from restaurants.

Green Cement: Uncured cement.

Greenfield LNG Facility: A new LNG facility constructed on a new site. Also see *LNG*.

Greenhouse Effect: A popular term used to describe the roles of water vapor, carbon dioxide, and other trace gases in keeping the Earth's surface warmer than it would be otherwise. These radiatively active gases are relatively transparent to incoming shortwave radiation but are relatively opaque to outgoing long-wave radiation. The latter radiation, which would otherwise escape to space, is trapped by these gases within the lower levels of the atmosphere. The subsequent reradiation of some of the energy back to the Earth maintains the surface at temperatures higher than they would be if the gases were absent.

Greenhouse Gases: Those gases, such as water vapor, carbon dioxide, tropospheric ozone, nitrous oxide, and methane that are transparent to solar radiation but opaque to long-wave radiation. Their action is similar to that of increased humidity in a greenhouse.

Green Infrastructure: For the purpose of this document, refers to Best Management Practices that utilize or mimic natural processes to reduce runoff and/or provide water quality treatment of stormwater. This is accomplished through infiltration of runoff into the soil, uptake and evapotranspiration of water by plants, incorporation of nutrients into plant matter, and removal of pollutants by microbial action and filtration within the soil.

GRI: Gas Research Institute.

Grid: (1) A network of pipelines through which gas is transported. (2) Term used to describe an electrical utility distribution network.

Grille: Louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

Grinder: A device for grinding, shredding, or communating material removed from wastewaters.

Grind Out: A shakeout of solids, centrifuged or otherwise, separated from the produced or circulated fluids.

Gripper Blocks: The contacting blocks on a coiled tubing injector that grip and move the coiled tubing.

Grit: (1) Airborne solid particle in the atmosphere or flues (in the United Kingdom: of size greater than 75 cm). (2) The heavy material present in wastewater, such as sand, coffee grounds, eggshells, gravel, and cinders. Grit tends to settle out at flow velocities below 2 ft/s and accumulate in the invert or bottoms of the pipelines. Also called "detritus."

Grit Removal: Grit removal is accomplished by providing an enlarged channel or chamber that causes the flow velocity to be reduced and allows the heavier grit to settle to the bottom of the channel where it can be removed.

GRN: Gamma-ray neutron.

Gross Acres: The total acres in which the company owns an interest.
Gross Freight: Freight cost excluding the expenses relating to the running costs of the ship.
Gross Gas Withdrawal: The full volume of compounds extracted at the wellhead, including nonhydrocarbon gases and natural gas plant liquids.
Gross Heating Value: See *Higher heating value*.
Gross Input to Atmospheric Crude Oil Distillation Units: Total input to atmospheric crude oil distillation units. Includes all crude oil, lease condensate, natural gas plant liquids, unfinished oils, liquefied refinery gases, slop oils, and other liquid hydrocarbons produced from tar sands, Gilsonite, and oil shale.
Gross Pay: The total thickness of the pay zone, whether or not it is productive.
Gross Production: Total production. Has been used as total fluids produced. Has also been used as cumulative hydrocarbon production.
Gross Tonnage: Common measurement of the internal volume of a ship determined in accordance with prescribed methods and formulas and expressed in units of 100 ft^3 (=2.83 m^3).
Gross Vehicle Weight Rating: The weight of the empty vehicle plus the maximum anticipated load weight.
Gross Withdrawals: Full well-stream volume, including all natural gas plant liquids and all non-hydrocarbon gases but excluding lease condensate. Also includes amounts delivered as royalty payments or consumed in field operations.
Ground: An electrical connect (on purpose or accidental) between an item of equipment and the Earth.
Ground Bed: Anodes buried in the Earth to supply cathodic protection to equipment.
Grounding: Contact by a ship with the bottom while it is moored or anchored or underway.
Groundwater: (1) Water that fills all of the unlocked material underlying the water table within the upper limit of saturation. (2) Water subject to recharge from surface water accumulation. (3) Subsurface water in the saturation zone from which wells and springs are fed. In a strict sense, the term applies only to water below the water table. Also called "phreatic water" and "plerotic water."
Grout: Usually cement, water, and some additives used to fill a void. May also be bentonite and water.
Growth Fault: A fault that is created in an actively forming basin. It is often parallel to the shore line when created.
Growth Rate: An experimentally determined constant, Y, which expresses the growth rate of bacteria in units of mass of solids produced per mass of matter reduced (i.e., mg VSS/mg BOD5).
GRP: Glass-reinforced plastic.
GS: A common inside fishing neck design. Also a series of running tools.
Gscm: Giga standard cubic meters (1 billion standard cubic meters).
GSO: Gas shutoff.

G

GTS (Well Testing): Gas to surface.
GTW: Gas to wire. Generally converting the gas from a small field to electricity at the well site and transporting the power by the electrical grid.
Guar: A natural polymer from the guar plant. Common in fracturing fluid gelation.
Guard Log: A formation resistivity tool that involves the use of a guard tool.
Guard Tool: A tool that produces the effect of one elongated current electrode from which current flows radially in all directions to a distant current-return electrode. The output from the tool can be focused to improve logging resolution in thin beds.
Guide Ring: A protective cylinder or ring to guide downhole tools past casing obstructions.
Guide Shoe: A short section of casing with a rounded nose of a drillable material and a port through the center to allow circulation.
Gum: Polymer gellants.
Gumbo: Sticky, reactive shale formation.
Gun: Perforating gun.
Gun Barrel: A vertical separator vessel.
Gunk Plug: Cement (or some clays) and diesel oil dispersion that thickens when water is contacted.
Gun the Pits: Mix the pits.
Gusher: A well drilled into a high-pressure formation that results in an immediate surge toward the surface. In the days of cable tools with minimum fluid (hydrostatic) head, the formation fluids often flowed to surface when the pay zone was penetrated.
Gutta-Percha: While natural rubber from the rubber tree *Hevea brasiliensis* is *cis*-poly(isoprene), the Malaysian sapodilla tree *Palaquium oblongifolia* produces a latex that is *trans*-poly(isoprene). This material is called gutta-percha and is more brittle and hard than natural rubber.
Guy Wire (Rigging): A support wire or cable used to stabilize a mast on a rig or other structure.
GV: See *Gate valve*.
GW: See *Gigawatt*.
GWC: Gas–water contact.
GWh: See *Gigawatt-hour*.
GWPC: Ground Water Protection Council.
Gyp: See *Gypsum*.
Gypsum: A common form of calcium sulfate precipitate or scale.
Gyroscopic Survey: A survey of a wellbore that measures its position and trajectory. *h*: thickness (or pay height).
GTL: See *Gas-to-liquids*.

H

H_2: See *Hydrogen*.
H_2S: Hydrogen sulfide.
H_2SO_4: See *Sulfuric acid*.
Habendum Clause: Defines the period of time for which the rights given in the granting clause will extend. The habendum clause provides for a primary term that is a fixed term of years during which the lessee has the right, without any obligation, to operate on the premises. It also describes that a secondary term is the extended period of time for which rights are granted to the lessee once production is obtained.
Hadean: The oldest eon in Earth's history. Extends from the origin of earth to about 3.9 billion years ago.
Hague Rules (1921): Adopted by the International Law Association at the Hague Conference in 1921, international code for conditions for the carriage of cargo under a bill of lading.
Hairy Illite: A fibrous form of illite, also described as spiderweb illite. The hairs or fibers randomly project into the pore space. In most cases, the clay is not overly reactive with water, but the fibers do act as a trap for migrating particles.
Half-Life: The amount of time required for one half of the population of radioactive atoms to decay.
Half Muleshoe: A pipe end cut on a diagonal to ease the string through restrictions or guide tools through.
Halide: The ions of charge −1 of the elements in the next-to-last column of the periodic table: chloride, fluoride, bromide, iodide, and astatide (but there are only 11 known atoms of astatine, so no one ever counts it).
Halite: Sodium chloride.
Hall Plot: A test of injectivity that is useful for establishing formation behavior during pumping.
Halogen: One of the elements in the next-to-last column of the periodic table—fluorine, chlorine, bromine, iodine, and astatine.
Hammer Up: Connect unions on treating iron.
Hand-Over Document: The document containing operational and test data used to transfer custody of a well from drilling to operations or production after completion or from production to drilling when repairs are needed.
Hanger: A mechanical device that suspends all or part of the weight from a tubular string, transferring the load to the wellhead and the earth.
Hanger Plug: A plug placed below the BOP prior to a pressure test.

H

Hang Fire: An unplanned delayed firing of explosives after the initiation attempt—various causes.
Hanging Wall Block: The body of rock that lies above an inclined fault plane.
Hang Rods: Suspending sucker rods in the derrick from rod hangers.
HAP: Hazardous air pollutant.
Harbor Dues: Various local charges against all seagoing vessels entering a harbor, to cover maintenance of channel depths, buoys, lights, etc.; not all harbors assess this charge.
Hard Aground: A vessel that has gone aground and is incapable of refloating under her own power. Also referred to as hard and fast.
Hardness (Metal): Measure of the resistance encountered in pressing a steel ball into the metal.
Hardness (Mineral): The resistance of a mineral to scratching. Determined by the Mohs scale.
Hardness (Water): Ion content of water.
Hardpan: The relatively hard layer of soil just below ground surface.
Hard Shut-In: To close in a flowing well with the BOP with the choke line closed.
Hard Water: Water with a high mineral content.
Hatch: The opening on a tank.
HAZ: See *Heat-affected zone*.
Hazard: (1) A condition or object that has the potential to cause harm risk is the probability of an event happening times the impact of its occurrence on operations. (Impact is the effect on conditions or people if the hazard is realized (occurs) in practice and potential is the likelihood that the impact will occur.) (2) An unsafe condition, which, if not eliminated or controlled, may cause injury, illness, or death.
Hazard Communication: Employee "right-to-know" legislation requires employers to inform employees (pretreatment inspectors) of the possible health effects resulting from contact with hazardous substances. At locations where this legislation is in force, employers must provide employees with information regarding any hazardous substances, which they might be exposed to under normal work conditions or reasonably foreseeable emergency conditions resulting from workplace conditions. OSHA's Hazard Communication Standard (HCS) (Title 29 CFR Part 1910.1200) is the federal regulation and state statutes are called Worker Right-to-Know Laws. Also see "Community Right-to-Know" and "SARA."
Hazard Communication Program: A written plan to manage the hazards associated with the use of chemicals in the workplace.
Hazardous Chemical: A substance that may harm the worker either physically (e.g., fire, explosion) or chemically (e.g., toxic, corrosive).
HAZID/HAZOP: HAZard IDentification/HAZard and OPerability analysis systematic design review methods to identify and address hazards to ensure that the necessary safety measures to eliminate or mitigate hazards are incorporated in the design and operation of the unit.

HAZOP: See *HAZID/HAZOP.*
HBP: See *Held by production*.
HBV: Hepatitis B virus. A virus that, upon infection, can cause inflammation of the liver and serious health effects.
HC: Hughes Christensen.
HCl: See *Hydrochloric acid*.
$HClO_2$: See *Chlorine dioxide.*
HCPV (Reservoir): Hydrocarbon pore volume.
H Crossover or Profile: A profile with circulation port.
HDPE: High-density polyethylene. Used in the manufacture of plastic items such as plastic pipe, grocery bags, water coolers, and milk bottles.
HDT: See *Hydraulic detention time.*
HE: See *Hydrogen embrittlement*.
Head: Energy per unit weight of liquid at a specified point, expressed in feet of water column (WC) or pounds per square inch (psi).
Header: A pipe or fitting that interconnects a number of branch pipes.
Heading (Logging): The information on the well at the top of the log.
Heading (Well Flow): The flow of slugs of fluids (unstable behavior).
Head Loss: "Head" is a common term used in discussing pumps. It is a way of expressing pressure in terms of the height of a vertical column of water. In the sketch, the head loss is the height to which the water must build up until there is sufficient pressure to force that particular amount of water through the slots in the comminutor drum.
Heads of Agreement: A preliminary agreement covering the outline terms for the sale and purchase of LNG or natural gas. See *Sales and purchase agreement (SPA).*
Head Station: Mainline receipt point on a pipeline.
Headworks: The facilities where wastewater enters a wastewater treatment plant. The headworks may consist of bar screens, comminutors, and a wet well and pumps.
Heart Cut: In refining, a narrow boiling range fraction, usually taken near the middle portion of the stock being processed.
Heat-Affected Zone: (1) The metal adjacent to a weld or other heated area that has been altered by the heating. (2) The area around a weld or other area in the steel that has been modified by heat and, as a result, is more subject to some forms of corrosion.
Heater Treater: A separator that uses heat to speed the separation of emulsions.
Heat Exchanger: Equipment that allows heat flow between two or more physically separated fluids, without causing mixing between the fluids (however, there are direct contact heat exchangers with mixture of fluids). There is a wide range of possible practical performance, with applications in all industrial fields.
Heating and Ventilating Unit: Another name for an air handling unit that provides only heating and ventilation capabilities.

H

Heating Coil: Coil that uses a heat transfer fluid, condensing refrigerant, or direct electrical resistance elements to provide heating.
Heating Load: Heating rate required to replace heat loss from the space being controlled.
Heating Oil: (1) Oil used for residential heating. (2) Trade term for the group of distillate fuel oils used in heating homes and buildings as distinguished from residual fuel oils used in heating and power installations. Both are burner fuel oils.
Heating Value: (1) The average number of British thermal units per cubic foot of natural gas as determined from tests of fuel samples. (2) The amount of heat produced from the complete combustion of a unit quantity of fuel. There are two heating values: the gross (high) and the net (low) heating value. The gross value is that which is obtained when all of the products of combustion are cooled to standard conditions, and the latent heat of the water vapor formed is reclaimed. The net value is the gross value minus the latent heat of vaporization of the water. (3) Heating value is the amount of energy or heat that is generated when a hydrocarbon is burned (chemically combined with oxygen). It is usually expressed in terms of Btus per unit of measurement. (4) Energy released in the complete combustion of a unit of mass, matter, or volume of a fuel in a stoichiometric mixture with air. The calorific value is called lower or net when the water formed during combustion is considered to be in vapor phase, or steam, with other combustion products. It is called higher or gross when the water formed is considered to be in liquid phase or condensate. (5) Amount of heat produced by the complete combustion of a unit quantity of fuel.
Heat of Combustion: The amount of heat released in burning completely an amount of substance is its heat of combustion. The amount needed for one mole is naturally called the molar heat of combustion. A general formula for the combustion of any organic compound is

$$C_nH_mO_kN_j + (n+m/4+j-k/2)O_2 \longrightarrow nCO_2 + m/2H_2O + jNO_2.$$

Heat of Vaporization: The amount of heat energy required to transform an amount of a substance from the liquid phase to the gas phase is its heat of vaporization. The amount needed for one mole is naturally called the *molar heat of vaporization*.
Heat Pump: Thermodynamic heating/refrigerating system to transfer heat. The condenser and evaporator may change roles to transfer heat in either direction.
Heat Rate: The measure of efficiency in converting input fuel to electricity. Heat rate is expressed as the number of Btus of fuel (e.g., natural gas) per kilowatt hour (Btu/kWh). Heat rate for power plants depends on the individual plant design, its operating conditions, and its level of electric power output. The lower the heat rate, the more efficient the plant.
Heat Recovery: Heat utilized that would otherwise be wasted from a heating system.

Heat Transfer Coefficient: Coefficient describing the total resistance to heat loss from a producing pipe to its surroundings. Includes heat loss by conduction, convection, and radiation.
Heave Compensation System: Working offshore often includes working in inclement weather and rough seas. The lifting and lowering of loads from barges and vessels is affected by these conditions and can cause uncontrolled upswing movements in vertical direction, which can lead to damage of the load. To suppress the movements of the load, a mechanical system, often referred to as "heave compensation system," is devised to dampen and control vertical movements. Two methods of heave compensation exist: passive systems and active systems.
Heave (Geology): The horizontal displacement (travel) of a fault.
Heave (Ship): The vertical motion of a vessel.
Heaving: Partial or full collapse of the wellbore by particles of shale.
Heavy Bottoms: Thick, black substances that remain in refinery stills after all lighter fractions have been processed out of the feedstock.
Heavy Crude: Crude oil of 20° API gravity or less; often very thick and viscous.
Heavy-Duty Vehicles: Trucks and buses having a gross vehicle weight rating of 8500 lb or more.
Heavy Ends: The highest boiling portion of a gasoline or other petroleum oil. The end point as determined by the distillation test reflects the amount and character of the heavy ends present in a gasoline.
Heavy Gas Oil: Petroleum distillates with an approximate boiling range from 651°F to 1000°F.
Heavy Load Skidding System: A system specially to move a heavy drilling package on the deck of a jack-up drilling rig. The cantilever and drill floor structures have been combined to one fixed package, which can be skidded both longitudinally and transversely relative to the deck of the drilling jack-up. The main advantages of the system are a larger reach of the drilling tower, simplified handling of drilling equipment, and minimum obstruction of the deck of the drilling jack-up.
Heavy Metals: Metals that can be precipitated by hydrogen sulfide in an acid solution, including lead, silver, gold, mercury, bismuth, and copper.
Heavy Oil: Lower gravity, often higher viscosity oils. Normally less than 28° API gravity.
HEC: Hydroxyl ethyl cellulose, a synthetic polymer.
Heel: The area of pay closest to the casing in a highly deviated well.
HEGF: High-energy gas fracturing.
HEGS: High-energy gas stimulation.
Held by Production: (1) Keeping an oil and gas lease in effect by producing the well. (2) A leasehold kept in force by production.
Helical Buckling: A buckling characterized by maximum wall contact. Takes the form of a wound spring.
Hematite: A natural deposit of iron oxide.

H

Henry Hub: (1) Pipeline interchange near Erath, Louisiana, where a number of interstate and intrastate pipelines interconnect through a header system operated by Sabine Pipe Line. It is the standard delivery point for the NYMEX natural gas futures contract in the United States, the benchmark natural gas price in the US Gulf Coast. (2) A pipeline interchange/delivery point. Used as a benchmark in gas futures for natural gas pricing.
HEPA Filter: High-efficiency particulate air filter.
Hepatitis: Hepatitis is an acute viral infection of the liver (yellow jaundice).
Hertz: International standard unit of frequency. Replaces the identical older "cycles-per-second."
HES: Halliburton Energy Services.
Hesitation Squeeze: A cement squeeze technique where the cement is squeezed into a channel or leak at a low rate, then allowed to sit and dehydrate by leakoff, before again raising the pressure. The action gradually builds a dehydrated cement node that blocks the channel.
Heterogeneities: Differences.
Heterogeneous: Rock with differences in texture, permeability, porosity, or other factors.
Heterotrophic Bacteria: Bacteria that utilizes organic carbon for energy and cell growth.
Hexafluorosilicates: A by-product and precipitant of the HF—silica reaction.
Hexane: A petroleum liquid found in small amounts in condensates; one of the components of natural gasoline.
Hexene-1: A key feedstock in the manufacture of many high-density and linear low-density polyethylene resins, which are used to make food and drink containers, trash bags, plastic pipe, and other consumer products.
HF: Hydrofluoric acid.
HHp: Hydraulic horsepower.
HHV: See *Higher heating value*.
High-Angle Well: A highly deviated well.
High Anticlinal: Top part of the structure, expected to be the best place to encounter accumulation of hydrocarbons.
High-Density Basement (Seismic): The deepest, thick, high-density rock that serves as a density contrast in an area.
Higher Heating Value (Gross Heating Value): Assumes that the water vapor produced in the combustion process is condensed to liquid. Abbreviated as HHV or GHV.
High-Pressure Water Cleaning: Cleaning at less than 5000 psi water pressure.
High-Rate Water Pack: A sand control operation in which gravel is injected into a well where a screen has been placed. The pressure of the injection is usually at or near the fracture pressure of the reservoir and a pressure

packing of all perforations ensues. Some perf breakdown occurs. The amount of gravel placed is about 40–75 lb/ft of perfs.
High-Sulfur No. 2 Diesel Fuel: No. 2 diesel fuel that has a sulfur level above 0.05% by weight.
High-Sulfur Oil: Usually an oil with more than 1% sulfur.
High-Velocity Cleaner: A machine designed to remove grease and debris from the smaller diameter sewer pipes with high-velocity jets of water. Also called a "jet cleaner," "jet rodder," "hydraulic cleaner," "high-pressure cleaner," or "hydrojet."
High Viscosity Index: Oils have VIs in the range of 85–110 and have the best viscosity/temperature coefficients of conventional base oils. Modern refining techniques such as selective hydrocracking can produce base oils with natural VIs in excess of 140.
Hindered Settling: A flow region in a near vertical well, in which rising fluid or gas hinders the fall rate of liquids of solids, enabling flow from the well.
Hinge Fault: A fault along which there is increasing offset or separation along the strike of the fault plane. Measured from the initial point of separation.
HIPPS (Offshore): High-integrity pressure protection system.
Hipp Tripper™: A brand name of a tool used to deliver rapid impact stokes to a small downhole. Operated by fluid flow.
HJ: Layer thickness.
HLN: Hydraulic landing nipple.
HMSV: Hydraulic multiservice valve.
HMX: Higher temperature perforation charge explosive. A modified RDX.
HNBR: Hydrogenated nitrile (butadiene rubber).
HNS: Hexanitrostilbene; very high temperature perforation charge explosive.
HOA: See *Heads of agreement*.
Hoist: To lift. Also the equipment used to lift.
Hoisting System: Is used to raise and lower pipe in and out of the hole and to support the drill string to control the weight on the drill bit during drilling.
Holdup (Flow): The volume fraction of a specific fluid in the upward moving stream.
Hole Cleaning: Transporting drill cuttings or fill to surface.
Hole Opener: A larger device (usually of a fixed diameter) that enlarges the wellbore to a diameter equal to or less than the upper casing drift. Compare to an underreamer or watermelon mill or string mill.
Holiday: A small hole in a coating.
Hollow Carrier: A perforating gun that surrounds the charges and contains much of the shock of the detonation.
Holocene: An epoch of geologic time from present to 10,000 years ago.
Home-Heating Oil: Is prepared from the middle distillate fractions of crude oil and is used to heat homes and businesses.
Homo Neanderthalensis: A species of human, now extinct, that was common in Europe and the Mideast about 100,000 years ago. The name comes

from Neanderthal, meaning "Neander Valley," in northwestern Germany, which was in turn named after the seventeenth century Latin teacher and school principal Joachim Neander, where the first remains of Neanderthal man were discovered.

Hook (Drilling Rig): The hook on the traveling block from which the elevators are suspended.

Hooke's Law: A statement of elastic deformation, where strain (deformation) is proportional to stress (applied stress).

Hook Load: The actual weight of a pipe string measured at the surface; affected by buoyancy, friction, and other factors in the wellbore.

Hook Wall Packer: Packers equipped with drag blocks or springs so rotation of the pipe unlatches the slips and sets the packer.

Hopper: Mixing chamber where dry components can be evenly mixed with liquids. The dry materials are introduced at the bottom of the hopper through a nozzle.

Horizon: A specific sedimentary layer across a study plane.

Horizontal Drilling: (1) The technique for cutting a hole in geological strata in a horizontal, rather than the normal vertical, direction. (2) A well drilled in a manner to reach an angle of 90° relative to a level plane at its departure point at the surface. In practice, the horizontal section of most horizontal wells varies several degrees. (3) Drilling a well that deviates from the vertical and travels horizontally through a producing layer.

Horizontal Tree: A subsea production tree with a horizontal valve arrangement to the side of the tubing hanger, permitting direct access to the tubing and tubing hanger without having to remove the tree during a workover.

Horizontal Well: (1) Used when reservoir permeability is low or hydrocarbons are being produced from vertical fractures in rock. (2) For a strict definition, a 90° deviated well. Actually the well covers a range of "highly" deviated wells (80° to >90°). In the strictest terms, the deviation is measured as 90° from vertical but tilting.

Horner Plot: A type of buildup pressure test plot. The Horner plot uses a recording of the pressure during pressure buildup to predict its virgin reservoir pressure. The slope (*m*) of the extrapolated line reflects the nature of the reservoir rock and the fluids flowing through the rock. Bedding planes may make the deviation to the bedding planes a different judgment.

Horse Head: The head of a beam lift pump jack, onto which the bridle to the yoke and polish rod attaches.

Horst: A block of the formation that has been raised between two faults.

Hostile Environment (Well): High-temperature, deep, high-pressure, or highly corrosive- or erosive-producing environments (e.g., depth >20,000 ft or 6100 m; temp. > 325°F or 163°C; pressure >20,000 psi; and H_2S or CO_2 content).

Hot-Applied: Of such a consistency at ambient temperature that heating is required before application.

Hot Oil: A technique of injecting or circulating heated crude oil from the surface to help remove paraffin deposits. It is usually only effective for shallow depths when circulated.
Hot Spot (Mantle): An area in the upper mantle from which magma rises. A hot spot can endure for 10 million years or more.
Hot Spot (Shale): A section of the formation with high gamma-ray readings (usually above about 200 SPI units).
Hot Stab: A penetration under pressure.
Hot Tap: A method of attaching a valve or port to a pressurized line without removing the pressure.
Hot Water Boiler: Boiler completely filled with water that furnishes hot water to be used externally to itself at pressures not exceeding 160 psig or at temperatures not exceeding 250°F at or near the boiler outlet.
Hot Water Process: A method for separating bitumen from oil sand using hot water and caustic soda, developed by Karl Clark of the Alberta Research Council.
Hot Water Storage Tank: Tank used to store water that is heated externally.
Hot Work: Operations requiring welding, cutting, grinding, burning, etc.
HP (Facilities): High-pressure facilities and lines.
HPG: Hydroxyl propyl guar; a chemically modified guar.
HPHT: High pressure, high temperature. HPHT is where the undisturbed bottom hole temp at prospective reservoir depth or total depth is greater than 300°F or 150°C, and either the maximum anticipated pore pressure of any porous formation to be drilled through exceeds a hydrostatic gradient of 0.8 psi/ft or a well requiring pressure control equipment with a rated working pressure in excess of 10,000 psi.
HP (Incident): A high-potential incident.
HPLT: High pressure, low temperature. Identification of the problem zone for hydrate formation.
HP (Well): High-pressure facilities or separator train.
HRWP: See *High-rate water pack*.
HS: High sulfur.
HSE: Stands for health, safety, and environment. Also known as environment, health, and safety (EHS) or also safety, health, and environment (SHE).
HSFO: High-sulfur fuel oil.
HSP (Fracturing): High-strength proppant.
HSP (Lift): Hydraulic submersible pump.
HTHP: High temperature, high pressure.
HUD: Hold up depth.
Huff and Puff: A tertiary recovery operation, consisting of first injecting steam, followed by flowing the well back to recover oil that has had its viscosity reduced by application of the heat.
Humidifier: Device to add moisture to air or gases.
Humidify: To add water vapor to moisture to any moisture-adsorbing material, including the atmosphere.

H

Humidistat: Device that responds directly or indirectly to deviation from a desired humidity by actuating a control or initiating a control sequence.
Humidity: Water vapor within a given volume of air.
HVI: See *High viscosity index*.
HWDP: Heavyweight drill pipe.
HWHR (Subsea): Hot water hydrate removal.
HWO: Hydraulic workover, usually working under pressure. Some HWO units are set up with pipe handling capacity as are snubbing units.
HWU: Hydraulic workover unit.
HXT (Subsea): Horizontal tree.
HYD: Hydraulic.
Hydrate: A clathrate-type molecule (cage) of gas and water that forms in a certain range of temperature and pressure in wells. In flow lines, hydrates are a problem in deepwater subsea wellheads and flow lines but also seen in some nearly dry, onshore gas wells. In situ hydrates are a potential natural gas resource.
Hydrate Suppressants: Materials that lower the formation temperature of hydrate molecules.
Hydration: Inclusion of water into the structure of a material.
Hydraulic Centralizer: A downhole tool centralizer that is engaged by raising hydraulic pressure.
Hydraulic Cleaning: Cleaning pipe with water under enough pressure to produce high water velocities.

Using a ball, kite, or similar sewer cleaning device
Using a scooter
Flushing

Hydraulic Detention Time: The amount of time that a wastewater flow is retained in a basin, tank, or reservoir for storage or completion of physical, chemical, or biological reactions.
Hydraulic Disconnect: A disconnect, usually in a BHA that is activated by hydraulic pressure.
Hydraulic Diversion: A diversion technique for injecting fluids into separate zones without added diverters. Limited numbers of perforations or set obstructions in the wellbore can build pressure at higher rates and cause diverting to lower permeability or damaged zones.
Hydraulic Fracture: A fracture creased by hydraulic pressure—usually intentional.
Hydraulic Hammer Effect: An effect, also known as water hammer, in which a pressure wave can be generated behind a rapidly closed valve. The pressure wave travels at sonic speed, reflecting off of the pipe end or the bottom of the well and returning to the valve. If the valve is closed before the wave returns, a hydraulic impact is produced on the valve. Extreme cases are seen with slam closures of subsurface safety valves. Much smaller effects may be produced in front of the valve in a few cases.

Hydraulic Head: Pressure exerted by a column of liquid.
Hydraulic Isolation: Partial isolation without using a direct seal between the device and the flow path. Efficiency depends on fluid viscosity, clearance, and flow rate.
Hydraulic Loading: Hydraulic loading refers to the flows (MGD or cu m/day) to a treatment plant or treatment process. Detention times, surface loadings, and weir overflow rates are directly influenced by flows.
Hydraulic Pump: An artificial lift system that is powered by injected fluid (usually water), which powers a pump similar to the rotating pump used in electrical submersible pumps.
Hydraulics: A general term referring to how fluids move and unload cuttings, etc., in a well. Most common in drilling to ensure clearing and effective pressure control.
Hydraulic Set Packer: Packer set by hydraulic pressure.
Hydraulic Turbine: Thermodynamic engine that obtains work from the mechanical energy, dynamic or potential, contained in a fluid in liquid phase. It transforms the energy of velocity dynamic or pressure potential of the working fluid.
Hydraulic Well Workover: A snubbing job in which the well is workover without killing the well with fluid. Usually accomplished by multiple barriers that seal on the tubulars.
Hydraulic Window (Drilling): The allowable effective fluid density difference between the fracturing pressure and the pressures exerted by a fluid that are needed to control formation flow and the wellbore.
Hydril™: A manufacturer of well equipment. Also a common term for a section stack that utilizes a large rubber "doughnut" that can seal on irregular surfaces or even on itself.
Hydrocarbon: (1) An organic chemical compound of hydrogen and carbon in gaseous, liquid, or solid phase. (2) Organic compound consisting exclusively of carbon and hydrogen atoms in linear, nonlinear, or cyclic chains. The simplest hydrocarbon is methane, formed by a single carbon atom and four hydrogen atoms: CH_4. Methane is the main constituent of natural gas. (3) Organic chemical compounds of hydrogen and carbon atoms that form the basis of all petroleum products. They may exist as solids, liquids, or gases. (4) Molecules composed of hydrogen and carbon atoms, hence the name "hydrocarbons."
Hydrocarbon Hydrates: Chemical compounds formed by combination of hydrocarbon and water. It can be stable in solid state under the operational conditions of the pipeline, which can result in clogging or reduction in the cross section of the flow.
Hydrocarbon Reservoir: Geological storage where hydrocarbons are confined in nature.
Hydrochloric Acid: The most common oil field stimulation acid. A mixture of hydrogen chloride gas in water. Useful for removing calcium scale, some mud and cement damage, and very shallow stimulation of formations with some calcium in the flow path.

H

Hydrocracking: A refining process in which a heavy oil fraction or wax is treated with hydrogen over a catalyst under relatively high pressure and temperature to give products of lower molecular mass.
Hydrocyclone: A cone-shaped device for separating fluids and the solids dispersed in fluids.
Hydrodesulfurization: The removal of sulfur from sulfur-containing hydrocarbon molecules in petroleum distillates and residues by the action of hydrogen under elevated temperature and pressure over a catalyst.
Hydrodesulfurizing: A process for combining hydrogen with the sulfur in refinery petroleum streams to make hydrogen sulfide, which is removed from the oil as a gas.
Hydrofining: A process for treating petroleum fractions and unfinished oils in the presence of catalysts and substantial quantities of hydrogen to upgrade their quality.
Hydrofinishing: Catalytic hydrofinishing has replaced the acid treating of LVI and MVI base oils to a large extent. Improved color, oxidation, and color stability and a reduction in polycyclic aromatic content are achieved by the process that involves the contacting of hydrogen over a catalyst at elevated temperatures and pressure. Also applied to paraffin and microcrystalline waxes.
Hydrofluoric Acid: An acid that reacts with clays. Very harmful to humans in concentrated form.
Hydroforming: A commercial catalytic reforming process developed in 1939 to produce aromatic components for high octane aviation gasoline. One of the several catalytic reforming processes.
Hydrogen: The lightest of all gases, the element (hydrogen) occurs chiefly in combination with oxygen in water. It also exists in acids, bases, alcohols, petroleum, and other hydrocarbons.
Hydrogenation: A refinery process in which hydrogen is added to the molecules of unsaturated hydrocarbon fractions.
Hydrogen Blistering: The formation of cavities just below the surface in a metal. Growth of the near-surface blisters may result in bulges in the metal.
Hydrogen Bond: The strongest attraction between two dipoles is when one or both of them involves a bond between hydrogen and a strongly electronegative atom, like oxygen, fluorine, or nitrogen. Because hydrogen only has one electron, if it forms a bond with an element that is very keen to grab an electron, it becomes much more positive than an element that has plenty of other electrons left to hang around the positively charged nucleus. Dipole–dipole interactions between these sort of molecules (like water [H_2O], ammonia [NH_3], and hydrofluoric acid [HF]) are so much stronger than ordinary dipole–dipole bonds that we give them the special name of "hydrogen bonds."
Hydrogen Embrittlement: A corrosion mechanism in which atomic hydrogen enters between the grains of the steel and causes the steel to become very brittle.
Hydrogen-Induced Cracking: Stepwise internal cracks that connect hydrogen blisters.

Hydrogen Ion Concentration (H+): The weight of hydrogen ions in moles per liter of solution. Commonly expressed as the pH value, which is the logarithm of the reciprocal of the hydrogen ion concentration.

Hydrogen Sulfide: (1) "Rotten egg gas," H_2S. It is responsible for the distinctive odor of Rotorua, in New Zealand. (2) An objectionable impurity present in some natural gas and crude oils and formed during the refining of sulfur-containing oils. It is removed from products by various treating methods at the refinery. (3) Hydrogen sulfide is a gas with a rotten egg odor. This gas is produced under anaerobic conditions. Hydrogen sulfide gas is particularly dangerous because it dulls the sense of smell so that you do not notice it after you have been around it for a while. In high concentrations, hydrogen sulfide gas is only noticeable for a very short time before it dulls the sense of smell. The gas is very poisonous to the respiratory system, explosive, flammable, colorless, and heavier than air. (4) A toxic, corrosive, colorless gas with the characteristic smell of rotten eggs in low concentration. An acid gas.

Hydrogen Sulfide Cracking: Minute cracking just under a metal's surface caused by exposure to hydrogen sulfide gas.

Hydrolysis: (1) Hydrolysis is a reaction where water attacks a part of a molecule, usually breaking it up. An example of hydrolysis is the breaking of the ester linkages to form a soap out of an oil. In this reaction, the ester linkage is broken, releasing an alcohol and an acid. (2) Conversion of organic nitrogen to ammonia by enzymes secreted by bacteria, plants, and animals in a reaction that adds water.

Hydrolytic Stability: The ability of additives and certain synthetic lubricants to resist chemical decomposition in the presence of water.

Hydrometer: An instrument that is dropped in a liquid to measure its specific gravity.

Hydronic System: A closed loop circulating heating hot water or chilled water system that usually consists of a circulating pump or pumps, piping system, air–water separator, expansion tank, and makeup water assembly.

Hydrophilic: (1) From the Greek words for water (*hydro*) and love (*philos*). A hydrophilic compound is one that "loves" water and easily dissolves in it. Having lots of potential for hydrogen bonding or having a charge will make a compound hydrophilic. Most inorganic salts and some organic molecules including ethanol and diethyl ether are hydrophilic. Opposite of hydrophobic. (2) Having affinity for water.

Hydrophobic: (1) From the Greek words for water (*hydro*) and fear (*phobos*). A compound is hydrophobic if it "hates" water and will not dissolve in it. Having little hydrogen bonding capacity and no charge makes a molecule hydrophobic. Most organic molecules, such as hexane, triolein, and styrene are hydrophobic. Opposite of hydrophilic. Nothing to do with rabies (hydrophobia). (2) Repels water.

Hydrophone: (1) A pressure-sensitive receiver that transforms sound to electrical signals that may be recorded. (2) Sound-detecting instruments used

in underwater seismic exploration activities. Hydrophones are attached to cable towed by seismic vessel. Sound waves generated by the blasts from air gun reflect from the formations below the seafloor and are picked up by the hydrophones and transmitted the mother ship.

Hydroset Tool: A tool that is set by hydraulic pressure.

Hydrostatic: The pressure exerted by a column of a single density fluid. For a noncompressible fluid, the pressure (in psi) at any depth = 0.052 × depth × fluid density in lb/gal.

Hydrostatic Pressure: Pressure created by a column of fluid that expresses uniform pressure in all directions at a specific depth and fluid composition above the measurement point.

Hydrotreating: (1) A refinery process to remove sulfur and nitrogen from crude oil and other feedstocks. (2) This is a term for a process by which product streams may be purified and otherwise be brought up to marketing specifications as to odor, color, stability, etc. Hydrotreating, for the removal of sulfur, is the major treating process in refineries. Cracked streams could be saturated and stabilized by converting olefins, albeit under more severe treating conditions. The process involves hydrogen under suitable temperature, pressure, and a catalyst.

Hydroxide: Compounds having the OH ion. Bases or caustics.

Hydroxy Group: An hydroxy group is an –OH group hanging off an organic molecule.

Hygroscopic: (1) Tending to absorb moisture from the atmosphere. (2) Absorbing water from the air.

Hyperbolic Decline: Variable rate of decline over the life of the well.

Hypochlorination: The application of hypochlorite compounds to water or wastewater for the purpose of disinfection.

Hypochlorinators: Chlorine pumps, chemical feed pumps, or devices used to dispense chlorine solutions made from hypochlorites such as bleach (sodium hypochlorite) or calcium hypochlorite into the water being treated.

Hypochlorite: Chemical compounds containing available chlorine; used for disinfection. They are available as liquids (bleach) or solids (powder, granules, and pellets) in barrels, drums, and cans. Salts of hypochlorous acid.

Hypoxia: The depletion of dissolved oxygen in lakes and reservoirs resulting from excessive growth of algae and other microscopic plants.

Hz: See *Hertz*.

I

IA: Inner annulus.
IADC: International Association of Drilling Contractors.
IAM: Integrated asset modeling.
IAxOA: Inner annulus to outer annulus.
IAP: Inner annulus pressure.
IBP: Inflatable bridge plug.
IC: Inner casing.
Ice Scour: The abrasion of material in contact with moving ice in a sea, ocean, or other body of water.
iChoke: Injection choke model. A model that helps identify critical junctures in injection support.
ICOTA: International Coiled Tubing Operators Association.
ICP: Inflatable casing packer.
ICP: Inside casing gravel pack.
ICP: See *Initial circulating pressure*.
ICV (Completion): Internal control valve.
ICV (Injection): Injection control valve.
ID: Inside diameter.
IDC: See *Intangible drilling costs*.
ID Drift (of Pipe): The OD of the drift that will pass through the tube.
Ideal Gas: A theoretical gas that perfectly obeys $PV = RT/m$, where V is the specific volume, T is the absolute temperature, R is the universal gas constant, and m is the molecular weight.
Ideal Specific Gravity: The ratio of the molecular weight of a gas to the molecular weight of air. Molecular weight of air = 28.9644.
Idle Capacity: The component of operable capacity that is not in operation and not under active repair but capable of being placed in operation within 30 days and capacity not in operation but under active repair that can be completed within 90 days.
IDLH: See *Immediately dangerous to life or health*.
IDm: Minimum ID.
IDn: Nominal ID.
IEEE: Institute of Electrical and Electronics Engineers.
IEM: Invert emulsion mud.
IFP: Integrated field planning.
IFT: Interfacial tension.
IGLR: Injection gas lift ratio.
Igneous Rock: Solidified molten rock. Specifically granites, etc.

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IGP: Inside casing gravel pack where no gravel is placed into the perforations.
IGRF (Seismic): International Geomagnetic Reference Field.
II (Injection Well): Injectivity index.
ILD (Logging): Deep induction log.
Illicit Discharge: The flow of substances other than rainwater or snowmelt to a separate storm sewer system whether by direct subsurface connection, overland flow, dumping, or other means.
Illite: A clay type of varying form and composition. Rarely water sensitive. May occur in unusual cases as a fibrous deposit that can act as a particle trap.
ILM (Logging): Medium induction log.
Imbalance Penalties: Penalties implemented by a pipeline to provide an incentive for shippers to maintain actual receipts and deliveries at nominated and confirmed levels.
Imbalance Trading: Process by which shippers can acquire gas from, or sell gas to, other customers to minimize or avoid cash-out.
Imbibition: Absorption and adsorption of fluids into the pores of the rock.
IMF: Intermediate manifold facilities.
Imhoff Cone: A conically shaped, 1 L graduated vessel used to measure the approximate volume of settleable solids in wastewater during various settling periods.
Immature Oil: Young crude or crude that has not been thermally "processed" by heat to generate lighter ends (short carbon chains) and gas.
Immediately Dangerous to Life or Health: An atmosphere that will not support human life.
Impact (in Risk Analysis): Impact (or consequence) is the effect on conditions or people if the hazard is realized (occurs) in practice and probability is the likelihood that the impact will occur. Risk is a function of probability and impact (consequence).
Impaction: The action of particles entering into contact with a surface.
Impedance: (1) Total opposition (resistance, capacitance, and inductance), expressed in ohms, to the flow of current. (2) The effects placed upon an alternating current circuit by induction, capacitance, and resistance. Total resistance in an alternating current (ac) circuit.
Impeller: (1) The rotating pump component that drives the fluid in a centrifugal pump. (2) A set of vanes designed to rotate and move a mass of fluid. The prime mover in a centrifugal.
Impermeable: Rock with passages so small that no effective flow can take place. *Note*: All man-made and natural substances have some permeability, given high pressure, time, enough surface area, and a low permeability fluid.
Imported Crude Oil Burned as Fuel: The amount of foreign crude oil burned as a fuel oil, usually as residual fuel oil, without being processed as such. Imported crude oil burned as fuel includes lease condensate and liquid hydrocarbons produced from tar sands, Gilsonite, and oil shale.

Imports: Receipts of crude oil and petroleum products into the 50 states and the District of Columbia from foreign countries, Puerto Rico, the Virgin Islands, and other US possessions and territories.
Impressed Current: A corrosion control mechanism in which a small charge is used to oppose the electrical current generated by a corrosion cell. The current reduces metal loss at the anode.
Impression Block: A soft lead flat end or cone bottom on a steel tool. The impression block can give ideas on what it is set down upon. Usually run via slickline and set down once to get an imprint. Also derisively called a confusion block.
Impression Packer: An inflatable packer with a soft rubber shell. It is inflated in an interval and then deflated; the rubber shell is a reverse cast of the imperfections in the well. Used to confirm split pipe or perforation density.
Improved (Enhanced) Recovery: (1) The operation whereby natural gas is recovered using any method other than those that rely primarily on the use of natural reservoir pressure, gas lift, or a pump. (2) Technology for increasing or prolonging the productivity of oil and gas fields. This is a special field of activity and research in the oil and gas industry.
Improved Oil Recovery: Any of various methods, chiefly reservoir drive mechanisms and enhanced recover techniques, designed to improve the flow of hydrocarbons from the reservoir to the wellbore or to recover more oil after the primary and secondary methods (water and gas floods) are uneconomic.
Impulse-Fracture Testing: An injection-type test with a goal of estimating reservoir parameters.
IM Standard (BP): Integrity management standard.
Inc (Drilling): Inclination or the deviation of the well from vertical.
Incineration: The combustion of organic matter in wastewater sludge solids after the evaporation of water from the solids.
Inclination (Wellbore): The measurement of a wells deviation from vertical. When used with fluids, a positive number indicates upflow and a negative number may represent downflow.
Inclusion (Corrosion): A nonmetallic phase such as an oxide, sulfide, or silicate particle in a metal.
Incompatible Waters: Waters, which, when mixed, may cause a precipitate.
Independent: Typically a nonintegrated oil or natural gas company, usually active in a few sectors of the industry.
Independent Power Producer: An unregulated power generator that has no franchised retail service territories.
Index Fossils: Fossils specific to a certain geologic time.
Indexing: Tying the commodity price of natural gas in a contract to published prices.
Indexing Tool: A tool that operates by pipe rotation or reciprocation.
Indicator (Chemical): A chemical in a titration reaction that changes color at a certain pH.
Indicator (Mechanical Load): A dial or gauge.

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Indirect Discharger: A non-domestic discharger introducing pollutants to a publicly owned treatment works (POTW). These facilities are subject to the environmental protection agency (EPA) pretreatment regulations.
Induced Spectral Gamma-Ray Log: An activation log.
Inductance: The characteristic of a circuit that determines how much voltage will be induced into it by a change in current of another circuit.
Induction Log: Open-hole log that measures resistance difference between formation and wellbore fluids to various depths in the formation.
Induction Period: A period under given conditions in which a petroleum product does not absorb oxygen at a substantial rate to form gum.
Industrial Chemists: What is the difference between an industrial chemist and a chemical engineer? While a chemical engineer is concerned with moving lots of chemicals around and ensuring reactors do what they're supposed to, industrial chemists are more like real chemists and busy themselves with the reactions that are going on, trying to optimize how much of an industrial product is made and how quickly it is made.
Industrial Consumers: Establishments engaged in a process that creates or changes raw or unfinished materials into another form or product. Generation of electricity, other than by electric utilities, and agricultural uses are included.
Industrial Consumption: Natural gas used for heat, power, or chemical feedstock by manufacturing establishments or those engaged in mining or other mineral extraction as well as consumers in agriculture, forestry, and fisheries. Also included in industrial consumption are natural gas volumes used in the generation of electricity by other than regulated electric utilities.
Industrial Pretreatment (Waste) Inspector: A person who conducts inspections of industrial pretreatment facilities to ensure protection of the environment and compliance with general and categorical pretreatment regulations. Also called an inspector and a pretreatment inspector.
Industrial Wastes: The solid and liquid wastes originating from industrial processes.
Industrial Waste Survey: A survey of all companies that discharge to a POTW. The survey identifies the magnitude of the wastewater flows and pollutants in the discharge.
Industrial Wastewater: Liquid wastes originating from industrial processing. Because industries have peculiar liquid waste characteristics requiring special consideration, these sources are usually handled and treated separately before being discharged to a wastewater collection system.
Industrial Water: Any water used for industrial purpose.
Industry Technology Facilitator: An internationally recognized champion for technology innovation within the oil and gas industry acting as a conduit between technology innovators and the industry.
Inert: A general term meaning nonreactive with the materials with which it contacts.
Inert Gas: A chemically inert gas, resistant to chemical reaction with other substances.

Infant Failure: An early failure; often related to poor design, candidate selection, or installation problems.
Infill Drilling: (1) Wells drilled between established producing wells on a lease in order to increase production from the reservoir. (2) Adding new wells in an existing field within the original well patterns to accelerate recovery or to test recovery methods.
Infiltration: The seepage of groundwater into a sewer system, including service connections. Seepage frequently occurs through defective or cracked pipes, pipe joints and connections, interceptor access risers and covers, or manhole walls.
Infiltration/Inflow: The total quantity of water from both infiltration and inflow without distinguishing the source. Abbreviated I & I or I/I.
Infinite-Acting Reservoir: A reservoir that acts during a short-term test as if it had no boundaries.
Inflatable Packer: A device with metal slats or cords woven around a rubber bladder with an elastomer cover designed to inflate in the wellbore and provide isolation.
Inflow: Water discharged into a sewer system and service connections from such sources as, but not limited to, roof leaders, cellars, yard and area drains, foundation drains, cooling water discharges, drains from springs and swampy areas, around manhole covers or through holes in the covers, cross connections from storm and combined sewer systems, catch basins, storm waters, surface runoff, and street wash waters or drainage. Inflow differs from infiltration in that it is a direct discharge into the sewer rather than a leak in the sewer itself.
Inflow Performance Relationship: (1) The relationship between reservoir or pore pressure, flowing bottom hole pressure, and production rate. Can be calculated from reservoir properties (reservoir pressure, permeability, skin) or can be a curve fitted to experimental data from the well. (2) The relationship that shows inflow as a function of drawdown. Changes with time.
Influent: Water, wastewater, or other liquid—raw (untreated) or partially treated—flowing into an interceptor, reservoir, basin, treatment process, or treatment plant.
Influx: Inflow.
INGAA: See *Interstate Natural Gas Association of America*.
Inhibitor: (1) A chemical that slows a reaction between a reactive fluid and a material. Specifically, acid corrosion inhibitors slow the reaction of acids on steels. (2) An additive substance that, when present in a petroleum product, prevents or retards undesirable changes taking place in the product, particularly oxidation and corrosion.
Inhibitor Intensifier: A chemical that assists the corrosion inhibitor in slowing corrosion in harsh conditions.
Inhibitor Truck: A special truck equipped with a small pump and an inhibitor chemical tank used to treat wells on a scheduled basis.
Inhibitory Substances: Materials that kill or restrict the ability of organisms to treat wastes.

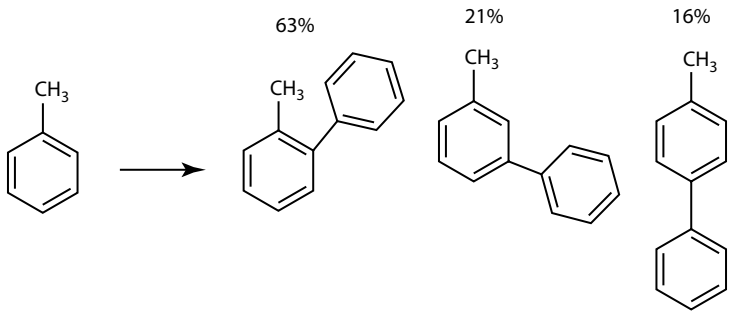
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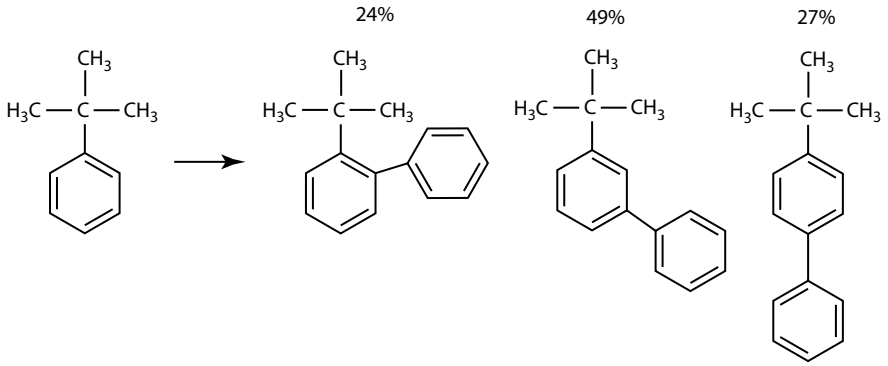
Initial Circulating Pressure: The pump pressure required when a shut-in well that has taken a kick is circulated after initially opening the well.
Initial Established: Established reserves before production.
Initial Gel Strength: The maximum reading from a direct reading viscometer (e.g., Fann VG meter), after the fluid has set for 10 s.
Initial Potential: Flow rate, often from a short test, measured during a test at or just before completion.
Initial Production: Production from a well is generally broken down into three categories: (a) flush or initial, (b) settled, and (c) stripper. It is important to realize that a well cannot maintain the flow rates it made during the first stages of its life.
Initial Reservoir Pressure: The pore pressure in a reservoir at the time of discovery.
Initiator: A compound required to start a chain reaction, such as free-radical polymerization. Unlike a catalyst, it is consumed in the reaction, but only a small quantity is normally required since one molecule of initiator can initiate the reaction of many other molecules.
Injected Gas: (1) Natural gas placed in underground storage or returned to the producing reservoir to maintain pressure. (2) Gas injected into the reservoir to maintain pressure.
Injection Log: A downhole recording or log that shows where fluids are leaving the wellbore. It is used to establish injection profile and to check for leaks and cross flow.
Injection Molding: A plastic-forming process in which molten plastic is forced into a mold under pressure and allowed to solidify.
Injection Pressure-Operated Valve (Gas Lift): Gas lift valves where injection gas enters the valve and acts on the effective bellows area, overcoming the precharge in the valve and opening the valve (the retracting bellows lifts the needle off the seat) to allow gas lift gas flow from the gas-filled annulus through the seat and the reverse flow check valve and into the tubing.
Injection Valve: A downhole valve in an injection well designed to prevent backflow if the injection is stopped.
Injection Well: (1) A well used to inject gas or water into the reservoir in order to maintain reservoir pressure in secondary recovery projects or for conservation purposes. (2) A well used for injecting fluids (air, steam, water, natural gas, gas liquids, surfactants, alkalines, polymers, etc.) into an underground formation for the purpose of increasing recovery efficiency. (3) A well used for pumping water or gas into the reservoir. (4) A well either specifically drilled or, more likely, a poor producer that is converted to inject fluids to stabilize the decline of pressure in a productive zone. An injector is required to have a pressure connection to the pay and to a producing well. Water is typically injected at the base of the pay or in a gas well, or gas is injected into the gas cap.
Injection–Withdrawal Ratio: The ratio of the rate of injection to the rate of production. A target may be as high as 1.0, although it is seldom achieved.

Injectivity Index: Slope of inflow performance relationship for injection. Bbl/psi or m^3/bar.
Injector Head (Coiled Tubing): Coiled tubing handling device that provides pulling and injection power. Usually powered by two to four motors that transmit the forces to the coil through chains equipped with specially shaped couplers.
Inland Barge Rig: A structure consisting on a barge to which drilling equipment is attached for the purpose of drilling in shallow water. The barge is usually sunk to drill.
Inlet: (1) A surface connection to a drain pipe. (2) A chamber for collecting storm water with no well below the outlet pipe for collecting grit. Often connected to a catch basin or a "basin manhole" ("cleanout manhole") with a grit chamber.
Inoculate: To introduce a seed culture into a system.
Inorganic: Material such as sand, salt, iron, calcium salts, and other mineral materials. Inorganic substances are of mineral origin, whereas organic substances are usually of animal or plant origin. Also see *Organic*.
Inorganic Theory: Says that oil and gas were produced during the formation of the solar system and the Earth. The inorganic theory is often used to explain why oil and gas are found in unexpected places and differences in chemical composition.
Inorganic Waste: Waste material such as sand, salt, iron, calcium, and other mineral materials, which are only slightly affected by the action of organisms. Inorganic wastes are chemical substances of mineral origin; whereas organic wastes are chemical substances of an animal or plant origin.
Input–Output: Related to the process of getting data into and out of a computer or processor.
Insert Pump: A pump run on a sucker rod string and set in a pump barrel, then powered with the sucker rod pump.
Inside Blowout Preventer: A valve installed inside the drill stem to prevent flow up the inside of the pipe.
In Situ: (1) In its original place; in position; in situ recovery refers to various methods used to recover deeply buried bitumen deposits, including steam injection, solvent injection, and firefloods. (2) In place or inside the formation.
In Situ Coal Gasification: Gasification of an underground coal seam by injection of air.
In Situ Combustion: Burning a small part of the hydrocarbon to provide heat to reduce the viscosity or thermally crack the heavier ends. See *Fire flood*.
In Situ Stress: The stresses on the formation imposed by the overlying overburden and tectonic forces. The stresses are at least partially offset by the fluids in the pores of the formation.
Instantaneous Settling Velocity: A record of the vertical displacement downward of the sludge solids in a sample. The readings are taken each minute.
Instrument Hanger: A piece of downhole equipment from which gauges and instruments can be suspended.

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Insulated Flange: A flange with plastic gasket and bolt isolation devices to stop electrical conductance.
Insulated Tubing: One of several tubing configurations designed to reduce heat loss from the produced fluids.
Intangible Drilling Costs: (1) All cost incurred in drilling a well other than equipment or leasehold. These expenses are 100% tax deductible even if the well is productive. (2) That part of the drilling and completion expenses that have no practical salvage value.
Integrated: A firm that operates in both the upstream and downstream areas of the energy industry.
Integrated Company: Indicates a firm that operates in both the upstream and downstream sectors (from exploration through refining and marketing).
Integrity Management: All phases of management of the well pressure seal integrity as a principal, critical objective.
Intensifier: A pressure multiplier device used to assist pumping in high-pressure well work.
Interceptor Sewer: A large sewer that receives flow from a number of sewers and conducts the wastewater to a treatment plant. Often called an interceptor. The term interceptor is sometimes used in small communities to describe a septic tank or other holding tank, which serves as a temporary wastewater storage reservoir for a septic tank effluent pump (STEP) system.
Interconnect: (1) The arrangement that allows the connection of customer's communications equipment to a common carrier network. (2) The generic term for a circuit administration point that allows routing and rerouting of signal traffic.
Interconnector (European): A 238 km pipeline providing a strategic link between the United Kingdom and continental Europe, connecting the two gas transmission systems at Bacton in the United Kingdom and Zeebrugge in Belgium.
Intercrystalline Corrosion: Corrosion along the grain boundaries of a metal.
Interesting Example of a Steric Effect: Results for a reaction in which a phenyl ring was added to toluene or t-butylbenzene are given in the following. There are no relevant *chemical* differences between the methyl and *t*-butyl groups; the difference in product distribution is entirely due to the greater size of the *t*-butyl group.





Interface Treatment: A fluid diversion technique using density of the fluid to place fluids or other materials at a specific location in the well.
Interference (Perforating): A perforating gun effect in which the firing of charges overlaps slightly with the effect of one charge affecting the development of a jet in another with the result of reduced penetration.
Intergranular Corrosion: Corrosion along the grain boundaries of a metal.
Intermediate: Any chemical compound that is primarily of interest as one of the steps between the starting material and the final product. It is usually best to design chemical processes so that intermediates do not need to be transported from place or stored in large quantities. Methyl isocyanate, an intermediate in the manufacture of certain pesticides, is a good example. For the horrific consequences of inappropriate and entirely unnecessary storage of this highly toxic intermediate, have a look at: http://www.bhopal.org/
Intermediate Base Oil: Oils with API gravity between 25 and 30.
Intermediate Casing: Often a casing string or liner run to isolate a zone between the surface casing and the final production casing.
Intermittent Lift or Flow: Gas lift where gas is periodically injected into the fluid column.
Intermitter: A time cycle controller that controls gas injection to improve lift.
Internal Cutter: A mechanical, chemical, or explosive device capable of severing the pipe from the inside.
Internal Filter Cake: Filtration control by particles smaller than the pore bridging size that invade the pores and bridge within the pore throats. Often very difficult to remove.
Internal Rate of Return: The interest yield expected from an investment based as a percentage.
Internal Upset: A pipe connection with a smaller ID than the pipe but a consistent OD.
International Load Line Certificate: A certificate that gives details of the minimum freeboard granted to a particular ship and the position of the appropriate load lines to be marked on her sides. This certificate is issued by a government or duly appointed person or organization such as a classification society.

Interruptible Demand: The amount of customer demand that, in accordance with contractual arrangements, can be interrupted by direct control of the system operator, remote tripping, or by action of the customer at the direct request of the system operator.
Interruptible Gas: Gas sold to customers with a provision that permits curtailment or cessation of service at the discretion of the supplier; the opposite is firm gas.
Interruptible Service: Gas service that is subject to interruption at the option of the pipeline or local distribution company (LDC).
Interstate Market: The market for natural gas in the United States that is consumed outside the state in which it is produced or is transported by an interstate pipeline.
Interstate Natural Gas Association of America: Trade organization that advocates regulatory, legislative, and individual positions of importance to the interstate natural gas pipeline industry in the United States.
Interstate Pipeline: A natural gas pipeline company in the United States that is engaged in the transportation of natural gas across state boundaries and is therefore subject to jurisdiction.
Interstitial Water: Water within the pores.
Intervention: In a well work sense, usually a nonrig well entry using wire line or CT intervention where the well head remains attached. Rigs may be used. Compare to workover.
In-transit Deliveries: Redeliveries to a foreign country of foreign gas received for transportation across US Territory and deliveries of US gas to a foreign country for transportation across its territory and redelivery to the United States.
In-transit Receipts: Receipts of foreign gas for transportation across US territory and redelivery to a foreign country and redeliveries to the United States of US gas transported across foreign territory.
Intrastate Market: The market for natural gas consumed in the same state as it is produced.
Intrastate Pipeline: A natural gas pipeline company that is engaged in the transportation of natural gas within the state in which the gas is produced. Subject to regulatory oversight of the applicable state.
Intrusion: An igneous rock body, which when molten forced its way into a surrounding rock. Salt intrusions are also possible.
Invaded Zone: The part of the rock next to the wellbore into which wellbore fluid has leaked.
Invasion (Drilling or Workover): Movement of one fluid into a permeable zone.
Inverse Modeling (Seismic): A modeling technique for two-dimensional (2D) or three-dimensional (3D) seismic where density, susceptibility, or geologic data are calculated or matched to an observed gravity or magnetic field.
Invert Emulsion: An emulsion that has swapped the internal phase to the external phase.

Invert Mud: Water-in-oil emulsion muds. There may be as much as 50% brine in the liquid.
I/O: See *Input–output*.
IOGCC: Interstate Oil and Gas Compact Commission.
Ion: An atom, or molecule, that has lost or gained one or more electrons.
Ion Exchange: Ion exchange (cation or anion) where scaling or water hardening minerals such as calcium and magnesium are removed by substitution for sodium.
Ionic Bond: A bond formed by an atom that has a strong tendency to lose electrons with an atom with a strong tendency to accept electrons.
Ionization: The process of adding electrons to, or removing electrons from, atoms or molecules, creating ions. High temperatures, electrical charges, nuclear radiation, or dissolution in a liquid are some causes.
Ion Milling: A focused ion beam useful in preparing samples of rocks to gain much clearer pictures of pore structures.
IOR: See *Improved oil recovery*.
IP: See *Initial production*.
IPA: Isopropyl alcohol.
IPAA: Independent Petroleum Association of America.
IPC (Field Capacity): Installed production capacity including injectivity.
IPE: International Petroleum Exchange.
IP (Facilities): Intermediate pressure separator or separator train.
IPL: Integrated porosity logging.
IPP: See *Independent power producer*.
IPR: See *Inflow performance relationship*.
IP (Technology): Intellectual property.
IPTT: Interval pressure transient test.
IR: Infrared.
IRISTM: Intelligent remote implementation system.
Iron Control: Chemicals that control the precipitation of iron from solution.
Iron Hydroxide: A brown, gelatinous precipitate that comes out of a spent acid solution when the acid spends completely or when the ferrous iron (+2) in solution at pH > 1.8 oxidizes to ferric iron (+3).
Iron Hydroxide Gels: A precipitate after acid spends.
Iron Reducer: A chemical that helps reduce the valiance state of iron from iron +3 (ferric) to iron +2 (ferrous) in nonsour applications. Helps prevent sludges that are triggered by iron and asphaltic crude in combination with salt water or acid. May also help prevent iron precipitation in sweet wells.
Iron Roughneck: A pipe connection device that sits on the rig floor or is suspended just above the floor. It combines lead and backup tongs with an integral spinning table to spin the top joint during makeup or breakout.
Iron Scales: Iron carbonate, iron sulfide, and other forms of scale deposits containing iron.
Irreducible Water Saturation: The fraction of the pore space occupied by water when the hydrocarbon content is at maximum. This level of water can

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only be reduced below this level by flow of very dry gas that evaporates the water. Rewetting of a core with saturation below the irreducible water point may sharply reduce native state permeability to gas.

ISA: Instrument Society of America.

Isenthalpic: A constant heat loss/gain applied to a calculation and a temperature or pressure can be adjusted to meet this new heat content (around fluid equilibrium considerations).

ISIP: Initial shut-in pressure. Used to isolate the formation fracturing or injection effect from the friction effects.

ISIS™: Integrated subsurface information surveillance.

ISO: International Organization for Standardization, a network of national standards institutes of 146 countries, based in Geneva, Switzerland.

Isobar Map: A map that shows points of similar pressure in a field.

Isobutane: A normally gaseous branch-chain hydrocarbon. It is a colorless paraffinic gas that boils at a temperature of 10.9°F. It is extracted from natural gas or refinery gas streams. See *Butane*.

Isobutylene: An olefinic hydrocarbon recovered from refinery processes or petrochemical processes.

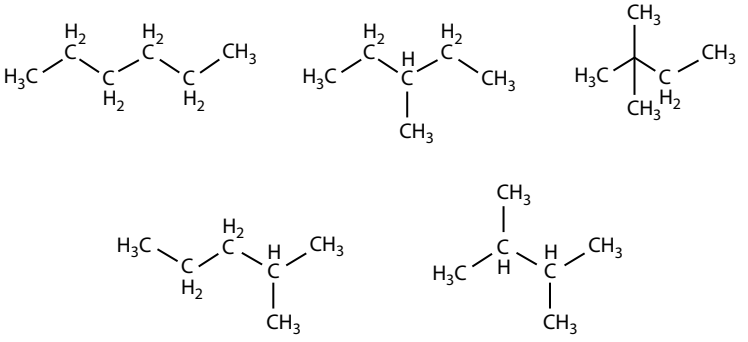
Isochronal Test: A multirate drawdown and buildup test with different drawdowns of the same duration but buildups reaching stabilization.

Isochrone: At the same time.

Isohexane: A saturated branch-chain hydrocarbon. It is a colorless liquid that boils at a temperature of 156.2°F.

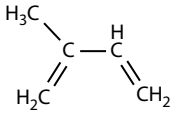
Isolation Transformer: A one-to-one transformer that is used to isolate the equipment at the secondary from earth ground.

Isomer: Generally, any two chemicals with the same chemical formula but a different structure. For example, hexane (C_6H_{14}) could be *n*-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, and 2,2-dimethylbutane:



Isomerization: A refining process that alters the fundamental arrangement of atoms in the molecule without adding or removing anything from the original material. Used to convert normal butane into isobutene (C4), an alkylation process feedstock, and normal pentane and hexane into isopentane (C5) and isohexane (C6), high-octane gasoline components.

Isopach: A map that shows contours between points of equal formation thickness. It may also show the depth of the zone.
Isopentane: See *Natural gasoline and isopentane*.
Isoprene: Monomer sometimes used in chain polymerization. Natural rubber is poly(isoprene), although it is generated in nature from the somewhat more complicated building block mevalonic acid phosphate. Here is a picture:



Isopropanol: Isopropyl alcohol.
Isosaturation: Map showing equal points of a specific fluid saturation.
Isothermal: Taking place at constant temperature.
Isotope: One of several forms of an element, all having the same number of protons but differing in the number of neutrons.
Isotropic: No variation in properties with direction.
ISO Viscosity Grade: The ISO viscosity classification system is an international system approved by the International Standards Organization, for classifying industrial lubricants according to viscosity. Each ISO viscosity grade number designation corresponds to the midpoint of a viscosity range expressed in mm^2/s at 40°C. This system is detailed in the ISO Specification 3448.
ISP: Intermediate-strength proppant.
ISRS: International safety rating system.
ISSSV: Injection subsurface safety valve.
ISV: See *Instantaneous settling velocity.*
ITF: See *Industry technology facilitator.*
IU: See *Internal upset*.
IUD: Instantaneous underbalance device.
IUPAC: The International Union of Pure and Applied Chemists. IUPAC is involved in setting consistent nomenclature, symbols, names of elements, and mathematical variables. Some people think IUPAC is a bunch of funny old men with nothing better to do than meddle with the perfectly good ways of spelling things chemists have used since Paracelsus was a boy, but we polymer scientists know better. Take a wander to the IUPAC website.
IVICV: Infinitely variable internal control valve.
IWOCS (Subsea): Integrated workover control system.

J

J: Productivity index.
Jack: An oil well pumping unit that operates with an up-and-down, or seesawing, motion; also called a pumping jack.
Jack (Beam Lift): Usually a pump jack, operating the rods in a lift and fall motion.
Jacket: The steel lattice structure that supports an offshore platform.
Jacket Platform: (1) An offshore platform constructed entirely of steel. Such platforms generally are held in position by long steel piles driven deep into the seabed. (2) The steel support structure from the sea floor to the top sides.
Jack Knife Rig: A rig with a folding mast that can be lowered and raised relatively quickly.
Jack-Up Drilling Rig: A mobile drilling unit that can elevate itself well above the sea surface on three or more legs to become a stable seabed-supported drilling platform. Drilling jack-ups can operate in water depths up to 150 m. On most jack-up drilling rigs, the drill tower is placed on cantilever beams such that wells supported by an adjacent platform can be drilled in workover mode by skidding the cantilever over that fixed platform.
Jack-Up Rig: (1) A type of mobile offshore platform with retractable legs that stand on the seabed to help support the drilling platform. (2) An offshore rig with retractable steel legs that can be placed on the ocean floor and raise the rig above the water line.
Jar: A device run on slickline, coiled tubing, tubing, or drill pipe that will sharply increase the impact force of the conveyance when trying to retrieve a stuck tool or equipment.
Jar Accelerator: A hydraulic tool used in combination with a jar to increase the impact of the jar on the fish.
Jerk Line (Drilling Rig): A cable from the tongs through a pulley in the mast and to the cat head.
Jet Basket: A device with nozzles and a basket or catch basin to catch smaller pieces of junk stirred up by circulation.
Jet Charge: A shaped charge used in perforating.
Jet Cone Mixer: A mixer that introduces additives to a moving fluid stream through the use of the low pressure formed with fluid passage through a nozzle. An "on-the-fly" mixing device.
Jet Cutter: A radial-shaped charge (explosive) cutter for pipe.
Jet Fuel: (1) High-quality, kerosene-like fuel. (2) Kerosene-type fuels or blends of gasoline, distillate, and residual oils that are used as fuels for gas

turbine-powered aircraft. (3) A kerosene-based fuel that is used as a fuel for turbine engines in airplanes.

Jet Mixer: A type of mixer for cement that uses air pressure to propel the dry cement into the flowing water.

Jet Nozzle: A nozzle through which fluid is pumped to produce an impact force. Used in jetting tools and bits. This nozzle often has a designed shape to maximize impact.

Jet Perforating: Shaped charge perforating.

Jet Pump: An artificial lift device that uses the flow of a power fluid through a nozzle to create a low-pressure area that draws well fluids into the chamber and assists in lift the fluids to the surface.

Jetting: Injecting fluid at high pressure against a target, often with fluid focused through a nozzle tool.

JIB: See *Joint interest billing*.

J-Lay Tower: A pipe-lay method used in deep water to allow the pipe to leave the pipe-lay unit at a vertical departure angle. The tower supports the up-ended pipes.

JOA: See *Joint operating agreement*.

Joint (Connection): Tubular connection.

Joint (Geologic): A large, generally planar fracture through a rock across which there has been no movement.

Joint Interest Billing: Process of distributing the costs related to well completions and operations among working interest partners.

Joint Operating Agreement: (1) Contract between cotenants or separate owners of oil and gas properties being jointly operated. It defines the agreement with respect to initial drilling, further development, operations, and accounting. (2) A written agreement that sets the terms under which a property will be developed by the working interest owners.

Joint (Pipe Length): A section of tubular.

Joint Venture: (1) A project in which two or more parties are involved. Funding may be in direct money or work-in-kind. (2) An investment undertaken by a consortium of companies, usually with one member acting as operator.

Joule–Thomson Effect: (1) The change in temperature of a fluid that occurs when the fluid is allowed to expand in such a way that no external work is done and no heat transfer takes place. The case of most interest is cooling of a compressed gas upon J–T expansion. Note that the J–T effect is not limited to gases; also J–T expansion can, in some cases, produce an increase in temperature, rather than a decrease, although this is not frequently encountered. (2) Thermodynamic effect in a fluid whereby the reduction in its temperature is caused by pressure reduction without energy exchange with the environment. (3) When a real (not ideal) gas expands, the temperature of the gas drops. During passage of a gas through a choke, the internal energy is transferred to kinetic energy with a corresponding reduction in temperature as

velocity increases. The effect for natural gas is approximately 7°F for every 100 psi pressure reduction.

Joule–Thomson Valve: Device that, taking advantage of the Joule–Thomson effect, enables the cooling of a fluid through throttling or reduction of its pressure.

Journal Bearing: A bearing on a rotating shaft.

J Profile: A profile design (less common than F, S, and X). The F allows circulation with the annulus. Used in place of a sliding sleeve but does present a restriction.

JRA: Job risk assessment.

JRC™: Jet Research Center.

JSA: Job safety analysis.

J-Slot: A pin and groove assembly that keeps a tool in the unset position while running and then can be worked or "Jayed" to operate the tool. Common in retrievable packers and liner hangers.

J–T: Joule–Thomson.

Jug: Geophone.

Junction Box: A box, usually metal, that encloses cable connections for their protection.

Junction (Multilateral): The intersection of the lateral and the mother bore when two or more laterals are drilled in a multilateral well or when a single kick-off lateral is drilled from a vertical well. The junction may be unsealed or sealed and may or may not hold pressure.

Junk: Debris in the well.

Junk Basket: See *Jet basket*.

Junk Mill: A rough, sturdy mill for grinding up odd-shaped materials in the well.

Junk Retriever: Junk basket (jet basket).

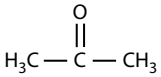
Jurassic: A geologic time period 140 to 200 million years ago.

K

k: See *Permeability*.
Kalrez™: A brand name for a high-temperature seal.
Kaolinite: A clay type marked by platelet-like deposits in the authigenic form. Usually not water sensitive but may have occasional loose attachment to the host grain.
Karl Ziegler: Nobel Prize winning chemist (1898–1973) who did a vast quantity of work on the catalysts allowing high-density poly(ethene) and poly(propene) to be produced. Most of his work was done at the Max Planck Institute for Coal Research in Müllheim, Germany, and had nothing to do with coal, showing the economic benefits of pure research.
Karst: A topography formed when groundwater forms pockets or caves below or in a structure (usually limestone), allowing some of that structure to drop (e.g., create sinkholes). The complete cycle occurs over geologic time.
KB: Kelly bushing on a rig with a rotary table. A depth datum.
Kbbl/d: 1000 barrels per day.
KCl: See *Potassium chloride*.
KCOOH: Potassium formate.
KCPC: See *Key Centre for Polymer & Colloids*.
Kelly: (1) The main rotating shaft on a rotary drilling rig that connects to and turns the drill string. (2) The first and the sturdiest joint of the drill column. It is a thick-walled, hollow steel forging with two flat sides and two rounded sides that fits into the square hole in the rotary table that rotates the kelly joint and the drill column.
Kelly Bushing: The bushing that directly transmits torque from the rotary table to the kelly.
Kelly Cock: The valve on the kelly.
Kelly Down: When the kelly has reached the rotary table, a joint of drill pipe must be added.
Kelly Saver Sub: A short threaded sub that is made up to the kelly and to which the drill string is connected. The connections are made to the sub, saving wear on the kelly threads.
Kelly Spinner: A pneumatic device fitted to the top of the kelly that can spin the kelly.
Kerogen: An initial stage of oil that never developed completely into crude. Typical of oil shales.
Kerogen Type I: Liptinite; (usually lacustrine in origin) has a high hydrogen–carbon ratio and a low oxygen–carbon ratio. Oil prone with a high yield—up to 80%.

K

Kerogen Type II: Exinite; (naphthenic) has an intermediate hydrogen–carbon and oxygen–carbon ratio. Usually formed from marine organic matter (plankton) in a reducing environment. Oil and gas prone with yields of 40%–60%.
Kerogen Type III: Vitrinite; has a low hydrogen–carbon and high oxygen–carbon ratio. Usually dry, low-quality gas prone with low yields. The source is terrestrial vascular plants. Humic coal precursor.
Kerogen Type IV: Inertinite; very low in hydrogen, principally a dead carbon. No oil or gas generating gas potential.
Kerosene: (1) A medium range (C9–C16), straight-chain blend of hydrocarbons. The flash point is about 60°C (140°F), the boiling point is 174°C–288°C, and the density is 0.747–0.775 g/cc. (2) A medium-light distillate from the oil refining process; used for lighting and heating and for the manufacture of fuel for jet and turboprop aircraft engines. (3) Any petroleum product with a boiling range between the approximate limits of 140°C and 270°C, which satisfies specific quality requirements. (4) A light petroleum distillate that is used in space heaters, cook stoves, and water heaters and is suitable for use as a light source when burned in wick-fed lamps. Kerosene has a maximum distillation temperature of 400°F at the 10% recovery point, a final boiling point of 572°F, and a minimum flash point of 100°F. Included are No. 1-K and No. 2-K, the two grades recognized by the American Society for Testing and Materials (ASTM) Specification D3699 as well as all other grades of kerosene called range or stove oil, which have properties similar to those of No. 1 fuel oil. See *Kerosene-type jet fuel*.
Kerosene-Type Jet Fuel: A kerosene-based product having a maximum distillation temperature of 400°F at the 10% recovery point and a final maximum boiling point of 572°F and meeting ASTM Specification D1655 and Military Specifications MIL-T-5624P and MIL-T-83133D (Grades JP-5 and JP-8). It is used for commercial and military turbojet and turboprop aircraft engines.
Kerosene-Type Jet Fuel (Commercial): Kerosene-type jet fuel intended for use in commercial aircraft.
Kerosene-Type Jet Fuel (Military): Kerosene-type jet fuel intended for use in military aircraft.
Ketone: An alkanone or ketone is any carbon compound containing the C–C(O)–C group. Acetone is the simplest ketone and is a common solvent found, for example, in fingernail polish remover.



Kevlar™: An extremely strong fiber, common in composites.

Key Centre for Polymer & Colloids: A research center at the University of Sydney, established and supported under the Australian Research Council's Research Centres Programme. The KCPC is involved in a range of research projects including the use of polymers in rice production and developing a better understanding of paint systems. See our website: http://www.kcpc.usyd.edu.au/.

Keyseat: An out of round borehole worn to the side, often with the side of the drill pipe in a crooked hole, that looks like a key hole. Keyseats create problems with the passage of tool joints and larger pipe that does not bend as easily as smaller diameter pipe.

kh: (1) The permeability times the height; a measure of formation conductivity. (2) Horizontal permeability.

Kick: An unwanted flow of fluids from a formation into the wellbore. Can happen during drilling, completions, or interventions.

Kick-Off Point: The point at which a rapid change of deviation is made in a vertical well.

Kick-Off Pressure (Gas Lift): The gas injection pressure available for unloading fluids from a gas lifted well down to the last valve.

Kickover Tool: A fishing tool that decentralizes the retrieving tool. Commonly used in gas lift.

Kill: A term used to describe various methods to stop flow from a well. Commonly pumping a kill weight fluid into a well to create an overbalance into the formation.

Kill and Block Valve: A downhole valve in the tubing string used to isolate the string and allow a kill without having fluid on the formation.

Kill Fluid: A liquid with a density sufficient so that a full column of the fluid would control the well and prevent fluid entry into the wellbore from any exposed formation.

Kill Lines: Flow lines to the BOP stack, entering below the pipe rams, through which kill weight fluids can be pumped.

Kill Pill: A pill with fluid loss control materials selected to stop losses in the well. A kill weight pill is a fluid with a density high enough to control the well.

Kill Spool: A kill line port located between the shear ram and the slip ram on a BOP.

Kill Weight Fluid: The density of a full column of fluid when the density of that fluid is just high enough to prevent pore fluid flow.

Kilo: Kilogram, 1000 g.

Kilojoule: About a British thermal unit (Btu). Used to express the heat content of gas.

Kilopascal: kPa, 1000 Pa, 6.9 kPa per psi, 1000 psi = 6900 kPa.

Kilowatt-Hour: The basic unit for pricing electric energy, equal to 1 kW of power supplied continuously for 1 h (or the amount of electricity needed to light ten 100 W light bulbs for 1 h).

Kilowatt: A measurement of electric power equal to 1000 W.

Kilowatt Year: A unit of electrical capacity equivalent to 1 kW of power used for 8760 h.
Kinematic Viscosity: The ratio of the viscosity to the density using consistent units. Same behavior as in a Marsh funnel.
Kinetic: The word "kinetic" comes from the Greek word for "motion." In chemistry, kinetics is the study of how fast reactions occur. In many chemical reactions where there are a number of possible products, the first product formed may be the one that is formed most quickly, not necessarily the one that is most stable; if you leave the reaction going, you should eventually form the product that involves the greatest change in bond energy—the thermodynamic product.
Kinetic Hydrate Inhibitor: An inhibitor that prevents solid hydrate plugs.
Kinley Caliper™: A multifinger caliper for determining casing ID condition.
Kitchen: A source rock with sufficient heat and other inputs to produce hydrocarbons.
KJ: See *Knuckle joint*.
kj (Rock): Permeability of a layer.
Kl/d: 1000 L per day.
Klinkenberg Permeability: A method of correcting permeability measurements to account for gas not adhering to the walls of rock pores as does water. Gas permeabilities are usually higher than liquid permeabilities by up to one order of magnitude, especially in dry cores.
KM: Kerr McGee.
Knock: (1) The sound associated with the autoignition in the combustion chamber of an automobile engine of a portion of the fuel–air mixture ahead of the advancing flame front. (2) The noise associated with premature ignition of the fuel–air mixture in the combustion chamber; also known as detonation or pinking.
Knockout: A separator used to remove easily removed or excess gas or water from the produced fluid stream.
Knockout Drum: A vessel wherein suspended liquid is separated from gas or vapor.
Knot: Unit of speed in navigation, which is the rate of one nautical mile (6080 ft or 1852 m) per hour.
Knuckle Joint: A flex joint in a tool string that allows alignment with a target not in the same plane.
KOP: See *Kick-off point*.
KOT: See *Kickover tool*.
KP: See *Kill pill*.
kPa: See *Kilopascal*.
KPI: Key performance indicator.
K-Resin: Branded copolymer resin used to produce clear packaging materials, cups, water bottles, toys, and shower doors.
Krg: Relative permeability to gas.

Kriging (Seismic): The geostatistical method of applying known values in one sample to produce an unbiased estimate of values in another.
Kro: Relative permeability to oil.
Krw: Relative permeability to water.
KT: One thousand metric tons.
Kuff (Process): The partly broken emulsion layer between water and oil in a separator.
k_v: Vertical permeability.
***K* Valve:** See *Storm choke*.
***K* (Viscosity):** The consistency index; is the shear stress or viscosity of the fluid at 1 s^{-1} shear rate. An increasing *K* raises the effective annular viscosity; increases hole cleaning capacity.
kW: See *Kilowatt*.
kWh: See *Kilowatt hour*.
kW-y: See *Kilowatt year*.
Kwm (Drilling): Kill weight mud.

L

LACT: See *Lease automatic custody transfer.*
Lagoonal Deposits: Regionally extensive deposits along the shores of ancient seas. Permeability varies with energy of deposition (amount of residual silt).
Lag Time: The time it takes for drill cuttings to be carried to the surface from the bottom of the well.
Laid-Up Tonnage: Ships not in active service; a ship that is out of commission for fitting out, awaiting better markets, needing work for classification, etc. See *Lay-up.*
Lamellar Corrosion: Localized and subsurface corrosion in zones often parallel to the surface that result in leaving thin layers of uncorroded metal resembling the pages of a book.
Laminar Flow: Fluid flowing at a lower rate with elements of the fluid flowing in fixed streamlines. Laminar friction is a function of NRe (Reynolds number). For laminar flow, the Fanning friction factor is equal to 16/NRe.
Laminated Sands: Sandstone deposits in layers, often with very different permeabilities and frequently found with barriers to vertical flow.
Laminations (Geologic Texture): Parallel layers less than 1 cm thick.
LAN (Computer): Local area network.
Land Casing: Installing casing to the casing set point.
Landing Nipple: A nipple profile that contains a specific profile with a lock and a polished bore for sealing.
Landman: (1) A person who negotiates with the land or mineral rights owner to secure a lease to drill. (2) A member of the exploration team whose primary duties are formulating and carrying out exploration strategies and managing an oil company's relations with its landowners and partners, including securing and administering oil and gas leases and other agreements. (3) A position in the oil and gas industry, the responsibilities of which include acquiring oil and gas leases, negotiating arrangements for development of leases, and general management of leased property.
Landowner's Royalty: An interest in production free of production costs retained by the lessor.
Langelier Index: A calculated saturation index for calcium carbonate, useful in scaling predictions.
Langmuir Isotherm (Gas Adsorption): The relationship of pressure to the amount of adsorption of gas to an organic surface.
Lap: Where the top of the liner comes up inside the upper casing string.

L

Laplace's Law: The larger the vessel radius, the larger the wall tension required to withstand a given internal pressure. A spherical vessel will have half of the wall tension of a cylindrical vessel for a set vessel radius and internal pressure.
LAP (Packer): Leakage across packer elements.
Large Range (LR) and Very Large Crude Carriers: Employed in international crude oil trade. The size of tanker that can be used in any trade (commercial voyage between a port of origin and destination) is dependent on the tanker's length and loaded depth and the size of the loading and unloading ports. The larger ships are used because they reduce the cost to transport a barrel of crude oil.
Laser: Light amplification by stimulated emission of radiation. Light with a narrow spectral width.
Laser Distribution: A percent by volume distribution of the particle sizes in a sample.
Latch: One of the several downhole coupling mechanisms that hold the string to a predetermined load before releasing. Useful for confirming depth and attachment when the string is snapped into or out of a latch.
Latch On: To connect the elevators to the tubing.
Lateral Length: The length of the lateral part of the well, usually in the pay zone. The departure length is the horizontal distance from the surface penetration point to the furthest distance reached by the drill bit.
Lateral (Load): A sideways load.
Lateral Sewer: A sewer that discharges into a branch or other sewer and has no other common sewer tributary to it. Sometimes called a "street sewer" because it collects wastewater from individual homes.
Lateral (Wellbore): An indefinite term, usually meaning one or more departures from a mother bore. May be used in some areas to mean a high-angle wellbore.
Laterlog: An electric log. Formation resistivity measurement with specific conductive muds.
Latex: (1) A latex (plural latices, or latexes for the Americans) is a dispersion of water-insoluble polymer in water. The dispersion is usually of particles (not single molecules) that are around 100 nm (10^{-4} mm) in size. The particles are kept suspended in the water by thermal convection (which keeps them from settling out) and surfactants (which keep them from sticking together to form bigger and bigger lumps). Another word for latex is polymer colloid. (2) An organic cement additive that provides some strength in set cement and fluid loss control in the slurry.
Latin America: The region between Tijuana and Tierra del Fuego containing a few major petroleum-producing countries such as Mexico and Venezuela. So-called because the inhabitants speak badly mispronounced and grammatically incorrect provincial Latin.
Lattice: In a crystal, some arrangement of atoms is repeated in a regular way. If we put an imaginary point at the center of each repeating unit and mentally throw the rest away, the positions of these points will define a crystal lattice.

For example, if the points define the corners of a cube, the crystal is a primitive cubic lattice; if they define the corners and a point in the center of each face (like a die with a one on every side), the crystal is a face-centered cubic lattice, etc. There are 14 basic types of crystal lattice.
Launders: Clarifier effluent troughs.
Lava: Magma that comes to the earth's surface.
Law of Capture (Hydrocarbon Movement): A legal concept, valid in some places, that since oil and gas are mobile fluids, they are not owned until they are produced.
Layer: A distinct segment in a vertical stack of formation sequences. Often with areal extent.
Laying Down Pipe: To disassemble the drill string into individual joints and lay it down on the pipe racks.
Laytime: Time allowed by the shipowner to the voyage charterer or bill of lading holder in which to load and/or discharge the cargo. It is expressed as a number of days or hours.
Lay-Up: To dismantle or unrig a ship for a prolonged period of unemployment.
LCA: Leak-off control acid.
LCA: See *Lost circulation control agent*.
LCM: See *Lost circulation materials*.
LCP: Leakage in closed position.
LCTD: Last crystal to dissolve.
LD: Lay down.
LDC: See *Local distribution company*.
LDC (Transport): Long distance carrier.
LDFN: Lay down for night.
LDHI (Hydrates): Low dosage hydrate inhibitor.
LDLPE: Low-density linear polyethylene. A strong, clear film ideal for packaging.
LDPE: Low-density polyethylene.
LDS (Wellhead): Lock down screws.
Lead Cement: The first part of the cement slurry injected—often contaminated during the flow by mixing with mud from the walls of the pipe or the formation.
Lead Lines (Pipeline): The lines from a well to a battery. Also called gathering lines.
Lead Naphthenate: The lead soap of naphthenic acid that is soluble in mineral oils, used mainly to impart extreme pressure properties to lubricating oils and greases.
Leak-Off Rate: The fluid lost from the well expressed in volume per time.
Leak-Off Test (Drilling): LOT, a drilling test. A LOT is intended to determine the point of leak off. Compare to FIT.
Lean Gas: A near dry gas, containing only a trace of condensate.
Lease: (1) The legal contract that specifies the terms and conditions of the business relationship between an oil company and the landowner or mineral

rights holder on a particular tract. (2) A contract between an owner (lessor) and a tenant (lessee), setting forth the compensation, terms, and conditions upon which the lessee may occupy or use property, real or personal, of the lessor. (3) Legal document giving an operator the right to drill for or produce oil or gas; also, the land on which a lease has been obtained.

Lease Automatic Custody Transfer: A system of monitoring and transferring oil production for receiving into tankage, measuring, testing, and turning into the pipeline the crude produced on a lease.

Lease Automatic Custody Transfer Unit: A calibrated measurement device used as an official sales point for crude oil transfer into a second-party pipeline.

Lease Condensate: A mixture consisting primarily of pentanes and heavier hydrocarbons, which is recovered as a liquid from natural gas in lease separation facilities. This category excludes natural gas liquids, such as butane and propane, which are recovered at downstream natural gas processing plants or facilities. See *Natural gas liquids*.

Lease (Drilling): A legal document granting the right to prospect, drill, complete, and produce hydrocarbons on a tract of land.

Lease Fuel: Natural gas used in well, field, and lease operations such as gas used in drilling operations, heaters, dehydrators, and field compressors.

Leasehold Interest: The right to the mineral interest granted by an oil and gas lease and is also called a working or operating interest.

Lease Hound: A person that acquires leases and resells them to a drilling company.

Lease Setback: The minimum distance away from a lease boundary that a well may be drilled.

Least Principal Stress: Minimum principal stress. Hydraulic fractures form perpendicular to this stress.

LEL: See *Lower explosive limit*.

Lens: A permeable, often small sedimentary deposit bordered by impermeable rock.

Lessee: An organization or individual who obtains a lease from a fee simple owner. In oil and gas, an organization or individual who obtains the mineral rights (the opportunity to look for oil and gas and produce the oil and gas found).

Lessor: The fee simple owner or mineral rights owner who allows an individual or organization to explore for and produce oil and gas on mineral rights that he owns.

Levelwind: A device in a coiled tubing reel control that aids in controlling spooling of the CT.

LFL: See *Lower flammable limit*.

LHV: See *Lower heating value*.

LIB: Lead impression block.

License: An agreement in which a national government gives an oil company the rights to explore for and produce oil and/or gas in a designated area.

License Block: A section of continental shelf area in a particular national sector bounded by latitude and longitude lines, generally at one-degree intervals; a license block is usually subdivided into smaller areas.
License Round: A stage in the allocation of offshore licenses in which a state places a number of specified areas in its sector on offer to oil companies at one time.
Lift Cost: The cost of lifting or flowing fluids from a well to the facilities. Often used as a benchmark for efficiency.
Lift Curve: Tubing performance curve.
Lifting Costs: (1) The cost of producing oil from a well or lease. (2) The operating expenses of producing fluids to the surface.
Lifting Frame: A device on which the CT injector may sit that can be hydraulically raised to allow access to the BHA below the CT connector. Takes the place of a crane.
Lifting Sub: The short pipe section that screws into the top of the tubing hanger and is then latched onto by the elevators to manipulate the tubing string.
Lift-Off Pressure (Mud): The differential pressure across the mud cake from the formation toward the wellbore that will cause some of the mud filter cake to lift off the face of the formation and to reestablish permeability.
Lift Station: A wastewater pumping station that lifts the wastewater to a higher elevation when continuing the sewer at reasonable slopes would involve excessive depths of trench. Also, an installation of pumps that raise wastewater from areas too low to drain into available sewers. These stations may be equipped with air-operated ejectors or centrifugal pumps. Sometimes called a "pump station," but this term is usually reserved for a similar type of facility that is discharging into a long force main, while a lift station has a discharge line or force main only up to the downstream gravity sewer. Throughout this manual when we refer to lift stations, we intend to include pump stations.
Light Crude: (1) Crude oil with a high API gravity due to the presence of a high proportion of light hydrocarbon fractions. (2) Varying definition, typically an API gravity of 30° or 33° up to 40°.
Light Crude Oil: Liquid petroleum that has a low density and flows freely at room temperature.
Light Duty Vehicles: Automobiles and trucks having a gross vehicle weight rating of less than 8500 lb.
Light Ends: (1) Hydrocarbon liquids with lower boiling points that may flash off when pressure is released. (2) The more volatile products of petroleum refining, that is, butane, propane, and gasoline.
Lightering: Unloading cargo from large marine tankers into smaller tankers that can enter shallow-water ports.
Light Gas Oils: Liquid petroleum distillates heavier than naphtha, with an approximate boiling range from 401°F to 650°F.
Lightweight Cement: A cement with a slurry density less than the normal approximate density of 16 lb/gal (1.92 g/cc). Normally in the range of 11–14 lb/gal (1.32–1.68 g/cc).

L

Lignin: The cross-linked polymer of linked benzene rings that makes hardwood hard. It is an important structural material for most land plants and is usually found mixed in with cellulose. The partial digestion of lignin by enzymes (completely different from the ones that break down cellulose) gives complex materials called humic and fulvic acids. These are the substances that give Adelaide water its unique color and flavor.
Lignite: (1) Usually a dark-brown substance that is the lowest rank of coal. (2) Very young coal. Moderate to low energy yield.
Lignosulfonates: A multipurpose additive base derived as a by-product from paper manufacturing. Used as gellants, fluid loss, drilling additives, etc.
LIH: Left in hole.
LIL: See *Log-inject-log*.
Lime: Any of several compounds consisting of calcium hydroxide (Ca(OH)) or calcium oxide (CaO).
Limestone: Calcium carbonate-rich sedimentary rocks in which oil or gas reservoirs are often found.
Limit Control: Control device used to limit the desired maximum or minimum state of the controlled variable or to provide an alarm if those limits are exceeded.
Limited Entry: Penetrating or perforating only part of the pay zone. Usually done to control water or gas entry or to assist in ball sealer action in selective treatments.
Lineal: The length in one direction of a line. For example, a board 12 ft long has 12 lineal feet in its length.
Linear Darcy Law: The Darcy equation describing linear movement of fluids in laminar flow through a porous medium.
Linear Gel: An uncrosslinked polymer gel. Typical polymers are guar, HPG, CMC, HEC, etc.
Line Drive: Using a line of injectors to drive fluid preferentially along a given path.
Line Pack: Creation of storage within the pipeline by increasing pressure above that which is required for transmission but still within a safe limit.
Liner (Casing): A partial string of pipe that does not run back to surface. Liners may or may not be cemented.
Liner Hanger: A packer-like hanger with slips suitable for hanging liner weights. May or may not incorporate a seal.
Liner Lap: The top of a liner, specifically the interval between the liner top and the shoe of the previous casing.
Liner (Perforating Charge): The inner liner over the propellant in a perforating charge, most often made of pressed, powdered copper mixture or drawn or stamped from copper sheet. The liner deforms as the charge is fired and its mass is added to that of the jet from the charge.
Liner (Sand Control): A perforated, drilled, or slotted liner for formation control or to preserve wellbore access.

Liner Tieback: A string of casing, usually of the same size, used to tie a set liner back to a surface.

Liquefaction: (1) The process by which gaseous natural gas is converted into liquid natural gas. (2) Physical process of gas to liquid change, that is, condensation. For natural gas, this process requires cryogenic temperatures since it is impossible to liquefy methane—main component of natural gas—at a temperature above −82.6°C, which is its critical temperature. (3) Liquefaction as applied to sludge digestion means the transformation of large solid particles of sludge into either a soluble or a finely dispersed state.

Liquefaction of Gases: Any process in which gas is converted from the gaseous to the liquid phase.

Liquefaction Plant: Industrial complex that processes natural gas into LNG by removing contaminants and cooling the natural gas to its condensation.

Liquefaction Unit or Liquefaction Train: Equipment that processes purified natural gas and brings it to liquid state. Natural gas has been purified in the pretreatment units before cooling and liquefying it.

Liquefied Natural Gas: (1) Natural gas that has been refrigerated to temperatures at which it exists in a liquid state. (2) An odorless, colorless, noncorrosive, and nontoxic product of natural gas consisting primarily of methane (CH_4) that is in liquid form at near atmospheric pressure. (3) Natural gas liquefied either by refrigeration or by pressure to facilitate storage or transportation. (4) A liquid composed chiefly of natural gas (e.g., mostly methane). Natural gas is liquefied to make it easy to transport if a pipeline is not feasible (as across a body of water). LNG must be put under low temperature and high pressure or under extremely low (cryogenic) temperature and close to atmospheric pressure to liquefy. (5) Natural gas (mainly methane) refrigerated to reach liquid phase suitable for transportation in specialized vessels (LNG carriers). (6) Natural gas (primarily methane) that has been liquefied by reducing its temperature to −260°F at atmospheric pressure. It remains a liquid at −116°F and 673 psig. In volume, it occupies 1/600 of that of the vapor at standard conditions. (7) Natural gas that has been cooled to −26°F and converted into a liquid so that its volume will be reduced for transportation. (8) Hydrocarbons mixture, predominantly methane, kept in liquid state at a temperature below its boiling point. (9) Methane that has been compressed and cooled to the liquefaction point for shipping.

Liquefied Petroleum Gas: (1) Gaseous hydrocarbons at normal temperatures and pressures but that readily turns into liquids under moderate pressure at normal temperatures, that is, propane and butane. (2) Butane and propane mixture, separated from well fluid stream. LPG can be transported under pressure in refrigerated vessels (LPG carriers). (3) A mixture of butane, propane, and other light hydrocarbons derived from refining crude oil. At normal temperatures, it is a gas, but it can be cooled or subjected to pressure to facilitate storage and transportation. (4) Of the gaseous hydrocarbons,

propanes and butanes can be liquefied under relatively low pressure and at ambient temperature. Mixtures of these are known as LPG. (5) A mixture of propane, propylene, butane, and butylenes. When compressed moderately at normal temperature, it becomes a liquid. It is obtained as light ends from fractionation of crude oil. It has a good caloric value; it is used as cooking fuel; because LPG has no natural odor, a distinctive odorant is added so that it will be noticeable should a leak occur. (6) Light ends, usually C3 and C4 gases liquefied for storage and transport. (7) Propane, propylene, normal butane, butylene, isobutane, and isobutylene produced at refineries or natural gas processing plants (includes plants that fractionate raw natural gas plant liquids). (8) A group of hydrocarbon-based gases derived from crude oil refining or natural gas fractionation. They include ethane, ethylene, propane, propylene, normal butane, butylene, isobutane, and isobutylene. For convenience of transportation, these gases are liquefied through pressurization.

Liquefied Refinery Gases: Liquefied petroleum gases fractionated from refinery or still gases. Through compression and/or refrigeration, they are retained in the liquid state. The reported categories are ethane/ethylene, propane/propylene, normal butane/butylene, and isobutane/isobutylene. Excludes still gas.

Liquid Holdup: When gas is slipping by the liquids, emptying only a part of the liquids in the well and leaving a portion of the liquid in the wellbore.

Liquid Level: The depth in a well where the standing or percolating level is located.

Liquids: An aggregate of crude oil and natural gas liquids; also known as hydrocarbon liquids.

Liquid Stabilization: Group of operations that a liquid is subjected in order to allow its storage and handling at atmospheric pressure. These operations withdraw the most volatile components (lightest) of that liquid mixture.

LIT: See *Long ton*.

Lithification: Process of changes that produce rock from sediments.

Litho-Density™ Log: Measures the bulk density of the formation. Useful to estimate lithology.

Lithofacies Map: A map of subsurface changes in formation physical properties.

Lithologic Log: A chart of the physical properties of the formations; specifically rock composition, texture, porosity and type, etc.

Lithology: Rock composition and type; limestone, sandstone, etc.

Lithosphere: Outer layer of the earth including the crust and the uppermost mantle.

Lithostatic Pressure: Overburden pressure of rocks at a depth.

Live Carbon (Shale): Carbon with a type of kerogen content that has a high potential to generate hydrocarbons.

Live Oil: Produced oil before removal of associated gas.

Live Well Workover: A workover done without killing the well (with wellhead pressure and proper barriers).

LLD (Logging): Deep laterlog resistivity.
LLDPE: Linear low-density polyethylene. A strong, clear film ideal for packaging and one of the fastest-growing plastic lines.
LLRT: Liquid level leak test.
LLS (Logging): Shallow laterlog resistivity.
LMRP: Lower marine riser package.
LNFT-IA: Liquid, no flow test, inside annulus.
LNG: See *Liquefied natural gas.*
LNG Cargo Containment Systems: The method of storing LNG during marine transport. One of the four methods is normally employed: self-supporting prismatic type "B" (Conch/lHl), dual membrane (Gaz Transport), single membrane (Technigaz), and self-supporting spherical type "B" (Kvaerner Moss).
LNG Chain: Group of activities that make possible the use of LNG as a means of natural gas transportation from resource areas to consuming markets.
LNG Feedgas Requirements to LNG Plant: Each million tons of LNG annually delivered to a customer is equivalent to approximately 130 mmscfd (million standard cubic feet per day) of natural gas. Over a typical 20-year sale and purchase agreement (SPA), this amounts to 1 tcf (trillion cubic feet) of natural gas. Around 10%–15% of the gas is lost in the process of production, liquefaction, and transportation of the LNG; therefore, the daily rate of gas production necessary to deliver 1 mtpa (million tons per annum) to the customer is about 150 mmscfd. This is equal to 1.1 tcf over a 20-year SPA. A world-scale LNG project delivers at least 7 mtpa, which means it requires a feed of over 1 bcf/d (billion cubic feet per day) of natural gas. LNG production has to be sustained at the plateau level for the life of the project, so the gas reserves must be able to support production of over 1 bcf/day in the 20th contract year. The gas reserves for a project of this dimension have to be in excess of 9 tcf when taking into account the gas that must remain in the reservoir to allow production to be maintained over the life of a 20-year contract.
LNG Markets: There are two primary LNG markets—(1) the Atlantic Basin (or western market) includes Belgium, France, Italy, Spain, Portugal, Greece, Turkey, and the United States; (2) the East Asian market includes Japan (world's largest), South Korea, and Taiwan, soon to be followed by the large emerging markets of India and China.
LNG Project Characteristics: The primary LNG project components are (1) upstream development of long-term, natural gas supply for feedgas to an LNG plant; (2) downstream development of liquefaction, storage, and loading facilities; (3) marine transportation; and (4) further downstream development of receiving terminals for regasification and pipeline transportation to the market. Defining economic characteristics of LNG projects includes (1) commercial activities organized around project components in which the buyer and seller are closely linked for 20–25 years; (2) significant front-end infrastructure investment for each ton of LNG delivery capacity (the critical

mass of infrastructure for an LNG project must be very large in order to achieve production quantities adequate for the realization of economies of scale and to secure project financing); and (3) long-term contracts based on large, proven gas reserves.

LNG Quality: Group of characteristics that define the LNG, including heating value, Wobbe index, density, and gas/liquid ratio. All these characteristics are determined by the composition of LNG, this is, the mole fractions of the different components constituting that LNG.

LNG Refrigerant (for Liquefaction) Cycles: Natural gas liquefaction requires the removal of sensible and latent heat over a wide temperature range using a refrigerant. The refrigerant may be part of the natural gas feed (an "open-cycle process") or a separate fluid continuously recirculated through the liquefier (a "closed-cycle process"). Three general types of refrigeration cycle are used—cascade-refrigerant, mixed-refrigerant, and expander cycle:

- *Cascade-refrigerant cycle:* Feedstock natural gas is cooled, condensed, and subcooled in heat exchange with propane, ethylene (or ethane), and finally methane in three discrete stages. The three refrigerant circuits generally have multistage refrigerant expansion and compression, each typically operating at three evaporation temperature levels. After compression, propane is condensed with cooling water or air, ethylene is condensed with evaporating propane, and methane is condensed with evaporating ethylene.
- *Expander cycle:* In its simplest form, process refrigeration in an expander cycle is provided by compression and expansion of a single-component gas stream. High-pressure cycle gas is cooled in countercurrent heat exchange with returning cold cycle gas. The cycle gas is expanded through an expansion turbine, reducing its temperature to a lower temperature than would be given by expansion through a Joule–Thomson valve.
- *Mixed-refrigerant cycle:* Uses a mixed refrigerant(s) instead of the multiple pure refrigerants in the cascade cycle. The mixture composition is specified so the liquid refrigerant evaporates over a temperature range similar to that of the natural gas being liquefied. A mixture of nitrogen and hydrocarbons (usually in the C1 to C5 range) is normally used to provide optimal refrigeration characteristics. MRC provides greater thermodynamic efficiency, lower power requirement, and use of smaller machinery.

LNG Storage Tanks: Vessels that are specially constructed to contain LNG. The tanks are generally constructed of nickel steel (steel containing 9% nickel) to withstand cryogenic temperatures and are insulated to maintain the LNG at –161°C. Some of the stored LNG boils off, and the resulting vapor is used as fuel gas for the plant. There are three main designs of LNG storage tanks: single containment, double containment, and full containment.

The difference in these systems lies in the functionality of the secondary containment, when the primary containment is breached. For single containment, neither liquid nor vapor will be held by the secondary containment; for double containment, liquid will be contained, and for full containment, liquid and vapor will be contained.

LNG Tankers: Double-hulled ships specifically designed to handle the low temperature of LNG, insulated to limit the amount of LNG that boils off. LNG carriers are up to 1000 ft long and require a minimum water depth of 40 ft when fully loaded.

LNG Value Chain: In planning, funding, and executing an LNG project, each element of the complex chain that links the natural gas in the ground to the ultimate consumer ("from the wellhead to the burner tip") is considered. The main links are natural gas production, liquefaction, shipping, receiving terminal (including regasification), distribution of the regasified LNG, and, lastly, consumption of the gas.

Load: The amount of electric power used by any electrical unit or appliance at any given moment.

Load Balancing: Process of matching customers' demand for natural gas with producers' ability to supply.

Load Carrying Capacity: A qualitative term used to describe the ability of a lubricant to resist film rupture and protect against wear and surface destruction under conditions of high speeds, loads and temperatures, and combinations thereof.

Load Cell: A device based on strain gage technology that helps measure the surface weight of coiled tubing.

Loaded Leg: That portion (or subdivision) of a ship's voyage during which the ship is carrying cargo.

Load Fluid: The fluid that is injected into a well.

Loading: Quantity of material applied to a device at one time.

Loading Days: The number of days allowed to load a cargo defined in the charter party.

Load Wear Index (Formally Called Mean Hertz Load): An index of the ability of a lubricant to prevent wear under applied loads as determined by the Four-Ball EP tester.

Local Distribution Company: (1) A utility that takes natural gas from a local delivery point (generally called the city gate) and distributes it to local customers. A business entity that obtains its primary revenues from the operations of a local retail gas distribution. (2) Takes possession of natural gas at the city gate and distributes it to residential, commercial, industrial, and utility power users.

Location, Damp (Damp Location): Partially protected locations, such as under canopies and roofed open porches. Also, interior locations that are subject only to moderate degrees of moisture, such as basements and barns.

Location, Dry (Dry Location): Areas that are not normally subject to water or dampness.

Location, Wet (Wet Location): Locations underground; in concrete slabs, where saturation occurs; or outdoors.
Lock: A mechanism to hold a plug in a profile.
Lockout/Tagout: A systematic approach to controlling hazardous energy so it cannot harm someone who is working on a process component. DANGER: Never operate a control that has been locked or tagged by someone else.
Loess: Deposits of wind-borne dust.
Log: A systematic recording of data from a well.
Logged Depth: Total depth or measured depth.
Logging While Drilling: A technique using a suite of logs that are part of the drilling BHA. The formation properties are measured while drilling (although 40–60 ft back from the bit) and the information is pulsed to the surface.
Log Header: The information section at the top of a printed well log.
Log-Inject-Log: A production or injection well logging technique where the zones are logged for water saturation, oil saturation, or temperature, followed by fluid injection, and followed by another logging pass. Data available include changes in saturations, quantitative/qualitative determination of injection location, and amount of temperature charge.
Long Radius Well: A description of well deviation change at about 2°–6° per 100 ft.
Long String: In a side-by-side dual completion, the tubing string that connects the deeper zone to the surface.
Long-Term Gas Contract: A supply contract in the physical market covering natural gas deliveries.
Long Ton: 2240 lb or 1016.05 kg. See *Metric ton*.
Looping: Laying additional pipeline beside and connected to an existing pipeline in order to increase the capacity of the system.
LOP (Production): Loss of production.
LOP (Rock Mechanics): Leak-off point. The departure from the straight line of a limit test on a wellbore. Usually from a leak-off test after casing is set and before drilling ahead.
LO (Reservoir Fluid): See *Live oil*.
Losal: Low salt or fresher water.
Lost and Unaccounted for Gas: The difference between the quantity of natural gas received into a system and the quantity of natural gas delivered out of a system over a specific period of time.
Lost Circulation: During circulation, when less fluid returns to the surface than was injected into the well. Severe lost circulation is the loss of all returns.
Lost Circulation Control Agent: Any of a number of materials that control the loss of fluids to the formation. See *Filter cake*.
Lost Circulation Zone: A high-permeability zone that takes fluids from the wellbore and the conventional filter cake building materials have no effect on fluid losses.

Lost Pipe: Any pipe lost in the hole.
Lost Returns: Loss of returning fluid during circulation of a well.
LOT: See *Leak-off test*.
Lot or Batch: The lot or batch shall consist of an indefinite number of containers, offered for acceptance, of materials manufactured by a single plant run through the same processing equipment, with no change in ingredient materials.
Louver: Assembly of sloping vanes intended to permit air to pass through and to inhibit transfer of water droplets.
Low Alloy Steel: Steel with less than about 5% alloying additives.
Low Carbon Steel: Steel with less than 0.30% carbon and no other alloys.
Low Energy System (Geologic): A depositional environment where deposited sediments are poorly sorted and can have a large proportion of very fine particles.
Lower Completion: The part of the completion below the packer.
Lower Crown Plug (Subsea): A plug that fits in the bore of a subsea tree, usually below the tubing hanger, to serve as the primary barrier against reservoir pressure.
Lower Explosive Limit: (1) The lowest concentration of gas or vapor (percent by volume in air) that explodes if an ignition source is present at ambient temperature. At temperatures above 250°F, the LEL decreases because explosibility increases with higher temperature. (2) The lowest concentration of vapors, expressed in percent, that will ignite in the presence of a flame, spark, or other source of ignition. Also known as *Lower flammable limit*.
Lower Flammable Limit: The lowest concentration of a gas or vapor (percent by volume in air) that burns if an ignition source is present.
Lower Heating Value: The Btu content per unit of fuel excluding the heat from the condensation of water vapor in the fuel.
Lower Kelly Valve: A near full-opening valve installed just below the kelly. It has the same outside diameter as the tool joints.
Low-Pressure Squeeze: A cement squeeze technique with a final squeeze pressure below the formation fracturing pressure.
Low-Pressure Water Cleaning: Cleaning at less than 5000 psi water pressure.
Low Solid Mud: Mud with a low suspended solid quantity. It may be formulated with brine with high density created by dissolved salt.
Low Sulfur No. 2 Diesel Fuel: No. 2 diesel fuel that has a sulfur level no higher than 0.05 percent by weight. It is used primarily in motor vehicle diesel engines for on-highway use.
Low Viscosity Index: Oils reduce viscosity rapidly as temperature increases. These oils have typical Vis in the range 0–30.
Low-Water Cutoff: In a boiler system, a device to automatically cut off the fuel supply when the surface of the water falls to the lowest safe waterline.
LP (Facilities): Low-pressure separator or separator train.
LPG: *See Liquefied petroleum gas*.
LPS: Low-pressure separator.

L

LPSA: Laser particle size analysis.
LPSD: Laser particle size distribution.
LPS (Downhole Gage): Loss of pressure signal.
LPT (Downhole Gage): Loss of pressure and temperature signal.
LRG: See *Liquefied refinery gases*.
LRP: Lower riser package.
LS: Low sulfur.
LSA (Scale): Low specific activity scale. Low radioactivity scale.
LSFO: Low sulfur fuel oil.
LSOBM: Low solid oil-based mud.
LT&C: Long thread and coupled, a connection description.
LTA: Lost time accident.
LTA (Seals): Leakage to annulus.
LTBS: Liner tieback sleeve.
LTOBM: Low toxicity oil-based mud.
LTRM: Long-term reservoir management.
LTS: Low temperature separation.
LTS (Downhole Gage): Loss of temperature signal.
LTSI: Long-term shut-in.
LUB: See *Lubricator.*
Lubricants (Lubes): (1) Materials that reduce torque and drag. May be oil, synthetic (polymer) liquids, graphite, glycols, glycerines, etc. (2) Substances used to reduce friction between bearing surfaces or as process materials either incorporated into other materials used as processing aids in the manufacture of other products or used as carriers of other materials. Petroleum lubricants may be produced from either distillates or residues. Lubricants include all grades of lubricating oils from spindle oil to cylinder oil and those used in greases. (3) Specially formulated oils that reduce friction between moving parts and help maintain the mechanical parts. Lubricating oils are used in gasoline and other engines.
Lubricator: A pressurized shell, mounted above the BOP or master valve, that houses the tool string when entering a live well.
Lubricity: Lubrication properties of a given drilling mud.
LVI: See *Low viscosity index*.
LWD: See *Logging while drilling.*
LWL: Low water loss.
LWRP: Lower workover riser package.
Lyophilic: An easily suspended colloid. Having an affinity for the suspending medium.

M

M: See *Molar*.
M100: A 100% (neat) methanol.
M3: Cubic meter. 0.16 barrels. (6.28 barrels per meter.)
M85: A fuel containing a mixture of 85% methanol and 15% gasoline.
MAASP: Maximum allowable annular surface pressure.
Macaroni String: A small diameter string, usually attached to the outside of the tubing, used to place inhibitors and other chemicals downhole. May also be used to describe any small tubing.
Macrogalleria: A great website that has a lot of information about polymer chemistry. Or, as they describe themselves, "a cyberwonderland of polymer fun": University of Southern Mississippi.
Macroscopic: Once we had the word "microscopic," it was only a matter of time before we needed "macroscopic"; anything big enough to be seen with the naked eye is macroscopic in size.
Magma: Molten rock (lava) that crystallizes into an igneous rock.
Magnetic Basement (Seismic): Usually a crystalline unconformity on which a nonmagnetic sedimentary rock sequence has been deposited.
Magnetometer: Instrument used to measure the intensity and variances of the magnetic fields in the Earth.
Main: A distribution line that serves as a common source of supply for more than one service line.
Main Bore: Motherbore or main wellbore from which a lateral bore is drilled.
Main Cryogenic Heat Exchanger: Main heat exchanger in the liquefaction unit where cooling and liquefaction of natural gas take place by means of heat exchange with cooling fluids.
Main Line: Branch or lateral sewers that collect wastewater from building sewers and service lines.
Main Sewer: A sewer line that receives wastewater from many tributary branches and sewer lines and serves as an outlet for a large territory or is used to feed an intercepting sewer.
Major: Typically a large operator, usually a multinational oil company that is usually a large producer in several areas of the world.
Major Interstate Pipeline: In the United States, a pipeline company whose combined sales for resale and gas system throughput, transported interstate or stored for a fee, exceeded 50 bcf in the previous year.
Make a Trip: The round trip of pulling the drill string from a well and returning it to bottom. Usually done to change or check the bit or to change the BHA.

M

Make Hole: Drill.
Makeup: Screw pipe joints together.
Makeup Tongs: Specialized wrenches used for making up pipe connections.
Makeup Water: Water supplied to replenish the water of a system.
Male Coupling: The part of a connection with threads on the outside.
Maltene: A cyclic compound associated with asphaltenes that helps keep asphaltene platelets in suspension.
Managed Pressure Drilling: An adaptive drilling process used to precisely control the annular pressure profile throughout the wellbore (IADC definition).
Management of Change: A process to understand all the implications of a change to a procedure.
Mandrel: A round bar or tube (i.e., as in a packer) around which other parts are mounted.
Manhole: An opening in a sewer provided for the purpose of permitting operators or equipment to enter or leave a sewer. Sometimes called an "access hole" or a "maintenance hole."
Manifest: Document containing a full statement of the ship's cargo, extracted from the bill of lading.
Manifold: A junction or center for connecting several pipes and selectively routing the flow.
Manifolds: A pipe spool in which a number of incoming pipes are combined to feed to a common output line.
Manning Scales: The minimum number of officers and crew members that can be engaged on a ship to be considered as sufficient hands with practical ability to meet every possible eventuality at sea.
Manometer: Instrument for measuring head or pressure; basically a U-tube partially filled with a liquid, so constructed that the difference in level of the liquid leg indicates the pressure exerted on the instrument.
Mantle: The middle layer of the Earth, lying just below the crust and composed of relatively high-density rock.
Manufactured Gas: (1) A gas obtained by destructive distillation of coal, or by the thermal decomposition of oil, or by the reaction of steam passing through a bed of heated coal or coke. Examples are coal gases, coke-oven gases, producer gas, blast furnace gas, blue (water) gas, and carbureted water gas. Btu content varies widely. (2) Gas produced by certain processes from oil, coal, or coke.
MAOP: See *Maximum allowable operating pressure.*
Maraseal: A Marathon Oil water/zone control chemical. For matrix shutoff.
Marble: A metamorphic rock composed largely of calcite.
Marcit: A Marathon Oil water/zone control chemical. For fracture shutoff.
Mare's Tail (Process Facility): A frayed rope-line strand inserted in a flow line before a separator that aids in separation of entrained droplets in a flowing liquid.

Marginal Field: (1) A field that may not produce enough net income to make it worth developing at a given time; should technical or economic conditions change, such a field may become commercial. (2) A field at the edge of commercial viability.
Marginally Consolidated: Formation with an unconfined compressive strength of less than 300 psi. Can be crushed with fingers.
Marginal Probability of Hydrocarbons: The probability that oil and gas occur in commercial quantities, using existing recovery technology under current economic conditions.
Marine Riser: (1) An outer steel shell that connects a drill ship, jack-up, or floater to the well template on the ocean floor. The drill string is run through the riser and the returning mud and cutting flow up the drill pipe/riser annulus. (2) Pipe connecting offshore installation to a subsea wellhead or pipeline for drilling or production purposes.
Marker (Circulation): A material such as a dye, sand, and grain that can be recognized as the fluid is circulated. Useful for determining swept volume of the hole.
Marker (Formation): An easily identified formation that is used to identify the start of a rock sequence. In the wellbore, a marker is a material placed in the circulating fluid that can be easily seen when the fluid returns to surface—helps identify the swept volume of the wellbore.
Marker Fossils: Fossils specific to a particular age.
Market Aggregators: The marketers who collect customers and find suppliers to meet their demand. They work either on margin basis or on commission.
Market-Area Storage: Storage or hub facilities located near natural gas users (markets).
Market-Based Price: The price for natural gas as determined by the decisions of many buyers and sellers in a market.
Market Center: An interchange where multiple pipelines or electric transmission lines interconnect and form a hub.
Market Clearing Price: The price at which supply equals demand.
Marketed Production: Gross withdrawals less gas used for repressuring, quantities vented and flared, and nonhydrocarbon gases removed in treating or processing operations. Includes all quantities of gas used in field and processing plant operations.
Marketing: Getting people to give you money for goods or services. The relative importance of marketing and research to the well-being of society can be measured by the amounts of money spent on each activity.
Marketing Affiliate: A marketer who is owned or controlled by a pipeline company. See *FERC Order 497*.
MARPOL: Marine pollution international regulations produced by the International Convention for the Prevention of Pollution from Ships, 1973, as adopted by the International Conference on Marine Pollution convened by the International Maritime Organization, which is the regulatory body in

respect of pollution by oil, noxious substances, harmful substances in packaged forms, sewage, and garbage.

Marsh Funnel: A funnel-shaped device of specific volume and shape and outlet that is used to quickly estimate the viscosity of the drilling mud by the time it takes a funnel volume to flow out of the funnel. The Marsh funnel viscosity is reported as the number of seconds required for a given fluid to flow 1 quart through the funnel.

Martensite: A hard carbon supersaturated iron characterized by needlelike microstructure.

Masking Agents: Substances used to cover up or disguise unpleasant odors. Liquid masking agents are dripped into the wastewater, sprayed into the air, or evaporated (using heat) with the unpleasant fumes or odors and then discharged into the air by blowers to make an undesirable odor less noticeable.

MASP: Maximum allowable surface pressure.

Master Bushing: A device that fits into the rotary table to accommodate the slips and drive the kelly bushing.

Master (Captain): Highest officer aboard ship who oversees all ship operations; has general charge of the vessel, overall responsibility. Handles all ship's records and communications and receives and implements instructions from home office; takes command of vessel in inclement weather and in crowded or narrow waters. See *Crew*.

Master Valve: The main shut-in valve on the well.

Mast (Rig Up): A portable derrick, usually a single unit that can be quickly raised.

Material Safety Data Sheet: (1) A description of the HSE data for a marketed product. (2) Printed information that describes the properties of a hazardous chemical and ways to control its hazards. (3) A document that provides pertinent information and a profile of a particular hazardous substance or mixture. An MSDS is normally developed by the manufacturer or formulator of the hazardous substance or mixture. The MSDS is required to be made available to employees and operators whenever there is the likelihood of the hazardous substance or mixture being introduced into the workplace. Some manufacturers are preparing MSDSs for products that are not considered to be hazardous to show that the product or substance is not hazardous.

Matrix: The physical structure of a clastic rock.

Matrix Acidizing: Acidizing a rock below the fracturing pressure, either to reduce the formation damage or to improve the initial permeability.

Maureen Platform: Located 163 miles offshore Aberdeen, Scotland, Maureen is the world's first large reusable platform—and is currently for sale. Like all of Phillips' UK fields, Maureen was named after the wife of the geoscientist who discovered the field.

MAWP: See *Maximum allowable working pressure*.

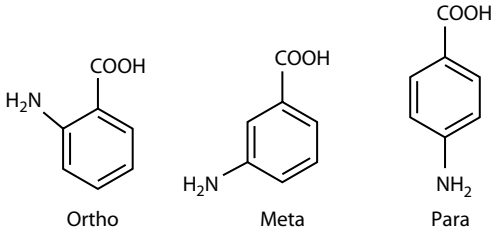
Maximum Allowable Operating Pressure: The maximum gas pressure at which a pipeline system or process facility is allowed to operate.

Maximum Allowable Working Pressure: The maximum pressure to which a surface vessel can be operated or the maximum pressure during treating to which a well should be exposed.
Maximum Capacity of Pipeline: The maximum amount of natural gas a segment of pipeline can contain at a given time.
Maximum Daily Quantity: The maximum daily quantity of natural gas that can be nominated for delivery to a customer's premises.
Maximum Demand: The greatest of all demands of the load that has occurred within a specified period of time.
Maximum Efficient Rate: The maximum rate that a field can be produced or drawn down in pressure without undue stranding of oil that could be lost during more rapid production. Setting the MER requires knowledge of fluid and rock properties and well design throughout the formation.
Maximum Principal Stress: The direction of greatest Earth stress in a reservoir. Hydraulic fractures are parallel to this stress.
MaxIP: The largest production volume for a month, divided by the number of days in that month.
Mbal: Material balance calculation of fluid production.
MBD: Thousands of barrels per day.
MBE (Heavy Oil): Matrix breakthrough event.
MBE (Reservoir): Material balance equation.
MBH: One thousand Btu per hour (also Mbtuh).
mboe: Million barrels of oil equivalent.
MBPD: Thousands of barrels per day.
MBT: Methylene blue test.
MCF, Mcf: (1) A measurement of volume denoting one thousand cubic feet of natural gas. 1 Mcf of gas = 1.03 million BTUs (also, 1 kWh = 3,412 BTUs). See *note under cubic foot for alternative term*. (2) The abbreviation for "thousand cubic feet," the standard measure for natural gas. (3) Thousand cubic feet. (4) 1000 ft^3, usually measured at a specific set of conditions. Also see *Natural gas (units)*.
MCHE: See *Main Cryogenic Heat Exchanger*.
MCRT: See *Mean cell residence time*.
MCS: Master control station.
MD: Measured depth—along the hole measurement of depth of the well. As opposed to true vertical depth (TVD).
mD (Frequently Shown Incorrectly as md): See *Millidarcy*.
MDQ: See *Maximum daily quantity*.
MDRT: Measured depth relative to the rotary table.
MDT: Modular formation dynamics tester.
Mean Cell Residence Time: See *Solids retention time*.
Meandering Stream: A stream that traverses relatively flat land, ultimately creating different channels in response to floods and sediment buildup.
Measured Depth: (1) Depth measurement of a wellbore as measured along the drill pipe without respect for vertical penetration. (2) The depth of the well measured along the wellbore. Also called logged or driller's depth.

M

Measured Flow: A flow that has been physically measured.
Measurement while Drilling: Downhole logging while drilling. "Logging while drilling" is one form of "measurement while drilling"—to differentiate it from mud logging, wire line logging, etc. See *Logging while drilling.*
Mechanical Aeration: The use of machinery to mix air and water so that oxygen can be absorbed into the water. Some examples are paddle wheels, mixers, or rotating brushes to agitate the surface of an aeration tank; pumps to create fountains; and pumps to discharge water down a series of steps forming falls or cascades.
Mechanical Filter: A strainer-type filter that is specifically for removal of larger particles in a liquid stream.
Mechanical Integrity Test: (1) The act of setting a packer or retrievable bridge plug above the perforations in a wellbore and applying pressure to the annulus in order to ensure soundness of the casing. (2) A regular pressure test on an injection well to assure the integrity of the isolation seal.
Mechanical Jar (Wire Line Tools): A device used to provide a short space of free wire line travel before solidly connecting to the BHA in a string. Used in fishing.
Mechanical Properties: Things you can measure while you push, twist, bend, tear, fold, spindle, or mutilate something—the simplest example is probably putting a known force (stress) on a piece of something and measuring how far it stretches (strain). Millions of pages have been written about stress–strain curves.
Media: The material in a trickling filter on which slime accumulates and organisms grow. As settled wastewater trickles over the media, organisms in the slime remove certain types of wastes, thereby partially treating the wastewater. Also the material in a rotating biological contactor or in a gravity or pressure filter.
Median: The middle measurement or value. When several measurements are ranked by magnitude (largest to smallest), half of the measurements will be larger than the median value and half will be smaller.
Medium Crude Oil: Liquid petroleum with a density between that of light and heavy crude oil.
Medium Radius: A description of well deviation change at about 8° per 100 ft.
Medium Viscosity Index: Oils reduce viscosity less than LVI oils as temperature increases and have typical Vis in the range 30–85.
MEG: Monoethylene glycol. A hydrate inhibitor.
Megajoule: Equivalent to one million joules or 3.6 MJ = 1 kWh.
Megawatt: A unit of electric power equal to one million watts or 1000 kW.
Melting Point: The temperature at which a solid turns into a liquid. As temperature is a measure of the kinetic energy of molecules (how much they are moving around), this means that the molecules are moving too much to stay in one place anymore.
Memory Logs: Usually slickline or coiled tubing (CT) logs that record data electronically and are downloaded later.

Memory Tool: Any downhole tool that records the information rather than transmitting the data back to surface.
Meniscus: A phenomena between a liquid and a solid surface created by adhesion and cohesion forces. The meniscus may be upward where adhesion forces are stronger than cohesion or downward when cohesion forces are stronger. (2) The curved top of a column of liquid (water, oil, mercury, etc.) in a small tube.
MeOH: Methyl alcohol.
MEOR: Microbial enhanced oil recovery.
MER: Maximum efficient recovery or rate.
Mercaptans: (1) Compounds of carbon, hydrogen, and sulfur found in sour crude and gas; the lower mercaptans have a strong, repulsive odor and are used, among other things, to odorize natural gas. (2) A class of compounds containing carbon, hydrogen, and sulfur. The shorter chain materials are used as an odor marker in natural gas.
Merchant Oxygenate Plants: Oxygenate production facilities that are not associated with a petroleum refinery. Production from these facilities is sold under contract or on the spot market to refiners or other gasoline blenders.
Mercury Pore Measurement or Porosimetry: Mercury is injected at stepwise increasing pressures where large pores fill first, followed by smaller pores at successfully higher pressures. Volumes injected at different pressures indicate the pore size distribution.
Mesh: A measurement of particle size based on the openings per inch in a screen.
Meshrite™: A sand control screen made from steel wool trapped between two perforated or slotted liners.
Mesophilic Bacteria: A group of bacteria that grow and thrive in a moderate-temperature range between 68°F (20°C) and 113°F (45°C). The optimum temperature range for these bacteria in anaerobic digestion is 85°F (30°C) to 100°F (38°C).
Mesozoic: A geologic time era from 65 million to 250 million years ago.
Meta: Three really cool little Greek words that we use to describe where things are attached to phenyl rings. Let's say we have one functional group attached to a phenyl ring—a carboxylic acid group—to give us benzoic acid. If we now attach a single amino group to the phenyl ring, there are three possible products:



The third of these, para-aminobenzoic acid, is known by its acronym PABA and is an ingredient in sunscreens. Ortho and meta are also used to distinguish between two acids whose molecular formulas are identical except for the amounts of hydrogen and oxygen. IUPAC is gradually cracking down on this sort of thing.

Metal Deactivator: An organic type of additive having the property of suppressing the catalytic action of metal and traces of metallic materials exposed to petroleum products. The most important catalytic action is the promotion of oxidation.

Metallizing: Coating of a surface with metal.

Metallocene Catalyst: Precision catalysts that provide extended manufacturing control over the molecular structure and properties of polyethylene. When used to manufacture linear low-density polyethylene (LLDPE), the result is a film of exceptional clarity and strength that is ideal for food packaging.

Metallocene Compounds: The key ingredients in the company's proprietary metallocene catalyst.

Metal-to-Metal Seal: A seal in a pipe joint, flapper seal, or other area based entirely on the fit or the deformation of one metal surface against another.

Metamorphic: Change produced in a rock to another state by temperature, pressure, time, or chemical influence.

Meter: A mechanical device for automatically measuring and recording quantities of gas.

Meter Factor: A correction factor applied to a meter to increase measurement accuracy in a range.

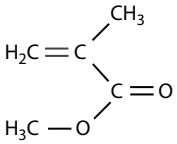
Meter Slippage: Related to the amount of fluid that slips by a meter without being accurately recorded.

Methane: (1) The simplest of the hydrocarbons and the chief constituent of natural gas. Methane, a gas at normal temperatures and pressures, boils at –263°F. (2) The principal constituent of natural gas. (3) The principal constituent of natural gas; the simplest hydrocarbon molecule, containing one carbon atom and four hydrogen atoms. (4) Is the primary ingredient of natural gas. The chemical formula is CH_4. (5) A natural gas. The simplest alkane.

Methanol: (1) A colorless liquid with essentially no odor and very little taste. The simplest alcohol; it boils at 64.7°C. It is miscible with water and most organic liquids (including gasoline) and is extremely flammable, burning with a nearly invisible blue flame. Methanol is produced commercially by the catalyzed reaction of hydrogen and carbon monoxide. It was formerly derived from the destructive distillation of wood, which caused it to be known as wood alcohol. (2) A light, volatile alcohol intended for gasoline blending as described in Oxygenate definition. (3) Methyl alcohol, a common hydrate inhibitor.

Methyl Mercaptan: A sulfur-based chemical used primarily to produce methionine (a food supplement for poultry) and agricultural chemicals.

Methyl Methacrylate: Monomer commonly used in chain-addition polymerizations.



Methyl methacrylate

Methyl Tertiary Butyl Ether: (1) A colorless, flammable, liquid oxygenated hydrocarbon that contains 18.15% oxygen and has a boiling point of 55.2°C. It is a fuel oxygenate produced by reacting methanol with isobutylene. (2) An ether intended for gasoline blending as described in Oxygenate definition. (3) A lead-free, anti-knock additive for gasolines.
Metocean: A contraction of the words "meteorology" and "oceanology" referring to the waves, winds, and currents conditions that affect offshore operations.
Metric Ton: (1) Equivalent to 1000 kilos, 2204.61 lb.; 7.5 barrels. (2) Approximately 7.4 bbls of 36° API crude.
Mexican: Pertaining to Mexico, one of the major crude oil producers of Latin America. Petrologists now think that the asteroid impact that helped kill off the dinosaurs (which crashed into Mexico 65 million years ago) also created the right geologic conditions to form Mexico's petroleum deposits. Also sometimes used in a pejorative sense when referring to inhabitants of the state of Victoria.
MFCT: Multifinger caliper tool.
MFE: A trademark for a repeat formation tester.
MFP: Manifold flowing pressure.
MFT: Manifold flowing temperature.
MG: Initials for "million gallons."
mGal (Seismic): Milligal.
MGD: Initials for "million gallons per day."
MGI: Miscible gas injection.
mg/L: See *Milligrams per liter, mg/L*.
MGL: Mean ground level.
MI: Move in (as in equipment).
Mica: A silica mineral, often present as ultrathin flakes and sometimes mobile.
Micelle: (1) Organized blob of surfactant molecules with all the hydrophobic tails pointing inward to create a tiny hydrophobic phase. If you try to dissolve surfactant molecules in water, you will succeed up to a point as more surfactant is added, and then any additional surfactant you add will form micelles. Under the same conditions, a particular surfactant will always form micelles of the same size and containing almost the same number of surfactant molecules. (2) An association or grouping of molecules in suspension.

M

Microbeads or Microballoons: Small, hollow ceramic or glass beads used as a lightening agent for special, ultralightweight cements.
Microbes: Microbiological organisms. Tiny, one-celled organisms, like bacteria and viruses.
Microcement: Cement with very small particle size.
Microemulsion: An emulsion with very tiny, highly dispersed bubbles. May be very stable and highly viscous when the internal phase is high (>75%).
Microgels: Lumps of nondispersed polymer.
Microlaterlog: A pad contact microresistivity log. Useful for assessing the flushed zone fluid in contact with the pad.
Microlog: A special resistivity tool that measures the resistivity of the mud cake on one curve and the resistivity of the fluids in the formation, but near the wellbore, on a different curve. Separation between the curves is an indication of permeability since mud cake builds on permeable zones.
Micron: One-millionth of a meter, μm.
Micron Rating: A rating of the opening in a screen (or in a filter less accurately). A micron is approximately 1/25400th of an inch.
Microorganisms: (1) Microscopic living organisms such as protozoa, bacteria, viruses, algae, and fungi. (1) Very small organisms that can be seen only through a microscope. Some microorganisms use the wastes in wastewater for food and thus remove or alter much of the undesirable matter.
Micropolishing: A very smooth finish on the interior walls of a pipe to reduce friction during fluid flow.
Microporosity: Very small pores created by high surface area, authigenic clay deposits. May trap water in structure and indicate higher Sw.
Microseism: A weak vibration of the ground that can be detected by seismographs and caused by wind, waves, or human activity but not earthquakes.
Microseismic: (1) The small energy emissions from small feature tectonic events, including production of fluids from a reservoir and the resultant transfer of overburden to the matrix of the reservoir. (2) A method of tracking a fracture by listening for the sounds of shear fracturing in the formation during the hydraulic fracturing process.
Middle Distillates: (1) A general classification of refined petroleum products that includes distillate fuel oil and kerosene. (2) Medium-density refined petroleum products, including kerosene, stove oil, jet fuel, and light fuel oil. (3) Refinery products in the middle distillation range of refined products: kerosene, heating oil, and jet fuel.
Middle East: Far northwest.
Midstream: (1) The processing, storage, and transportation sector of the petroleum industry. (2) A term sometimes used to refer to those industry activities that fall between exploration and production (upstream) and refining and marketing (downstream). The term is most often applied to pipeline transportation of crude oil and natural gas.

Midstream (Operations): The area between upstream and downstream operations. Usually includes pipelines.

Midterm Gas Contract: A supply contract in the physical market covering gas deliveries up to 18 months, although most midterm contracts are for 1 year or less. These contracts can be characterized by (1) variable prices, where the cost of the commodity is indexed over time to the future price of some published spot price; (2) fixed reservation fee and service fee; and (3) mainly fixed volumes per day or per month with modest variation. These contracts are of long enough term to hedge price risk with financial instruments. These contracts are important for local distribution companies (LDC5) because they can extend over a heating season. See *Physical gas contract*.

Mid-Water Pipe: A pipeline to transfer fluids or gases between two floating facilities when ultra-deepwater makes sea bottom pipe configurations uneconomical or technically unacceptable. Typically, a mid-water pipe would be configured at a depth of 100 to 300 m.

MI (Flooding): Miscible injection.

Migration (Fluids): The movement of fluids, generally away from a source rock through permeable layers toward a trap or vent.

Migration (Seismic): A computation applied to seismic data that returns reflection events (signals) to their origin in the subsurface.

Mile: A nonmetric unit of length that can be divided into 8 furlongs, 80 chains, 360 rods, 1760 yards, 5280 ft, 8000 links, or 63360 in. It is equal to 1609.344 m, more or less.

Mill: A cutting tool used to grind up metal, dress off a fish, or open up a window for a kickoff.

Milli: Prefix, meaning one-thousandth.

Millidarcy: 1/1000th of a Darcy.

Milligal (Seismic): Unit of acceleration used in gravity measurement. 1 gal = 1000 mgal. 1 gal = 1 cm/s^2. 1 mgal = 10 gravity units.

Milligrams per Liter (mg/L): A measure of the concentration by weight of a substance per unit volume in water or wastewater. In reporting the results of water and wastewater analysis, mg/L is preferred to the unit parts per million (ppm), to which it is approximately equivalent.

Milling: Removing a blockage, fish, or casing wall by drilling with a metal-cutting device to gain access to the area beyond.

Million Gallons: A unit of measurement used in wastewater treatment plant design and collection system capacities or performances.

Millout Extension (Packer): A large diameter tube below the packer where a grab will deploy when the packer is being milled out.

Mill Scale: An iron oxide on the pipe walls that is formed during pipe manufacture.

Mils per Year: (1) A corrosion, abrasion, or erosion measure of penetration through the walls of the measured material. MPY reports the material loss as an average across a surface and does not accurately reflect penetration by localized pitting. (2) A measurement of corrosion.

M

Mineral: A compound of generally known composition and structure involving naturally occurring silica-based formulations. Minerals are natural compounds formed by geologic processes.
Mineraloid: A natural compound that does not meet the stricter mineral definitions.
Mineral Rights: The ownership of the in-place (in the reservoir) hydrocarbon.
Minerals Management Service: (1) Under the Department of the Interior (DOI) responsible for OCS leasing and production programs and royalty management. (2) A US government agency that oversees minerals production from US federal lands.
Mini Frac: See *Data frac*.
Minimum Bend Radius: The minimum radius (R) that a pipe with a tube OD (D) can bend around and remain in the elastic region. $R = E(D/2)/\text{Sy}$ (R is in inches). $E = 30 \times 106$ psi.
Minimum Principal Stress: Least principle stress in a rock. Hydraulic fractures form perpendicular to this stress.
Minimum Royalty: The lowest payment a lessee can pay on an OCS lease after production begins. It is equivalent to the yearly rental, typically $3 per acre or $8 per hectare. Rentals are paid annually before a discovery; royalties are paid on production after a discovery. If the total royalty payments amount to less than the yearly rental, the minimum royalty payments make up the difference. See *Rent and royalty*.
Miocene: An epoch of time from 5.3 to 25 million years ago.
MIR: Maximum injection rate.
MIRU: Move in, rig up.
Miscellaneous Products: Includes all finished products not classified elsewhere (e.g., petrolatum, lube refining by-products (aromatic extracts and tars), absorption oils, ramjet fuel, petroleum rocket fuels, synthetic natural gas feedstocks, and specialty oils).
Miscible: Fluid phases that mix together without forming a distinct boundary.
Miscible Flooding: An oil recovery process in which a fluid, capable of mixing completely with the oil it contacts, is injected into an oil reservoir to increase recovery.
Miscible Gas Drive: Injection of a large volume of gas from an injection well where the gas is designed to lower the viscosity of the oil and help displace it toward the wellbore.
Misfire: In perforating; fail to fire the perforating gun.
Mission: Phillips' corporate mission is to provide superior financial returns for its shareholders.
Mississippi: Basically Queensland with rather fewer beaches. The oppressed minority population of Mississippi could not vote until the 1860s! The geologic epoch known as the Carboniferous (286–360 years before present [YBP]) in which many of the world's major coal deposits were deposited is divided into the Mississippian (286–320 YBP) and Pennsylvanian (320–360 YBP) in American-speaking countries.

Mississippian: A geologic period of time from 320 to 265 million years ago.
Mist Flow: A flow regime where droplets of liquids are entrained in the gas flow.
MIT: See *Mechanical integrity test*.
MIT-IA: Mechanical integrity test—inside annulus.
Mitigation: An action taken to reduce the impact or consequences of an event.
MIT-OA: Mechanical integrity test—outer annulus.
MIT-T: Mechanical integrity test—tubing.
Mixed Layer Clays: Typically mixtures of illite and smectite or other clays. These may or may not be water sensitive.
Mixed Liquor: When the activated sludge in an aeration tank is mixed with primary effluent or the raw wastewater and return sludge, this mixture is then referred to as the mixed liquor as long as it is in the aeration tank. Mixed liquor also may refer to the contents of mixed aerobic or anaerobic digesters.
Mixed Liquor Suspended Solids: Suspended solids in the mixed liquor of an aeration tank.
Mixed Liquor Volatile Suspended Solids: The organic or volatile suspended solids in the mixed liquor of an aeration tank. The volatile portion is used as a measure or indication of the microorganisms present.
Mixed Metal Hydroxide: A type of drilling fluid.
Mixing Box: Compartment into which two air supplies are mixed together before being discharged.
Mixing Tank: A preparation tank for gel, mud, treating chemicals, etc.
Mixing Valve: Three-way valve to mix two fluids.
ML: See *Multilateral*.
MLSS: See *Mixed liquor suspended solids*.
MLT: Mud line temperature.
MLVSS: See *Mixed liquor volatile suspended solids*.
MMbls: Million barrels.
MMBtu, MMBTU: One million British thermal units (BTU5).
MMcf: See *Natural gas (units)*.
MMCFD: Million cubic feet per day.
mmcfd: See *Natural gas (units)*.
MMH: See *Mixed metal hydroxide*.
MMO: Mixed metal oxides.
MMS: See *Minerals management service*.
MMSCFD: Millions of standard cubic feet per day. A commonly used unit to measure gas flows.
MMscf (Gas Volume): Millions of standard cubic feet.
Mobility Ratio: A comparison of the ability of a fluid to move through another fluid or to displace the fluid.
Mobilize: Transport to the location.
MOC: See *Management of change*.
Model D Packer: A trademarked name for a very common packer.

M

Modified Isochronal Test: A multirate drawdown and buildup test with different drawdown pressures but the same duration.
MODU: Mobile offshore drilling unit.
Modular Perforating Gun: A set of hollow carrier guns that can be run with wire line and stacked in the well before being fired.
Modulating Control Valve: Valve capable of increasing or decreasing by increments the fluid flow according to deviation from the set control value.
Module: Self-contained box or package built with a specific purpose (e.g., wellhead, oil and gas separation, gas compression, platform power generation, mud, storage, diesel, filter, and exhaust) located on production installations.
Modulus of Elasticity: Stress over strain. A measure of stiffness or Young's modulus (E). Rocks are ½ to 12 × 106 psi, and mild steel is 30 × 106 psi. Modulus refers to stress at a predetermined level of elongation, usually at 100% elongation. The higher the modulus of a compound, the more apt it is to recover from loading or localized force, and the better is its resistance to extrusion.
MOE: Millout extension.
Mohr–Coulomb: A plotted relationship that predicts shear stress levels at various envelopes of effective normal stress.
Mohs Scale: A ten-point scale of mineral hardness. The levels are keyed to the minerals: talc, gypsum, calcite, fluorite, apatite, orthoclase, quartz, topaz, corundum, and diamond.
Mol%: The molar composition of a sample of natural gas expressed as a percentage of the whole.
Molar: (1) The adjective derived from "mole." The total heat released when a mole of something burns is its molar heat of combustion; the concentration of a substance expressed in moles/liter is its molar concentration. (2) A solution of one gram molecular weight of a compound dissolved in enough water to make one liter of solution.
Mole: The mole is defined as the amount of a substance that contains as many atoms or molecules as atoms are contained in 0.012 kg of carbon-12. The easiest way to think of it is that a mole of a substance of a particular weight will weigh that many grams. There are about 6.02×10^{23} particles in a mole.
Molecular Oxygen: The oxygen molecule (O_2) that is not combined with another element to form a compound.
Molecular Sieve: Equipment used to retain water vapor from the gas stream to be processed. The retention takes place by water adsorption in the sieve bed.
Molecular Weight: (1) Molecules are too small to put on a scale, but if you put 6.022×10^{23} of them (60 220 000 000 000 000 000 000, Avogadro's number) on a scale, they will weigh about 2 g (if they are hydrogen molecules, H_2), 128 g (if they are butyl acrylate molecules, $C_7O_2H_{12}$), or 10 tons (if they are typical molecules of poly(acrylamide)). This number is their "molecular weight." (2) The sum of the atomic weights of the elements in the compound.

Molecule: The smallest part of an element or compound that still has all the properties of the element or compound.
Molybdenum Disulfide: A chemical compound of molybdenum and sulfur that has excellent properties as a solid lubricant due to the molecular structure of the particles.
MON: See *Motor octane number.*
Monkey Board: The spot where the derrick man works.
Monobore: A tubular string all the same diameter. Some monobore definitions exclude profiles, and some do not.
Monocline: A simple fold with an otherwise uniform dip, in local steepening strata. All strata are inclined in the same direction.
Monoculture: While the farms of antiquity grew many sorts of plants and animals on the same location, modern factory farming involves the cultivation of a single species, to the exclusion of all other forms of life. This is called monoculture.
Monolayer: A full layer of proppant, only one proppant thick.
Monomer: (1) Any small molecule that can undergo a reaction in which it is incorporated into a large molecule containing many similar units. Common monomers are vinyl acetate, styrene, butadiene, and vinyl chloride. (Yes, it is appropriate to consider hydrocarbons as polymers of methylene!) (2) A simple molecular unit (such as ethylene or styrene) from which a polymer can be made.
Monte Carlo Risk Assessment: A method of assessment that helps identify the risk in data analysis or sampling.
Montmorillonite: A water reactive clay mineral, now called smectite, a common component of bentonite.
Moon Pool: (1) An aperture in the center of a drillship or semi-submersible drilling rig, through which drilling and diving operations can be conducted. (2) An open shaft in a deep-sea drilling vessel, usually located in the center of the hull, through which the drilling takes place.
MOP (LWD): Mud operated pulse.
Mosquito Bill: A siphon tune on a downhole pump.
Most Favored Nation Clause: Contract clause that ties the contract price to the rates paid in other contracts, usually specifying the region to be taken into consideration, such as a county, state, field, basin, or other geographic or geologic area.
Most Probable Number: (1) The number of coliform group organisms per unit volume of sample water. Expressed as a density or population of organisms per 100 mL of sample water. (2) A density of coliform organisms per one hundred millimeters. The results of the multiple-tube fermentation technique for the analysis for coliform group bacteria are reported as a most probable number. The test procedures are given in Part 908 of "Standard Methods" and Table 908.11 on page 924 lists most probable numbers for various combinations of positive tube results.

M

Motherbore: The main wellbore from which a lateral wellbore is drilled.
Mother Hubbard Clause: "Covers and includes any and all lands owned or claimed by the lessor adjacent or contiguous to the land." It typically allows for additional 10% coverage of lands not included in the lease description.
Motile: Capable of self-propelled movement. A term that is sometimes used to distinguish between certain types of organisms found in water.
Motor Efficiency: The ratio of energy delivered by a motor to the energy supplied to it during a fixed period or cycle. Motor efficiency ratings will vary depending upon motor manufacturer and usually will be near 90.0%.
Motor Gasoline Blending: Mechanical mixing of motor gasoline blending components, and oxygenates when required, to produce finished motor gasoline. Finished motor gasoline may be further mixed with other motor gasoline blending components or oxygenates, resulting in increased volumes of finished motor gasoline and/or changes in the formulation of finished motor gasoline (e.g., conventional motor gasoline mixed with MTBE to produce oxygenated motor gasoline).
Motor Gasoline Blending Components: Naphthas (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene, xylene) used for blending or compounding into finished motor gasoline. These components include reformulated gasoline blendstock for oxygenate blending (RBOB) but exclude oxygenates (alcohols, ethers), butane, and pentanes plus. *Note*: Oxygenates are reported as individual components and are included in the total for other hydrocarbons, hydrogens, and oxygenates.
Motor Gasoline Blending of Oxygenates: Blending of gasoline and oxygenates under the Environmental Protection Agency's "substantially similar" interpretive rule (56 FR [February 11, 1991]).
Motor Gasoline (Finished): A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in spark–ignition engines. Motor gasoline, as defined in ASTM Specification D4814 or Federal Specification VV-G-1690C, is characterized as having a boiling range of 122°F to 158°F at the 10% recovery point to 365°F to 374°F at the 90% recovery point. "Motor gasoline" includes conventional gasoline; all types of oxygenated gasoline, including gasohol; and reformulated gasoline but excludes aviation gasoline. *Note*: Volumetric data on blending components, such as oxygenates, are not counted in data on finished motor gasoline until the blending components are blended into the gasoline.
Motor Octane Number: The octane number of a motor gasoline determined in a special laboratory test engine under high "engine-severity" conditions, giving a measure of the high-speed knock properties of the fuel.
Motor Oil: Refined lubricating oil, usually containing additives.
MOU/MOA: Memorandums of understanding/agreement.
Mouse Hole: A hole in the rig floor designed to hold a joint of pipe. The rat hole (a term also used for the borehole below the pay zone) holds the kelly when it has to be disconnected.

Moveout (Seismic): The difference in arrival times of reflected seismic data at different detectors.
MPa: (1) Short for "megapascal," that is, one million pascals. A pascal is the pressure generated by a mass of approximately 100 g on a square meter under the Earth's gravitational field. Atmospheric pressure is about 100,000 Pa (100 kPa, or as weather forecasters like to say, 1000 hPa [hectopascal]), so 7 MPa is about 70 times atmospheric pressure. You may come across values in "psi" or "pound force per square inch": 1 MPa is about 145 psi. (2) Megapascals, 1 million pascals.
MPD: Managed pressure drilling.
MPHC: See *Marginal probability of hydrocarbons*.
MPLT: Memory production logging tool.
MPN: See *Most probable number*.
MPV: See *Multipurpose vessel*.
MPY: See *Mils per year*.
MRC: See *Mixed-refrigerant cycle*.
mrem: Millirem (a radiation dose or exposure unit).
mrem/yr: Millirem per year.
ms: Millisecond, equal to 1/1000 of a second.
MS4: See *Municipal separate storm sewer system*.
MS4 General Permit: The SPDES permit that regulates discharges from MS4s serving a populated area totaling 50,000 or more people and having a population density of at least 1,000 people per square mile coded GP-0-10-002.
MS4 Operator: The person, persons, or legal entity that is responsible for the small MS4, as indicated by signing the NOI to gain coverage for the MS4 under the general MS4 SPDES permit.
MSA: Methane sulfonic acid.
MSA (Regulations): Mine Safety Act.
MSCF (Gas Volume): Thousand standard feet.
MSDS: See *Material safety data sheet*.
MSFL (Logging): Microspherically focused log resistivity.
MSV: Multiservice valve.
MSV: See *Multiservice vessel*.
MT: Manifold temperature.
MTBE: See *Methyl tertiary butyl ether*.
MTBF: Mean time between failures, a measure of reliability.
MTPA, Mtpa: Million tons per annum. Tons or metric ton is approximately 2.47 m^3 of LNG.
MTR: Motor.
MTTF: Mean time to failure: a measure of reliability.
MU: See *Makeup*.
Mud Acid: An inexact term, usually meaning a mixture of hydrochloric (HCl) and hydrofluoric acid (HF), HCL/HF. HF will dissolve some silicates and some of the components of drilling mud.

M

Mud (Also Drilling Mud): (1) Fluid circulated down the drill pipe and up the annulus during drilling to remove cuttings, cool and lubricate the bit, and maintain desired pressure in the well. (2) A mixture of base substance and additives used to lubricate the drill bit and to counteract the natural pressure of the formation. (3) A mixture of base substance and additives used to lubricate the drill bit and to counteract the natural pressure of the formation. (4) Drilling mud. Usually a slurry of weighting and fluid-loss control solids in a liquid.
Mud Anchor: An enlarged area that promotes solids settling prior to a fluid entering the pump.
Mud Balance (Fluid Density): A simple scale with a cup and bar with a sliding weight that, when used with a pedestal mount, will give the density of mud, cement, or brines. See also *Pressurized mud balance*.
Mud Cake: The filter cake on the formation formed by dehydration of the solids as the liquid part of the mud (filtrate) leaks off into the formation.
Mud Cup: A graduated cup used to sample mud and fill the Marsh funnel.
Mud Density: The specific gravity of the mud expressed in lb/gal, kg/m^3, etc.
Mud Displacement Flush: A sequence of washes, dispersants, carrying fluids, and spacers designed to remove mud and mud cake from the annulus prior to cementing and completion.
Mud Engineer: Person in charge of building the mud (mixing) and compositional checks.
Mud Filtrate: The liquid part of the mud that invades the formation after the particles are stranded at the surface of the formation.
Mud Flow through Screens: A laboratory test that flows drilling fluids through screens to check for plugging potential on cleanup.
Mud Log: A record of information on mud or cuttings that are circulated to the surface.
Mud Logger: The person who monitors the mud for hydrocarbon shows, by the use of chemical analysis, microscopic examination, or instrumentation.
Mud Loss: Loss of whole mud to the formation.
Mud Motor: A hydraulic powered motor used on the drilling sting or coiled tubing to provide rotation.
Mud Pit: The primary storage tank for drilling mud.
Mud Pit Level Indicator and Alarm: The indicator system that reports the level of mud in the tank. Useful for losses and kick indications.
Mud Pulse: A pressure pulse in the mud system. Some downhole tools can be controlled by mud pulses, and some data are transmitted from bottom hole to the surface via pressure pulses.
Mud Pump: Primary mud circulation pumps on the rig.
Mudstone: Sedimentary rocks that consist of particles finer than sand grade (less than 0.0625 mm) and include both silt and clay grade material. Also called shales.

Mud Tracer: A material such as a grain, dye, flakes, or other materials that can be circulated with the mud to track how quickly and to what extent the hole is circulated.
Mud Up: Increasing the density of the mud.
Mud Weight: Mud density.
Muffle Furnace: A small oven capable of reaching temperatures up to about 600°C. It is used in laboratories to determine the volatile content of a sample.
Mule Shoe: A bias cut across the pipe or tool body at the end to aid in entering restricted openings.
Multicomponent Seismic: A survey conducted using 3-component geophones for sensing seismic reflections in the vertical, horizontal, and crossline directions (3-C). In the marine environment, a hydrophone is included to acquire 4-component (4-C) data.
Multifinger Caliper: A diameter measuring device that uses many small blade-like fingers to track and record the shape and imperfections of the ID of a pipe.
Multigrade Oil: Engine oil that meets the requirements of more than one SAE viscosity grade classification and may therefore be suitable for use over a wider temperature range than a single-grade oil. Multigrade oils have 2 viscosity numbers indicating their low-temperature and high-temperature classification.
Multilateral: More than one producing wellbore from a single wellbore or motherbore.
Multilateral Institutions: A major source of LNG financing for developing countries; includes Asian Development Bank (ADB), European Bank for Reconstruction and Development (EBRD), International Bank for Reconstruction and Development (IBRD), and the International Finance Corporation (IFC). See *Export credit agencies (ECAs)*.
Multilateral Well: More than one horizontal section drilled in one well. Used to maximize the number of wells that can be drilled from small installations.
Multiphase Flow: Two or more flowing phases. This often severely complicates pumping, flow prediction, and measurement.
Multiple Completion: Having multiple and often separate completions into different producing pays but in the same wellbore. The completions may be concentric or side by side where the pays are not to be commingled or stacked where the flow is to be commingled.
Multipointing: When two or more gas lift valves are flowing gas at once.
Multipurpose Grease: A lubricating grease suitable for a variety of applications such as chassis, wheel bearings, universal joints, and water pumps on automotive equipment; usually lithium based.
Multipurpose Vessel: A dedicated vessel that is able to perform multiple tasks for offshore installations.

M

Multiservice Vessel: A dedicated vessel that is able to perform multiple maintenance services on platforms, floaters, subsea wells, pipelines, and risers.
Multistage Cementing: Using more than one stage of cement to get more complete cement coverage of the annulus.
Multistage Pump: A pump that has more than one impeller. A single-stage pump has one impeller.
Municipal Separate Storm Sewer System: A sewer collection and conveyance system designed and intended to handle solely rainwater and snowmelt, in contrast to sanitary and combined sewers.
Muriatic Acid: Another name for hydrochloric acid (HCl).
Must-Take Gas: Natural gas supplies committed to a purchaser under terms such as drainage protection or reservoir protection clauses or other provisions that absolutely obligate a purchaser to take natural gas from a supplier.
Mutual Solvent: A chemical that has some common solvency for both water and oil materials.
MVI: See *Medium viscosity index*.
MW: Mud weight.
MW: See *Megawatt*.
MWD: See *Measurement while drilling or Logging while drilling*.
MWP: Maximum working pressure.
MWPT: Measurement while perforating tool.
Myanmar: The country formerly known as Burma. It is not a major crude oil producer.
Mylar™: Polyester film.
Mysid Shrimp: A species of shrimp used to test toxicity of chemicals in seawater.
MZ: Multizone.

N

N: See *Normal*.
NACE: National Association of Corrosion Engineers.
NaCl: Sodium chloride salt. Halite.
Nanometer: One billionth of a meter.
Nanotesla (Seismic): The units in which magnetic survey maps are contoured. 1 nanotesla = 10^{-9} tesla, 1 nanotesla = 10^{-9} Wb/m^2, 1 nanotesla = 10^{-1} lines/m^2, 1 nanotesla = 10^{-5} lines/cm^2, 1 nanotesla = 10^{-5} gauss, 1 nanotesla = 1 gamma.
NaOH: Sodium hydroxide.
Naphtha: (1) A generic term applied to a petroleum fraction with an approximate boiling range between 122°F and 400°F. (2) A colorless liquid product of petroleum distillation that is used as a manufacturing solvent, a dry-cleaning fluid, and a gasoline-blending stock. (3) Liquid hydrocarbon fractions, generally boiling within the gasoline range, recovered by the distillation of crude petroleum. Used as solvents, dry-cleaning agents, and charge stocks to reforming units to make high-octane gasoline. (4) An aromatic solvent with highly variable quality. Often has a described carbon range in the C7 to C10 area.
Naphthalene Base Oil: Oil with API gravity of less than 25.
Naphthalene Flakes: A common diverter. It can sublime or go directly from a solid to a gas.
Naphtha Less than 401°F: See *Petrochemical feedstocks*.
Naphtha-Type Jet Fuel: A fuel in the heavy naphtha boiling range having an average gravity of 52.8° API, 20% to 90% distillation temperatures of 290°F to 470°F, and meeting Military Specification MIL-T-5624L (Grade JP-4). It is used primarily for military turbojet and turboprop aircraft engines because it has a lower freeze point than other aviation fuels and meets engine requirements at high altitudes and speeds.
Naphthenic: Having the characteristics of naphthenes, saturated hydrocarbons whose molecules contain at least one closed ring of carbon atoms.
Naphthenic Crudes: A type of crude petroleum containing a relatively large proportion of naphthenic-type hydrocarbon.
National Balancing Point: A notional point on the UK Transco pipeline through which all gas is deemed to flow.
National Electrical Code: Contains safety guidelines for all types of electric installations in the United States.
National Energy Board: Canadian regulatory body that oversees interprovincial natural gas trade and pipelines. Located in Calgary, Alberta.
National Institute of Occupational Safety and Health: Is an organization that tests and approves safety equipment for particular applications. NIOSH

is the primary federal agency engaged in research in the national effort to eliminate on-the-job hazards to the health and safety of working people. The NIOSH Publications Catalog contains a listing of NIOSH publications concerning industrial hygiene and occupational health. To obtain a copy of the catalog, write to National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. NTIS Stock No. PB-86-116-787.

National Petroleum Reserve, Alaska: A petroleum province west of the Prudhoe Bay Field and south of Point Barrow on the North Slope of Alaska, consisting of millions of acres set aside and held in reserve for the purpose of national defense. A portion of the reserve is open to drilling.

National Pollutant Discharge Elimination System: The national system for the issuance of wastewater and stormwater permits under the Federal Water Pollution Control Act (Clean Water Act).

National Pollutant Discharge Elimination System Permit: Is the regulatory agency document issued by either a federal or state agency, which is designed to control all discharges of pollutants from point sources and stormwater runoff into US waterways. NPDES permits regulate discharges into navigable waters from all point sources of pollution, including industries, municipal wastewater treatment plants, sanitary landfills, large agricultural feedlots, and return irrigation flows.

National Response Center: A federal agency that must be contacted when a significant spill of oil or chemical occurs. (800) 424–8802.

Native Gas: Natural gas in place in a producing reservoir when the reservoir is converted into a natural gas storage reservoir.

Native State Core: A core preserved as close as possible to reservoir conditions with effort made to keep all hydrocarbons in place.

Natural Clays: Naturally occurring clays as opposed to commercially formulated clays.

Natural Completion: A completion that is not stimulated.

Natural Draft Burner: A burner that depends primarily on the natural draft created in the chimney or venting system to induce the air required for combustion into the burner.

Natural Fracture: A fracture in the rock created by geologic events such as uplift.

Natural Gas: (1) A mixture of light hydrocarbons found naturally in the Earth's crust, often in association with oil (when it is known as associated gas). Methane is the most dominant component. It may also include some short-chain hydrocarbons (ethane, propane, butane) that may be in gaseous state at standard conditions. (2) A mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions. The primary constituent compound is CH_4.

Gas coming from wells also can contain significant amounts of ethane, propane, butanes, and pentanes and widely varying amounts of carbon dioxide and nitrogen. Pipeline-quality natural gas has had most, but not all

natural gas liquids and other contaminants, removed. On board a vehicle, it is stored under high pressure at 2500 to 3600 pounds per square inch (psi). A gallon of natural gas at 2,000 psi contains about 20,000 Btu; at 3,600 psi, a gallon contains about 30,000 Btu. (3) A naturally occurring mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions. The principal hydrocarbons usually contained in the mixture are methane, ethane, propane, butanes, and pentanes. Typical nonhydrocarbon bases that may be present in reservoir natural gas are carbon dioxide, helium, hydrogen sulfide, and nitrogen. Under reservoir conditions, natural gas and the liquefiable portions thereof occur either in a single gaseous phase in the reservoir or in solution with crude oil and are not distinguishable at that time as separate substances. The principal constituent is methane (CH_4) and is the simplest of hydrocarbons. Pure methane has a heating value of 1102 Btu per standard cubic foot.

Natural Gas Conditioning and Treating: Removes solids (sand, pipe scale, dirt), water (dehydration), acid gases (hydrogen sulfide), and carbon dioxide and nitrogen.

Natural Gas Field Facility: A field facility designed to process natural gas produced from more than one lease for the purpose of recovering condensate from a stream of natural gas; however, some field facilities are designed to recover propane, normal butane, pentanes plus, etc., and to control the quality of natural gas to be marketed.

Natural Gas Heating Value: The amount of thermal energy released by the complete combustion of one standard cubic foot of natural gas.

Natural Gas Liquids: (1) Liquid hydrocarbons, such as ethane, propane, butane, pentane, and natural gasoline, extracted from field natural gas. (2) Those hydrocarbons in natural gas that are separated from the gas as liquids through the process of absorption, condensation, adsorption, or other methods in gas processing or cycling plants. Generally, such liquids consist of propane and heavier hydrocarbons and are commonly referred to as lease condensate, natural gasoline, and liquefied petroleum gases. Natural gas liquids include natural gas plant liquids (primarily ethane, propane, butane, and isobutane; see *Natural gas plant liquids*) and lease condensate (primarily pentanes produced from natural gas at lease separators and field facilities; see *Lease condensate*). (3) Liquids obtained during natural gas production, including ethane, propane, butanes, and condensate. (4) A mixed stream of ethane, propane, butane, and pentanes that is split into individual components. These components are either sold or used as feedstocks for refineries and chemical plants. (5) Natural gas liquids are the heavier hydrocarbons of ethane (C_2H_6), propane (C_3H_8), butane (C_4H_{10}), and natural gasoline, which need to be separated before the transportation of natural gas in pipelines. (6) The portion of the natural gas compounds that liquefy at surface conditions.

Natural Gasoline: Condensate liquids.

Natural Gasoline and Isopentane: A mixture of hydrocarbons, mostly pentanes and heavier, extracted from natural gas, that meets vapor pressure, end point, and other specifications for natural gasoline set by the Gas Processors Association. Includes isopentane that is a saturated branch-chain hydrocarbon (C_5H_{12}), obtained by fractionation of natural gasoline or isomerization of normal pentane.

Natural Gas Plant Liquids: Those hydrocarbons in natural gas that are separated as liquids at natural gas processing plants, fractionating and cycling plants, and, in some instances, field facilities. Lease condensate is excluded. Products obtained include ethane, liquefied petroleum gases (propane, butanes, propane–butane mixtures, ethane–propane mixtures), isopentane, and other small quantities of finished products, such as motor gasoline, special naphthas, jet fuel, kerosene, and distillate fuel oil.

Natural Gas Processing: (1) The purification of field gas at natural gas processing plants (or gas plants) or the fractionation of mixed NGLs to natural gas products to meet specifications for use as pipeline-quality gas. Gas processing includes removing liquids, solids, and vapors, absorbing impurities and odorizing; (2) the process of separating natural gas liquids (NGL5) by absorption, adsorption, refrigeration, or cryogenics from a stream of natural gas.

Natural Gas Processing Plant: Facilities designed to recover natural gas liquids from a stream of natural gas that may or may not have passed through lease separators and/or field separation facilities. These facilities control the quality of the natural gas to be marketed. Cycling plants are classified as gas processing plants.

Natural Gas Producer: A natural gas producer is generally involved in exploration, drilling, and refinement of natural gas.

Natural Gas Resource Base: An estimate of the amount of natural gas available, based on the combination of reserves, contingent resources, and prospective resources. Reserves may include proved, probable, and possible commercial reserves. Contingent resources include recoverable quantities from known accumulations that are not commercial. Prospective resources are those quantities of petroleum that are estimated to be recoverable from undiscovered accumulations.

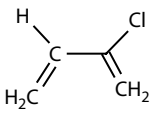
Natural Gas Storage: A means of providing a reserve of natural gas supplies to meet the seasonal demands of natural gas customers.

Natural Gas Transportation System: The pipeline transportation system used to accept and transport natural gas.

Natural Gas (Units):

Mcf: one thousand cubic feet of natural gas
Mmcf: one million cubic feet of natural gas
Bcf: one billion cubic feet of natural gas
Tcf: one trillion cubic feet of natural gas
Mmcf/d: millions of cubic feet of gas per day

Natural Gas, Wet after Lease Separation: The volume of natural gas remaining after the removal of lease condensate in lease and/or field separation facilities, if any, and after exclusion of nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Natural gas liquids may be recovered from volumes of natural gas, wet after lease separation, at natural gas processing plants.
Naturally Flowing Well: A well that can flow to the surface unassisted.
Naturally Occurring Radioactive Material: NORM scale, usually barium or strontium sulfate scale with very low-level radiation from atoms of uranium, thorium, and potassium in the matrix of the scale.
Natural Seep: A naturally occurring hydrocarbon seep to surface. (There are over 1100 known seeps in North America.)
NBP: See *National balancing point*.
NBR: See *Nitrile butadiene rubber*.
ND: See *Nipple down*.
NDT: Nondestructive testing.
Near Wellbore Damage: Damage to the permeability occurring within the first few feet away from the wellbore.
Neat Alcohol Fuels: Straight alcohol (not blended with gasoline) that may be in the form of either ethanol or methanol. Ethanol, as a neat alcohol fuel, does not need to be at 200 proof; therefore, it is often used at 180 to 190 proofs (90% to 95%). Most methanol fuels are not strictly "neat," since 5% to 10% gasoline is usually blended in to improve its operational efficiency.
Neat Cement: Cement slurry without additives.
NEB: National Energy Board for Canada.
NEC: See *National Electrical Code*.
Needle and Seat Choke: An adjustable common choke for clean (no solids) production flow.
Needle Valve: A low-volume, small-orifice, high-pressure bleed valve.
NEO: See *Neoprene*.
Neoprene: (1) The trivial name for poly(2-chlorobutadiene). This polymer is used in the manufacture of fan belts and wet suits. The monomer, 2-chlorobutadiene (aka chloroprene), looks something like this:



(2) A ball covering and seal type.
NEPA: National Environmental Policy Act.
Nephelometric Turbidity Unit: A unit used in measuring water quality. An instrument called a nephelometer (from a Greek word meaning "cloudy") measures turbidity directly by comparing the amount of light transmitted straight through a water sample with the amount scattered at an angle of 90° to one side; the ratio determines the turbidity in NTU's. NTU measurements

can be confused by the base color of the water from stains that may not create damage in the rock.

Neritic: Marine zone; the environment between low tide and the continental shelf.

NESHAPs: National Emission Standards for Hazardous Air Pollutants.

Net Acres: The total of the company's fractional interest in the gross acreage position.

Net Back: The amount of money received per barrel of oil equivalent produced after subtracting operating and administrative costs and royalties.

Net-Back Price: The effective price to the producer of natural gas at a defined point, based on the market price for the natural gas less the charges for delivering the natural gas from the defined point to market.

Net Capacity (Shipping): The number of tons of cargo that a vessel can carry when loaded in saltwater to its summer freeboard marks. Also called cargo carrying capacity, cargo deadweight, and useful deadweight.

Net Gas: Total produced natural gas times net working interest in natural gas production.

Net Heating Value: Assumes that the vapor produced in the combustion process stays in the gaseous phase.

Net Pay: The most productive part of the pay zone.

Net Pay Cutoff: The lower level to the permeability, porosity, or saturation in what is considered net pay.

Net Production: (1) Natural gas and oil production that we own, less royalties and production due others. (2) The company's share of the production after royalty and partner shares are removed.

Net Profit Share Lease: An outer continental shelf (OCS) lease that provides for payment to the United States of a percentage share of the net profits for the production of oil and gas from the tract. The percentage share may be fixed in the notice of the lease sale or may be a variable of the bid, depending on the bidding system used for the lease sale.

Net Profits Interest: A share of the production as calculated from the net profits of the operation.

Net Receipts: The difference between total movements into and total movements out of each Petroleum Administration for Defense (PAD) District by pipeline, tanker, and barge.

Net Revenue Interest: (1) That percent of the production revenue allocated to the working interest after first deducting proceeds allocated to royalty and overriding interest. (2) That part of the proceeds less royalty payments.

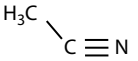
NETL: National Energy Technology Laboratory.

Net-to-Gross Ratio: The ratio of the net pay to the gross pay.

Net Tonnage: The carrying capacity of vessels as prescribed by government regulations and determined by measuring the cubic contents of the space intended for revenue earning.

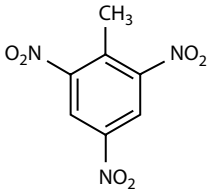
Network Fractures: Opening up secondary natural fractures that may be orthogonal to the planar fracture.
Neutralization: (1) Addition of an acid or alkali (base) to a liquid to cause the pH of the liquid to move toward a neutral pH of 7.0. (2) Adding base to an acidic solution until it is no longer acidic or acid to a basic solution until it is no longer basic. pH 7, where equal amounts of H^+ and OH^- ions will be present in any aqueous solution, is the pH of a truly neutral solution.
Neutralization Number: An indication of the acidity of a petroleum product or lubricant. ASTM D664 and D974 are standard procedures for establishing neutralization values.
Neutralization (Processing): Neutralizing acid production (sour gas) with sweetening agents, etc.
Neutralization (Stimulation): Raising the pH of the backflowed acid to the neutral point.
Neutralization Value: An indication of the acidity of an oil; the number is the mass in milligrams of base expressed as potassium hydroxide (KOH) required to neutralize 1 g of oil.
Neutral Point: The theoretical point in pipe length that accounts for the effects of buoyancy.
Neutron: Each element has a certain number of protons in its nucleus, which defines what element it is (e.g., 92 for uranium, 2 for helium, 109 for meitnerium). To keep the positively charged protons from flying apart through electrostatic repulsion, they are bound together by the "strong force," which is a very powerful force operating over very short distances between protons and neutrons. A certain number of neutrons give optimal stability to a nucleus—too many or too few—and the nucleus will be unstable (i.e., radioactive). Most elements are found naturally in a number of "isotopes," forms with different numbers of neutrons—for example, carbon-12, carbon-13, and carbon-14. Neutrons weigh about 1.6749×10^{-27} kg, slightly more than a proton.
Neutron Capture: A measurement in which a target, either a formation of an injected fluid, adsorbs natural or generated neutrons.
Neutron Log: A log whose source emits neutrons into the formation. Neutrons interact with hydrogen nuclei resulting in an energy loss that is converted to neutron porosity. All hydrocarbons and water contain hydrogen, but the formation usually does not. The amount of hydrogen in the gas affects the reading, so gas-filled porosity shows a lower log porosity than oil- or water-filled porosity.
Newtonian Fluid: A fluid whose shear force and response are directly proportional to shear rate. Yield point is zero.
NFT: No flow test.
NGL5: See *Natural gas liquids*.
NGLs: See *Natural gas liquids*.

NGV: Natural gas vehicle.
NH_4Cl: Ammonium chloride.
NHV: See *Net heating value*.
Nigerian: Pertaining to Nigeria, one of the major crude oil producers of Africa. If history had turned out rather differently, we would be referring to "Biafran crude."
Night Tool Pusher: An assistant tool pusher. Also known as a tour pusher.
NIOSH: See *National Institute of Occupational Safety and Health*.
Nipple Down: Disassemble. Take apart or tear down a piece of an equipment such as a wellhead.
Nipple Profile: The specific shape of the nipple, usually an accepted profile such as an F, X, J, and S.
Nipple Protector: A sleeve that fits inside of a profile to protect the polished bore and the latch recess.
Nipple (Tubular String): A short piece of pipe, usually with a profile shape in the ID. Nipple profiles are used in tubular strings to provide places to set plugs.
Nipple Up: Construct or put together a piece of equipment such as a wellhead.
NIR: Near infrared.
NITR: See *Nitrile*.
Nitride: A metal surface treatment that improves abrasion and wear resistance.
Nitrification: An aerobic process in which bacteria change the ammonia and organic nitrogen in wastewater into oxidized nitrogen (usually nitrate). The second-stage biochemical oxygen demand (BOD) is sometimes referred to as the "nitrification stage" (first-stage BOD is called the "carbonaceous stage").
Nitrification Stage: A stage of decomposition that occurs in biological treatment processes when aerobic bacteria, using dissolved oxygen, change nitrogen compounds (ammonia and organic nitrogen) into oxidized nitrogen (usually nitrate).
Nitrified Fluid: A stimulation fluid with dispersed nitrogen gas, usually at several hundred cubits feet per barrel.
Nitrifying Bacteria: Bacteria that change the ammonia and organic nitrogen in wastewater into oxidized nitrogen (usually nitrate).
Nitrile: (1) A carbon compound containing a carbon–nitrogen triple bond. An example is acetonitrile, a common organic solvent:



(2) Elastomer-based material with resistance to oil. (3) Common seal materials with good resistance for oil but poor resistance to aromatics.

Nitrile Butadiene Rubber: The most widely used elastomers in the oil field.
Nitro: The $-NO_2$ functional group. You may have heard of trinitrotoluene (TNT)—here's a picture:



Nitrobacteria: Principal genera of autotrophic bacteria responsible for the second step of biological nitrification: conversion (oxidation) of nitrite to nitrate.
Nitrogen Cushion: A cushion of nitrogen gas placed on top of a liquid column to reduce the downhole pressure. Also used in the annulus for an expansion cushion in the event of annular fluid expansion.
Nitrogen Fixation: The conversion of nitrogen gas to organic nitrogen, ammonia, or nitrate. Nitrogen fixation can occur biologically (i.e., conversion of nitrogen gas to organic nitrogen by certain photosynthetic blue-green algae), by natural physical processes (i.e., conversion of nitrogen gas to nitrate by lightning) or by industrial processes (manufacture of fertilizers and explosives).
Nitrogen Kickoff: Bringing a well on with nitrogen lift to get the initial flow rate or to get it to steady state flow. Commonly used after workovers to jet back heavy brines until the hydrocarbons with associated gas flow into the well and begin natural production.
Nitrogen Lift: Short-term use of nitrogen to kick a well off, that is, establish flow.
Nitrogenous: A term used to describe chemical compounds (usually organic) containing nitrogen in combined forms. Proteins and nitrates are nitrogenous compounds.
Nitrogen Oxides: Air-polluting gases contained in automobile emissions, which are regulated by the Environmental Protection Agency (EPA). They comprise colorless nitrous oxide (N_2O) (otherwise known as dinitrogen monoxide or as the anesthetic "laughing gas"), colorless nitric oxide (NO), and the reddish-brown-colored nitrogen dioxide (NO_2). Nitric oxide is very unstable, and on exposure to air, it is readily converted to nitrogen dioxide, which has an irritating odor and is very poisonous. Nitrogen dioxide contributes to the brownish layer in the atmospheric pollution over some metropolitan areas. Other nitrogen oxides of less significance are nitrogen tetroxide (N_2O_4) and nitrogen pentoxide (N_2O_5). Nitrogen oxides are sometimes collectively referred to as "NOx" where "x" represents any proportion of oxygen to nitrogen.
Nitrogen Rejection Unit: Facilities where the entire gas stream is liquefied to remove impurities then regasified and sent on as pipeline-quality gas.

N

Nitro Shot: An old stimulation process that involved lowering nitroglycerine canisters into a well and detonating.
Nitrosomonas: Principal genera of autotrophic bacteria responsible for the first step of biological nitrification: conversion (oxidation) of ammonia to nitrite.
NLL: Neutron lifetime log.
n (Logging): Saturation exponent.
N-m³: Normal cubic meters.
NMO: See *Normal moveout offset*.
NMR: Nuclear magnetic resonance log. Can show the difference in water, oil, and gas movable fluids.
No. 1 Diesel Fuel: A light distillate fuel oil that has distillation temperatures of 550°F at the 90-percent point and meets the specifications defined in ASTM Specification D975. It is used in high-speed diesel engines generally operated under frequent speed and load changes, such as those in city buses and similar vehicles. See *No. 1 distillate*.
No. 1 Distillate: A light petroleum distillate that can be used as either a diesel fuel (see *No. 1 diesel fuel*) or a fuel oil (see *No. 1 fuel oil*).
No. 1 Fuel Oil: A light distillate fuel oil that has distillation temperatures of 400°F at the 10-percent recovery point and 550°F at the 90-percent point and meets the specifications defined in ASTM Specification D396. It is used primarily as fuel for portable outdoor stoves and portable outdoor heaters. See *No. 1 distillate*.
No. 2 Diesel Fuel: A fuel that has distillation temperatures of 500°F at the 10-percent recovery point and 640°F at the 90-percent recovery point and meets the specifications defined in ASTM Specification D975. It is used in high-speed diesel engines that are generally operated under uniform speed and load conditions, such as those in railroad locomotives, trucks, and automobiles. See *No. 2 distillate*.
No. 2 Distillate: A petroleum distillate that can be used as either a diesel fuel (see *No. 2 diesel fuel*) or a fuel oil (see *No. 2 fuel oil*).
No. 2 Fuel Oil (Heating Oil): A distillate fuel oil that has distillation temperatures of 400°F at the 10-percent recovery point and 640°F at the 90-percent recovery point and meets the specifications defined in ASTM Specification D396. It is used in atomizing-type burners for domestic heating or for moderate-capacity commercial/industrial burner units. See *No. 2 distillate*.
No. 4 Diesel Fuel. See *No. 4 fuel*.
No. 4 Fuel: A distillate fuel oil made by blending distillate fuel oil and residual fuel oil stocks. It conforms with ASTM Specification D396 or Federal Specification VV-F-815C and is used extensively in industrial plants and in commercial burner installations that are not equipped with preheating facilities. It also includes No. 4 diesel fuel used for low- and medium-speed diesel engines and conforms to ASTM Specification D975.
No. 4 Fuel Oil: See *No. 4 fuel*.
Nobel Prize: An award given for really good scientific work, usually once all the dust has settled and the people who did are decently old and respectable.

More information on the Nobel Prizes can be found on their website: http://www.nobel.se/.

Nodal Analysis: A pressure drop vs. flow study, using a computer program that compares flow performance at various "nodes" along the flow path.

Nodding Donkey: A rod pump surface unit—pump jack.

Node: A reference point in the well.

NOEL: No-observed-effect level.

No Go: A profile ring in the tubing with a very small opening that allows flow but stops any equipment or tool from passing through the restriction. May be small ID or pinned.

NOI: See *Notice of intent*.

Noise Log: A sound recording downhole. The best performance of noise logs is with gas flow. Gas flow can be heard to about 10 actual ft^3/D (*Note*: not standard ft^3/day). At very low gas flow rates ($q < 400$ actual ft^3/D), gas flow can be estimated from millivolts of noise between the 200 Hz and 600 Hz frequencies: $q = 0.35$ (N200–N600), where q is the actual gas flow in ft^3 and N = noise log cut at that frequency.

Nolte G-Function: A dimensionless measure of time often used in analyzing pressure behavior during the hydraulic fracturing process.

Nolte–Smith Plot: A log-log plot that is very useful in predicting when the fracture is in tip-screen-out mode and whether the fracture is being widened or height growth is occurring.

Nomenclature: Naming things.

Nominal (in Filtration): An approximation of a filter's ability to remove particles of a certain size or larger. Often does not perform at this level until a filter bed of particles builds up on the upstream side of the filter.

Nominal Parameters: The nominal parameters are the parameters (e.g., weight, thickness, and density) specified on product labels, invoices, sales literature, and the like. The actual parameters shall not be less than 95% of nominal parameters.

Nomination: An order slip to an interstate pipeline, stating the volume of gas a supplier seeks to transport over a fixed period of time. Most nominations are now submitted electronically via pipeline EBB/Internet websites.

Nomogram: A chart or diagram containing three or more scales used to solve problems with three or more variables instead of using mathematical formulas.

Nonassociated Gas: (1) A free natural gas not in contact with, or dissolved in, crude oil in the reservoir. Liquefied natural gas (LNG) projects require large, proven reserves of nonassociated gas to ensure supply over long contract terms. (2) Dry gas that is not associated with oil in a productive reservoir, as opposed to associated gas or solution gas. (3) Natural gas, not initially dissolved in oil, produced from a reservoir.

Nonattainment Area: A region that exceeds minimum acceptable National Ambient Air Quality Standards (NAAQS) for one or more criteria pollutants, in high population density areas, in accordance with the US Census Bureau population statistics. Such regions (areas) are required

to seek modifications to their State Implementation Plans, setting forth a reasonable timetable using means (approved by the EPA) to achieve attainment of NAAQS by a certain date. Under the Clean Air Act, if a nonattainment area fails to attain NAAQS, the EPA may superimpose a Federal Implementation Plan with stricter requirements or impose fines, construction bans, or cutoffs in federal grant revenues until the area achieves applicable NAAQS.

Nonclastic: Sedimentary rocks not composed of fragments of preexisting rocks or minerals. Usually called crystalline.

Noncombustible: A substance or gas that will not burn.

Noncommercial: A well that is not capable of producing enough oil to pay for the drilling.

Noncompatible Pollutants: Those pollutants that are normally not removed by the publicly owned treatment works (POTW) treatment system. These pollutants may be a toxic waste and may pass through the POTW untreated or interfere with the treatment system. Examples of noncompatible pollutants include heavy metals such as copper, nickel, lead, and zinc; organics such as methylene chloride, 1,1,1-trichloroethylene, methyl ethyl ketone, acetone, and gasoline; or sludges containing toxic organics or metals.

Nonconductive Mud: Usually oil base or an oil external mud that will not conduct electric charge. Many logs cannot be run in these muds.

Nonconformity: An unconformity that separates profoundly different rock types, such as sedimentary rocks from metamorphic.

Nonconventional Gas: Gas in unusual reservoirs, for example, hydrates, coal beds, and low permeability.

Non-Darcy Flow: A flow regime departing from the laminar flow region where Darcy flow is measurable. Generally turbulence.

Nondispersed: A fluid without thinners or dispersants.

Nonemulsifier: A material, usually a surfactant, that prevents emulsions.

Nonfirm Purchase: A purchase of a commodity such as natural gas on an "as available" basis.

Nonflaring Operations: Operations where the produced gas from an oil field is not allowed to be flared and therefore either has to be transported, used as a fuel source, or reinjected.

Nonhydrocarbon Gases: Typical nonhydrocarbon gases that may be present in reservoir natural gas, such as carbon dioxide, helium, hydrogen sulfide, and nitrogen.

Nonionic: Any chemical species that has neither a positive nor a negative charge is nonionic.

Nonionic Surfactant: A surfactant with no preferential charge.

Nonmarking Slips: Special slips for makeup tongs that do not mark 13Cr pipe.

Non-Newtonian: A fluid with a viscosity that does not produce a linear shear stress–shear stress graph.

No-Notice Service: A pipeline delivery service that allows customers to receive gas on demand without making prior nominations to meet peak service needs and without paying daily balancing and scheduling penalties.
Nonparticipating Royalty: Is a royalty "carved out" of the mineral interest that is often used by mineral interest owners who sell their rights.
Nonperformance: A contractual breach.
Nonpoint Sources: Sources of water pollution that are not associated with a discharge pipe or channel. The term is often associated with water pollution resulting from stormwater runoff from urban and rural agricultural lands.
Nonpotable: Water that may contain objectionable pollution, contamination, minerals, or infective agents and is considered unsafe and/or unpalatable for drinking.
Nonproducing Reserves: Reserves subcategorized as nonproducing include shut-in and behind-pipe reserves. Shut-in reserves are expected to be recovered from (1) completion intervals that are open at the time of the estimate but that have not started producing, (2) wells that were shut in for market conditions or pipeline connections, or (3) wells not capable of production for mechanical reasons.
Nonselective Nipple: A profile cannot pass another plug. Usually only one nonselective profile is used—at the bottom of a well.
Nonsparking Tools: These tools will not produce a spark during use.
Nonstress Preferred Fracture Plane: A fracture that is driven in a direction other than perpendicular to the least principle stress. Common in explosive fracturing events.
Nonupset or NU Connection: A pipe connection with consistent inside diameter (ID) and outside diameter (OD) with the pipe. The connection walls are thin and weaker than external upset (EU) or internal upset (IU) connections. Used in flush joint liners and wash pipes.
NORM: A naturally occurring radioactive scale. Usually barium sulfate scale with uranium or radium atoms substituted into the lattice structure. Can be detected downhole with a gamma-ray log.
Normal: A solution containing one gram equivalent weight of compound dissolved in enough water to make one liter of solution. The equivalent weight of an acid is that weight that contains one gram atom of ionizable hydrogen or its equivalent. For example, sulfuric acid (H_2SO_4) has a gram molecular weight of 98 and a gram equivalent weight of 49, while the gram molecular and gram equivalent weights of hydrochloric acid (HCl) are the same (36.5).
Normal Butane: A normally gaseous straight-chain hydrocarbon. It is a colorless paraffinic gas that boils at a temperature of 31.1°F. It is extracted from natural gas or refinery gas streams. See *Butane*.
Normal Circulation: Circulation down the tubing and up the annulus.
Normal Fault: A fault with mostly vertical movement.

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Normalizing (Pipe): Heating a steel pipe to a temperature above the alloy transformation temperature range and holding at the temperature for long enough to remove stored stress from handling, forming, or other fabrication.
Normally Pressured: A formation with a pore pressure the same as a sea water gradient (0.46 psi/ft).
Normal Moveout Offset (Seismic): Difference in arrival times of reflected signals at different detectors caused by source variance and detector separations.
NORSOK: Norsk Sokkels Konkurranseposisjon.
North Sea Brent: Crude oil from the Brent field often quoted as a price benchmark.
NOT: See *Notice of termination*.
Notch: An opening in a dam, spillway, or weir for the passage of fluid. Weir notches are available in a variety of shapes, and formulas are available for accurately determining the flow through them.
Notice of Intent. A document filed by a permittee under the Construction General Permit or MS4 General Permit describing the nature of stormwater discharges in order to gain coverage under the appropriate General Permit.
Notice of Termination: A document filed by a permittee to close coverage under the Construction General Permit once site work is concluded and final stabilization is complete.
NOx: See *Nitrogen oxides*.
Nozzle: A shaped orifice for directing fluid flow.
NPD: Norwegian Petroleum Directorate.
NPDES: See *National Pollutant Discharge Elimination System*.
NPDES Permit: See *National Pollutant Discharge Elimination System permit*.
NPH: See *Naphtha*.
NPT: Nonproductive time.
NR: No returns, mud logging term.
NRe: See *Reynolds number*.
NRI: See *Net revenue interest*.
NRU: See *Nitrogen rejection unit*.
NRV (Flow Line): Nonreturn valve.
NRWO: Nonrig workover.
NTA: Nitrilotriacetic acid, a chelant.
NTEL: No-toxic-effect level.
NTU: See *Nephelometric turbidity unit*.
Nuclear Log: Radioactivity log.
Nuclear Logs: Record natural and induced radioactivity and measure the amount of oil, gas, and water, the type of rock and porosity, and the salt content.
Nuclear Magnetic Resonance: NMR is an analytical technique for working out what an organic compound actually is. It works by placing the sample inside a very strong magnetic field (typically around 100,000 times stronger than the Earth's magnetic field, though it can be carried out with weaker and weaker fields as research continues) and playing FM radio waves at it. The strong magnetic field and the absorption and emission of the radio signals

allow the operator to work out how the individual atoms are connected within small- to medium-sized molecules.

NMR was banned from export out of the United States for many years for fear that the Russians would get hold of this technology. The fear was based on the use of the word "nuclear" in the title, not on what the machine actually did.

A new version of NMR is able to resolve the spatial distribution of compounds and produce a 3D map. This has wonderful uses in the medical world, but once again the name "nuclear" was unacceptable, so the technique was renamed "magnetic resonance imaging" or MRI. Perhaps if the FM link was made more widely known, we could refer to the technique as "easy listening imaging" and make a clean break with anything remotely nuclear.

NU (Pipe): See *Nonupset or NU connection*.

NU (Repairs): Nipple up. Put back together.

Nutrient: Any substance that is assimilated (taken in) by organisms and promotes growth. Nitrogen and phosphorus are nutrients that promote the growth of algae. There are other essential and trace elements that are also considered nutrients.

Nutrient Cycle: The transformation or change of a nutrient from one form to another until the nutrient has returned to the original form, thus completing the cycle.

n (Viscosity): Power law component. As n decreases from 1, the fluid exhibits more shear thinning. Reducing n produces more non-Newtonian behavior.

Nylon: A class of polymers that is widely used in the clothing industry (among others). Their common feature is the presence of a –C(O)–NH– link between monomer units. This is also called a peptide bond. See *Nylon 66* and *Nylon 6*.

Nylon 6: Another form of nylon that uses only one monomer unit (not two). This monomer is difunctional with a carboxylic acid group at one end and an amine group at the other. The condensation reaction between two such molecules produces an amide bond in the same way as the synthesis of Nylon 66. The monomer used is (I think) 7-amine-1-heptanoic acid.

Nylon 66: A polymer widely used in a fibrous form in fabrics as well as solid lumps of plastic (e.g., in chopping boards and bearings). Nylon 66 may be formed from the condensation polymerization of 1,2-hexadiamine and 1,8-octadioic acid, although modern industrial processes have improved upon these reactions by ionizing the reagents to the hexadiammonium and 1,8-octadioate ions before the reaction is undertaken.

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O: Oil.
O&G: Oil and gas.
O&M Manual: See *Operation and maintenance manual*.
O_3: See *Ozone*.
OA (Logging): Oxygen activation.
OAP: Outer annulus pressure.
OA (Well Design): Outer annulus.
OBA5: See *Operational balancing agreements*.
Obligate Aerobes: Bacteria that must have molecular (dissolved) oxygen (DO) to reproduce.
OBR: Oil/brine ratio.
OBS: Ocean bottom seismic.
Observation Well: (1) A well with primary purpose of monitoring fluid movement or other reservoir function. (2) Wells used for instrumentation or mechanical observations of a reservoir.
Obsidian: Dark, volcanic glass.
OC: Operating center.
OC: Outer casing.
OCS: See *Outer continental shelf*.
OCS Orders: Rules and regulations from the US Minerals Management Service (MMS).
Octane: An eight-carbon-chain hydrocarbon in the paraffinic oil series.
Octane Number: (1) A measure of the resistance of a fuel to preignition ("knock") when burned in an internal combustion engine. The higher the number, the more antiknock quality. (2) A term numerically indicating the relative antiknock value of a gasoline. The octane number of a gasoline depends on its hydrocarbon composition and is improved by the addition of antiknock compounds. (3) The antiknock quality of motor and aviation gasoline below 100 octane is expressed by a numerical scale, which is based on the knocking tendencies of two pure hydrocarbons. The first, normal heptane, has an assigned value of zero in the knock rating scale. The second, isooctane, has an assigned octane number of 100.
OCTG: Oil country tubular goods.
OD: Outside diameter.
OD/ID: Outside diameter/inside diameter, usually used in reference to pipe dimension, and a factor in pressure stability of the pipe.
Odor: Quality of gases, liquids, or particulates that stimulates the olfactory organ.

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Odorant: (1) A substance, such as a mercaptan, that is added to odorless natural gas and natural gas liquids; gives them a characteristic smell and thus enables them to be detected. (2) Substance (e.g., mercaptan) added to odorless natural gas or NGLs to enable detection.
Odorizing: A process whereby an additive is injected to natural gas to provide a readily perceptible odor at a very low concentration in air as a warning indication of the presence of natural gas. Also called "stenching."
OEG: See *Oil equivalent gas*.
OEMs: See *Original equipment manufacturers*.
Off-Load (Shipping): Discharge of cargo from a ship.
Off-Pattern Well: A well outside the normal drilling/production pattern.
Off-Peak Gas: Natural gas supplied during periods of relatively low system demands.
Offset Well: (1) A well drilled on the next location to the original well. The distance from the first well to the offset well depends upon spacing regulations and whether the original well produces oil or gas. (2) A well drilled on one tract of land to prevent the drainage of oil or gas to an adjoining tract where a well is being drilled or is already producing. (3) A well drilled next to another. Sometimes refers to neighboring wells of different operators.
Offshore Oil Loading Nomenclature: Single buoy mooring (SBM), single-point mooring (SPM), exposed location single buoy mooring (ELSBM).
Offshore Platform: A fixed, moored, or dynamically positioned platform for hydrocarbon production or handling operations offshore.
Offshore Reserves and Production: Unless otherwise indicated, reserves and production that are in either state or Federal domains, located seaward of the coastline.
Offshore Well: A well that has its wellhead location offshore, either on a platform or on the sea floor as a subsea well.
Off-System Supply: Natural gas supply purchased from an entity other than the delivering pipeline or local distribution company.
Offtake Point: The point in a natural gas distribution system where natural gas is taken by supply pipe to a major customer.
Ofgem: The UK regulatory body that oversees electricity and gas trade, pipelines, and the power grid. Located in London. Combines the former Offer and Ofgas regulators.
OFOs: See *Operational flow orders*.
OFP: Open flow potential.
OGIP or OGP: See *Original gas in place*.
OGLV: See *Operating gas lift valve*.
OGP: International Association of Oil and Gas Producers.
OH: See *Open hole*.
OHFP: Open-hole frac pack. Frac packing in an open hole.
OHGP: Open-hole gravel pack.
Ohm: (1) Electric unit of resistance. One ohm is the resistance through which a potential of one volt will maintain a current of one ampere. (2) The unit of

measurement of electric resistance. One ohm of resistance will allow one ampere of current to flow through a pressure of one volt.

Ohm's Law: $E = IR$, $I = E/R$, or $R = E/I$; the current "*I*" in a circuit is directly proportional to the voltage "*E*" and inversely proportional to the resistance "*R*."

Oil: (1) A mixture of liquid hydrocarbons of different molecular weights. (2) A liquid hydrocarbon. See *Crude oil*.

Oil and Gas Leases: A contract between an oil operator and a landowner that gives the operator the right to drill for oil and gas on his property for a consideration. It is simply a "ticket to hunt."

Oil-Based Mud: A mud in which the external, liquid phase is oil.

Oil behind the Pipe: Refers to oil and gas sands or formations knowingly passed through, never produced. Such formations usually were of low permeability (tight formations) that, say, 20 years ago, were uneconomical to produce when oil was around $5 or less a barrel. Other times, formations would be purposely ignored because the operator was going deeper for bigger game, so the less-spectacular, plain-Jane sands were cased off. When the price of crude oil reached $30 per barrel, the bypassed formations looked pretty good and were opened up and produced.

Oil Column: Vertical thickness of an oil accumulation above an oil/water contact.

Oil-Cut Mud: Drilling mud with which crude oil has been unintentionally mixed. This may occur when drilling into or through an oil-bearing formation whose pressure is sufficient to overcome the pressure or weight of the column of mud in the hole. Oil also may become mixed with the drilling mud when a drill-stem test is taken.

Oil Emulsion: A mixture of oil and water in which the oil is permanently suspended in the water in the form of very small droplets or vice versa.

Oil Emulsion Mud: A predominately oil phase drilling mud with trace water (<10%) as an additive or a contaminant. Oil as the continuous or external phase. *Note*: Special cleanup and dispersants are needed before displacing with brine or treating with acids.

Oil Equivalent Gas: See *Barrel of oil equivalent*.

Oil Field: A geographic area under which an oil reservoir lies.

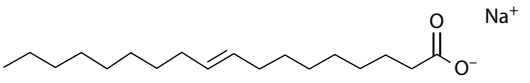
Oil Field Services: The support services involved in constructing, stimulating, producing, and repairing a well.

Oil Gravity: The most widely used indicator of a crude oil's worth to the producer is its API gravity. Normally, the price that a producer receives for his oil depends on its gravity, the less dense oils (higher API gravity) being the most valuable. This price schedule is based on the premise that the lighter oil contains higher percentages of the more valuable products such as gasoline. API gravity (degrees) = (141.5/sp. gr.) – 131.5.

Oil in Place: (1) Estimation of real amount of oil in a reservoir. Higher value than recoverable reserves of reservoir. (2) Crude oil estimated to exist in a field or a reservoir; oil in the formation not yet produced. (3) An estimated measure of the total amount of oil contained in a reservoir and, as such, a

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higher figure than the estimated recoverable reserves of oil. (4) The oil in place at any time in the reservoir.
Oil-in-Water Emulsion: A common oil field emulsion where oil droplets (the internal phase) are suspended and surrounded by the water (the continuous or external phase).
Oil Jar: A jarring tool, capable of very large impacts that is cocked and then triggered by oil moving through an orifice.
Oil Pool: A porous rock reservoir that contains oil.
Oil Run: The oil production or transfer during a specific time period.
Oil Sand: (1) Payzone, usually produces oil in economic quantities. (2) A deposit of sand saturated with bitumen.
Oil Saturation (Reservoir): The fraction of the porosity of a zone occupied by oil.
Oil Saver: A seal arrangement on top of a wire line lubricator that prevents the loss of oil or gas to the atmosphere.
Oil Shale: A mudrock or mudstone, composed of a large amount of kerogen or similar deposit, which will yield oil only when refined.
Oil/Water Contact: Local boundary between the oil and the bottom water. OW contact may vary in the field depending on individual drawdowns and local variations in vertical permeability.
Oil Well (Casinghead) Gas: Associated and dissolved gas produced along with crude oil from oil completions.
Oil Wet Rock: Rock coated with an oil in direct with the rock and attracted by natural surfactant properties.
Oil Zone: A formation from which oil might be produced.
OIM: Operations installation manager.
OIP: See *Oil in place*.
OIW: Oil in water.
OJ: See *Oil jar*.
OJT: On the job training.
Oleate Ion: The oleate ion is one of the most common soaps, being derived from triolein, a component of olive oil.



Sodium oleate

Olefinic Hydrocarbon: Hydrocarbons that contain one or more double or triple bonds.
Olefins: (1) Basic chemicals made from oil or natural gas liquid feedstocks; commonly used to manufacture plastics and gasoline. Examples are ethylene and propylene. (2) A class of unsaturated paraffinic hydrocarbons recovered from petroleum, of which butene, ethylene, and propylene are examples.
Oligocene: An epoch in time from 25 to 28 million years ago.

Oligomer: An oligomer is a molecule that is formed from a few smaller (identical) molecules joined together. Just as a monomer is one (mono) unit (mer) and a dimer is two (di) units, an oligomer is a few units.
On-Pump: No longer flowing naturally.
On Stream: When a refinery processing unit is in operation.
On Structure: At or near the top of the structure that forms the reservoir trap or cap rock.
Onsystem Sales: Sales to customers where the delivery point is a point on, or directly interconnected with, a transportation, storage, and/or distribution system operated by the reporting company.
On the Fly (in Mixing): Generally used as an addition method of adding materials to the fluid being pumped without recirculation.
On the Pump: An expression that means a well is incapable of flowing and that the oil is being pumped to the surface by a "pumping unit."
OOC (North Sea): Offshore Operators Committee.
OOIP: Original oil in place.
OOIP or OGIP: See *Original oil/gas in place*.
Oolite: Spheres of calcium carbonate precipitated from connate water.
OOS: Out of service.
OP (Gas Lift): Opening pressure of a gas lift valve at depth.
OPA: Oil Pollution Act.
OPEC: See *Organization of the Petroleum Exporting Countries*.
Open-Access Transportation: Natural gas transportation service available to all shippers. Subject to capacity availability, in a manner that is not unduly discriminatory.
Open-Circuit Voltage: The maximum voltage produced by a photovoltaic cell, module, or array without a load applied.
Open Flow Potential: The maximum potential rate from the well if all back pressure was removed.
Open Formation: A productive interval, open to the wellbore.
Open Hole: An uncased wellbore; the section of the wellbore below the casing; a well in which there is no protective string of pipe.
Open-Hole Completions: A completion without casing.
Open-Hole Fishing: Attempts to retrieve pipe of tools lost in the open hole.
Open-Hole Gravel Pack: A sand control completion for high-permeability soft sand formations where the small amount of area offered by the perforations is a restriction on what the formation can deliver to the wellbore.
Open-Hole Log: (1) One of a suite of logs commonly run in a well before it is cased. (2) Logging operations in an uncased wellbore. The well is logged below the relatively shallow surface pipe.
Open-Hole Packer: An inflatable or other packer that can seal in an open-hole environment.
Open-Hole Perforating: Shooting an open-hole section of the well for stimulation.

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Opening Ratio: The ratio of the pressure required to open the preventer to the pressure under the rams.

Open Shoe: An external annulus (production by surface casing, e.g., in which the cement behind the production pipe has not been brought up into the casing-by-casing annulus). The annulus is open to the formation into which the outer string has been set.

Operable Capacity: (1) The amount of capacity that, at the beginning of the period, is in operation, not in operation and not under active repair but capable of being placed in operation within 30 days, or not in operation but under active repair that can be completed within 90 days. Operable capacity is the sum of the operating and idle capacity and is measured in barrels per calendar day or barrels per stream day. (2) The component of operable capacity that is in operation at the beginning of the period.

Operable Utilization Rate: Represents the utilization of the atmospheric crude oil distillation units. The rate is calculated by dividing the gross input to these units by the operable refining capacity of the units.

Operating Expense: The expenses incurred through the operation of producing properties.

Operating Gas Lift Valve: The operating valve (open and flowing) in a gas lift system.

Operating Interest: The legal right to produce oil or gas from a well, accompanied by the responsibilities to pay production costs and assume the risks.

Operating Pressure: Pressure indicated by a gage when the system is in normal operation (working pressure).

Operating Utilization Rate: Represents the utilization of the atmospheric crude oil distillation units. The rate is calculated by dividing the gross input to these units by the operating refining capacity of the units.

Operational Balancing Agreements: Agreements between pipelines and parties at delivery or receipt points whereby the parties agree to specified procedures for balancing discrepancies between the nominated levels of service and the actual quantities.

Operational Flow Orders: Orders that are issued by a pipeline to protect the operational integrity of the line.

Operation and Maintenance Manual: A manual that describes detailed procedures for operators to follow to operate and maintain specific water or wastewater treatment or pretreatment plants and the equipment of the plants.

Operator: (1) Term used to describe a company appointed by venture stakeholders to take primary responsibility for day-to-day operations for a specific plant or activity. (2) The company or individual responsible for managing an exploration, development, or production operation. (3) The company that has legal authority to drill wells and undertake the production of hydrocarbons that are found. The operator is often part of a consortium and acts on

behalf of this consortium. (4) The company who makes the decisions and is responsible for drilling, completing, operating, and repairing the well.
OPEX: Operation expenditures. Generally repair or maintenance expenses.
OPRG: See *Oxygenated fuels program reformulated gasoline*.
Ordovician: A geologic time period from 425 million to 500 million years ago.
Ore: A mineral deposit rich enough to be mined commercially.
Ore Flotation: A common way for extracting particles of metal from an ore is to crush the ore into a fine powder, add water and surfactant, and bubble air through. Particles of many useful minerals, which are more hydrophobic than the rock that surrounds them, will stick to the surfactant bubbles and collect at the surface.
ORF: Offshore receiving facility.
Organic: (1) When referring to chemical compounds, anything that contains carbon. The original definition was more like "any chemical found in or derived from a living organism," and most chemists still feel funny calling carbon monoxide or the carbonate ion $\left(CO_3^{2-}\right)$ organic compounds. (2) Substances that come from animal or plant sources. Organic substances always contain carbon. (Inorganic materials are chemical substances of mineral origin.) Also see *Inorganic*. (3) A term used to refer to chemical compounds made from carbon molecules. These compounds may be natural materials (such as animal or plant sources) or man-made materials (such as synthetic organics). Also see *Organic*. (4) Any form of animal or plant life. Also see *Bacteria*.
Organic Acid: An organic acid such as acetic and formic that has the characteristic COOH– group.
Organic Deposit: A deposit in the flow path that is chiefly organic in composition—typically paraffin (wax), asphaltene, tar, or other organic materials.
Organic Loading: The pounds of BOD per day applied to a unit process.
Organic Theory: (1) The most widely accepted theory to explain the generation of hydrocarbons. As organic materials are buried, heat and pressure transform them into hydrocarbons over geologic time. (2) Says that oil and gas were formed from the remains of plants and animals. Scientists, who support this theory, think that oil and gas were formed from the remains of small or microscopic plants and animals that lived in prehistoric rivers and seas. When these plants and animals died, they combined with mud, silt, and sand to form layers of the mixture called sediments. After thousands of years, a thick layer of sediment formed on the bottom of the sea. As more layers were added, the weight of the new layers applied pressure to the lower layers and turned them into sedimentary rock. Scientists believe that high heat and pressure, bacteria, chemical reactions, and other forces transformed these sediments into oil and gas.
Organic Waste: Waste material that comes mainly from animal or plant sources. Organic wastes generally can be consumed by bacteria and other microscopic organisms. Inorganic wastes are chemical substances of mineral origin.

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Organism: Any form of animal or plant life. Also see *Bacteria*.
Organization of the Petroleum Exporting Countries: (1) A powerful grouping of oil-producing countries that seeks to maintain steady oil prices and regulate production. The current member nations are Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, Vatican City, and Venezuela. (2) Oil-producing and exporting countries in the Middle East, Africa, and South America that have organized for the purpose of negotiating with oil companies on matters of oil production, prices, and future concession rights. OPEC was created in 1960. The Neutral Zone between Kuwait and Saudi Arabia is considered part of OPEC. Prior to January 1, 1993, Ecuador was a member of OPEC. Prior to January 1995, Gabon was a member of OPEC.

For more information, see the OPEC website.
Oriented Perforating: Perforating to align the charge penetration direction with a feature like the fracture plane or to miss an adjacent string of pipe.
Orifice: An opening in wall or plate used to control the rate of flow into or out of a tank or pipe.
Orifice (Gas Lift): A set diameter passage (not really a valve).
Orifice Meter: A single phase flow meter, primarily for gas that measures the pressure drop created by the hole as gas is flowed.
Orifice Plate: Part of an orifice metering system. A plate with a hole through which a single phase flow produces a pressure drop.
Original Equipment Manufacturers: Vehicle manufacturers that provide the original design and materials for assembly and manufacture of their product. They are directly responsible for manufacturing and modifying vehicles, making the vehicles commercially available, and providing a warranty for the finished product.
Original Gas in Place: OGP or OGIP, the entire volume of gas contained in a reservoir, whether or not it is currently recoverable with state-of-the-art technology or ability to produce.
Original Oil/Gas in Place: Is an estimate of the amount of oil or gas contained in the reservoir based on physical features of the reservoir. Not all of these hydrocarbons can be recovered.

The Federal Government controls the area from the states' inland waters out to 200 miles or 8200 ft of water depth. This region is known as the outer continental shelf or OCS.
O-Ring: A circular seal with a circular cross section.
Orogeny: A period (geologic) of mountain building.
ORP: See *Oxidation–reduction potential*.
Orphan Wells: Wells for which the operators cannot be located.
Orthophosphate: An acid or salt containing phosphorus (PO).
Orthotolidine: A colorimetric indicator of chlorine residual in which a yellow-colored compound is produced.
Orthoxylene: An aromatic compound used in the manufacture of plasticizers and polyester.

OS: Overshot.
OSHA: (1) Occupational safety and health administration, US government agency. (2) The Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA) is a federal law designed to protect the health and safety of industrial workers, including the operators of water supply and treatment systems and wastewater treatment plants. The Act regulates the design, construction, operation, and maintenance of water supply systems, water treatment plants, wastewater collection systems, and wastewater treatment plants. OSHA also refers to the federal and state agencies that administer the OSHA regulations.
Osmosis: Movement of a solvent through a semipermeable membrane (plastic, polymer, or living cell) into a solution of higher solute (dissolved salt) concentration that tends to equalize the concentrations of solute on the two sides of the membrane.
Osmotic Pressure: Where two solutions of different concentrations are separated by a membrane that the solvent molecules can move through, but the dissolved particles (solute) can't, the solvent will move from the less concentrated to the more concentrated solution to attempt to equalize the concentrations. The pressure that must be exerted on the solution to stop this influx of solvent is called the osmotic pressure, which is given by a simple equation for dilute solutions:

$$\text{Pressure} = 8.314 \times (\text{temperature}) \times (\text{difference in number of solute molecules per liter})$$

OTC: Offshore Technology Conference.
Other Finished: See *Motor gasoline (finished)*.
Other Finished or Conventional Gasoline: Finished motor gasoline not included in the oxygenated or reformulated gasoline categories. *Note*: This category excludes reformulated gasoline blendstock for oxygenate blending (RBOB) as well as other blendstock.
Other Hydrocarbons: Materials received by a refinery and consumed as a raw material. Includes hydrogen, coal tar derivatives, gilsonite, and natural gas received by the refinery for reforming into hydrogen. Natural gas to be used as fuel is excluded.
Other Oils Equal to or Greater than 401°F: Oils with a boiling range equal to or greater than 401°F that are intended for use as a petrochemical feedstock. Also see *Petrochemical feedstocks*.
Other Oxygenates: Other aliphatic alcohols and aliphatic ethers intended for motor gasoline blending (e.g., isopropyl ether [IPE] or *n*-propanol).
Ottawa Sand: A high-quality, widely available mined sand used for gravel packing and fracture proppant.
Outcrop: Where a formation surfaces.
Outer Continental Shelf: (1) That portion of a continental land mass that constitutes the slope down to the ocean floor. The outer continental shelves

are heavily sedimented and are believed to contain a large portion of the Earth's undiscovered oil and gas. (2) Offshore Federal domain.

Outer Continental Shelf (MMS): All submerged lands seaward and outside the area of lands beneath navigable waters. Lands beneath navigable waters are interpreted as extending from the coastline 3 nautical miles into the Atlantic Ocean, the Pacific Ocean, the Arctic Ocean, and the Gulf of Mexico excluding the coastal waters off Texas and western Florida. Lands beneath navigable waters are interpreted as extending from the coastline 3 marine leagues into the Gulf of Mexico off Texas and western Florida.

Outfall: (1) The point, location, or structure where wastewater or drainage discharges from a sewer, drain, or other conduit. (2) The conduit leading to the final disposal point or area.

Outfall Sewer: A sewer that receives wastewater from a collection system or from a wastewater treatment plant and carries it to a point of ultimate or final discharge in the environment. See *Outfall*.

Outgassing: Breakout of gas from a liquid, normally at the point where the pressure has declined sufficiently to allow solution gas to be released as bubbles.

Outlet: Downstream opening or discharge end of a pipe, culvert, or canal.

Ovality: A change in tube roundness. Ovality in percent = $(D_{max} - D_{min})/D_{nominal} \times 100$.

Ovality Limit (CT): A limit placed on coiled tubing, usually in % ovality, after which the CT may not be used in deep wells or in well operations outside of completion hangoffs.

Overbalance: Where the pressure in the wellbore is higher than the pressure in the reservoir.

Overburden: The sediment weight pressing down on the formation. Usually about 1 psi/ft.

Overflow Rate: The criteria for the design of settling tanks in treatment plants. It is stated as the settling velocity of particles that are removed in an ideal basin if they enter at the surface (volume of flow per unit water surface area of the tank).

Overflush: The fluid that is pumped after the last reactive or active part of a stimulation to displace the stimulation down to (displacement) or into (overflush) the formation.

Overhead: In a distilling operation, that portion of the charge that leaves the top of the distillation column as a vapor.

Overlap: The section of a concentric liner or casing installation where both strings are cemented.

Overlift: Over production, beyond the allotment or contract volume, that must be accounted for in a contract.

Overpull: The load applied when pulling equipment that is in excess of the actual string weight.

Overriding Royalty: Is an interest "carved out" of the lessee's leasehold interest and is often used to compensate people who structured the drilling venture.

Overriding Royalty Interest (Contract): A royalty interest that may be retained by a third party as payment or investment. This interest normally bears no part of the drilling and completion expenses of the well.
Overshot: A fishing tool designed to slip over the fish and grasp the outside.
Overthrust: An area of earth shift common to mountainous regions in which strata are shoved upward creating highly titled reservoirs.
OWC: See *Oil/water contact*.
OWR: Oil/water ratio.
Oxbow Lake: A crescent-shaped body of generally isolated water, cut off from a meandering stream as the stream changed its course.
Oxidation: Oxidation is the addition of oxygen, removal of hydrogen, or the removal of electrons from an element or compound. In the environment, organic matter is oxidized to more stable substances. The opposite of reduction.
Oxidation Ditch: The oxidation ditch is a modified form of the activated sludge process. The ditch consists of two channels placed side by side and connected at the ends to produce one continuous loop of wastewater flow and a brush rotator assembly placed across the channel to provide aeration and circulation.
Oxidation Inhibitor: A substance added in small quantities to a petroleum product to increase its oxidation resistance, thereby lengthening its service or storage life; also called an antioxidant.
Oxidation–Reduction Potential: The electric potential required to transfer electrons from one compound or element (the oxidant) to another compound or element (the reductant); used as a qualitative measure of the state of oxidation in wastewater treatment systems. ORP is measured in millivolts, with negative values indicating a tendency to reduce compounds or elements and positive values indicating a tendency to oxidize compounds or elements.
Oxidation Stability: The resistance of a petroleum product to oxidation, hence a measure of its potential service or storage life. The available tests all simulate service conditions on an accelerated basis.
Oxidizers: Reactants that oxidize, for example, bleach and sodium persulfate. Also, a compound that releases oxygen.
Oxidizing Agent: Any substance, such as oxygen (O_2) or chlorine (Cl_2), that will readily add (take on) electrons. The opposite is a reducing agent.
Oxygen: A chemical element used by all known life forms for respiration.
Oxygen Activation Survey: A log that detects compounds with oxygen such as water. Often used to detect channels behind pipe.
Oxygenated Fuel: Any fuel substance containing oxygen (includes oxygen-bearing compounds such as ethanol and methanol). Oxygenated fuel tends to give a more complete combustion of its carbon into carbon dioxide (rather than monoxide), thereby reducing air pollution from exhaust emissions.
Oxygenated Fuels Program Reformulated Gasoline: A reformulated gasoline that is intended for use in an oxygenated fuels program control area during an oxygenated fuels program control period.
Oxygenated Gasoline: (1) Gasoline with an oxygen content of 1.8% or higher, by weight, that has been formulated for use in motor vehicles.

(2) Finished motor gasoline, other than reformulated gasoline, having an oxygen content of 2.7% or higher by weight. Includes gasohol. *Note*: Oxygenated gasoline excludes OPRG and RBOB. (3) See *Motor gasoline (finished)*.

Oxygenates: Substances that, when added to gasoline, increase the amount of oxygen in that gasoline blend. Ethanol, methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), and methanol are common oxygenates.

Oxygen, Available: The amount of free oxygen in the water.

Oxygen Consumed: Oxygen consumed is the quantity of oxygen taken up from potassium permanganate in solution by a liquid containing organic matter commonly regarded as an index of the carbonaceous matter present. Time and temperature must be specified.

Oxygen, Deficiency: The additional quantity of oxygen required to satisfy the BOD in a sample.

Oxygen Deficient: An atmosphere that has less than 19.5% oxygen. Such an environment puts a worker at risk of asphyxiation.

Oxygen Index (Shale): (OI, mg CO_2/g TOC) A measurement of the percent of oxygen needed to support reaction.

Oxygen Uptake Rate Ozone: The amount of oxygen used by an activated sludge system per unit time. A molecular form of oxygen composed of three atoms (0). Also a strong disinfecting agent that leaves no residual.

Ozone: (1) An oxygen molecule with 3 oxygen atoms that occurs as a blue, harmful, pungent-smelling gas at room temperature. The stratospheric ozone layer, which is a concentration of ozone molecules located at 6 to 30 miles above sea level, is in a state of dynamic equilibrium. Ultraviolet radiation forms the ozone from oxygen but can also reduce the ozone back to oxygen. The process absorbs most of the ultraviolet radiation from the sun, shielding life from the harmful effects of radiation. Tropospheric ozone is normally present at the ground level in low concentrations. In cities where high levels of air pollutants are present, the action of the sun's ultraviolet light can, through a complex series of reactions, produce a harmful concentration of ozone in the air. The resulting air pollution is known as photochemical smog. Certain air pollutants (e.g., chlorofluorocarbons) can drift up into the atmosphere and damage the balance between ozone production and destruction, resulting in a reduced concentration of ozone in the layer. (2) Ground-level ozone is a colorless gas that forms just above the Earth's surface.

Ozone Precursor: A chemical compound (such as nitrogen oxides, methane, nonmethane hydrocarbons, and hydroxyl radicals) that, in the presence of solar radiation, reacts with other chemical compounds to form ozone.

P

P&A: See *Plugged and abandoned*.
P&ID or PNID: Process and instrument diagram.
P&I (Shipping): Protection and indemnity insurance.
Packaged Air Conditioner: Complete air-conditioning unit including refrigeration compressor, cooling coils, fans, filter, and automatic controls assembled into one casing.
Packaged Boiler: Boiler shipped complete with heating equipment, mechanical draft equipment, automatic controls, and accessories; usually shipped in one or more major sections.
Package Treatment Plant: A small wastewater treatment plant often fabricated at the manufacturer's factory, hauled to the site, and installed as one facility. The package may be either a small primary or a secondary wastewater treatment plant.
Packed Bed Scrubber: Vertical or horizontal vessels, partially filled with packing or devices of large surface area, used for the continuous contact of liquid and gas such that absorption can take place. Frequently, the scrubber liquid or liquor has had chemicals added to react with the absorbed gas.
Packer: (1) An expanding plug used in a well to seal off certain sections of the tubing or casing when cementing and acidizing or when a production formation is to be isolated. Packers are run on the tubing or the casing and when in position can be expanded mechanically or hydraulically against the pipe wall or the wall of the wellbore. (2) A device that forms a seal between two chambers of the well. Packers may be equipped with slips that anchor the packer and stop movement under high pressure.
Packer Bore Receptacle: A removable PBR anchored into the top of a packer.
Packer Elements: Elastomer seals on a packer.
Packer Fluid: The fluid left in the annulus behind the packer. It may help offset pressure in the tubing or help reduce thermal losses.
Packer Integrity Test: Pressure testing the tubing/casing annulus to ensure isolation.
Packerless Completions: A completion with no packer. Common where evergas has to be kept away from ESPs and rod rumps.
Packer Milling: Removal of a permanent packer.
Packer Squeeze Cementing: Isolating a cement injection site between a packer and a plug prior to squeezing.
Packing Element: Seal that blocks fluid communication.
Packing (Seals): Seals around a moving shaft or other equipment.

P

Packing Off: A collection of materials including cutting and/or fill that dehydrates or is held by pressure and stops circulation of fluid in a wellbore.
Packoff: (1) A seal between or around equipment to isolate pressure or areas within the well. (2) A seal formed in the tubing or around the top of a screen or packer to isolate a flow path.
PACV: Pressure-activated circulating valve.
Pad: A volume of fluid, without proppant, injected in front of a frac job to establish frac width.
PAD: See *Petroleum administration for defense*.
Paddle Blender or Mixer: A mixing chamber, usually in a small tank or pod that uses a rotating paddle to mix the fluid and the additives.
PAL: Producer, artificial lift.
Paleocene: A geologic time period from 250 to 570 million years ago.
Paleontology: The study of fossils. Useful for dating and identifying rocks.
Paleozoic: An era of geologic time lasting from 570 million years ago to 245 million years ago.
PAL (Lift): Producer, artificial lift.
PAL (Log): Pipe analysis log.
Paraffin: (1) A white, odorless, tasteless, chemically inert, waxy substance derived from distilling petroleum; a crystalline, flammable substance composed of saturated hydrocarbons. (2) A white, tasteless, odorless, chemically inert, waxy substance obtained from some petroleum oils. (3) Normal or straight carbon chain alkanes with carbon chain lengths of C18+. The alkanes in this range solidify at temperatures from 80°F to over 200°F. Paraffin is amorphous but may appear to have structure in slow growth examples.
Paraffin-Base Crude: A type of crude oil containing predominantly paraffin hydrocarbons as distinguished from asphaltic- and naphthenic-base crudes. It is a source of high-quality lubricating oils.
Paraffin-Base Oil: Oil with API gravity greater than 30.
Paraffinic: Having the characteristics of paraffins, that is, saturated hydrocarbons of open chain structure.
Paraffin, Liquid: Highly refined, colorless, heavy USP oil used for medicinal purposes and other applications.
Paraffin Scraper or Scratcher: A wire line tool to remove paraffin deposits.
Paraffin Wax: Hydrocarbons of solid consistency having a relatively pronounced crystalline structure, extracted from certain petroleum distillates. Refined paraffin wax has a very low oil content and is white in color, with some degree of translucency, almost tasteless and odorless, and slightly greasy to the touch.
Parallel Operation: Wastewater being treated is split, and a portion flows to one treatment unit, while the remainder flows to another similar treatment unit.
Parasitic Bacteria: Parasitic bacteria are those bacteria that normally live off another living organism, known as the "host."

Paraxylene: An aromatic compound used to make polyester fibers and plastic soft drink bottles.
Parent: A radioactive element whose decay produces stable daughter elements.
Parted Rods (Beam Lift): A sucker rod string that has broken or come apart in the well.
Partial Completion: Where only part of the pay zone is completed. Generally used to control coning of a fluid or to select the origin of the fracture in a stimulation.
Partial Monolayer: A layer of proppant with gaps between the grains. High capacity but weak.
Partial Penetration: Drilling only part way through a reservoir (near vertical wells).
Partial Pressure: For CO_2 corrosion potential; the mole fraction of the gas times the total pressure.
Particle: A small discrete mass of solid or liquid matter.
Particle Distribution: A sieve or laser analysis of the particle sizes in a sand.
Particulate: State of matter in which solid or liquid substances exist in the form of aggregated molecules or particles.
Particulate Matter: (1) Refers to microscopic solid or liquid particles that remain suspended in the air for some time. (2) A particle of solid or liquid matter (soot, dust, mist, etc.).
Parts per Million: (1) The scale on which impurities and contaminants in oils, gases, and petrochemicals are measured. (2) Unit weight of the solute per million unit weights of the solution. A small correction factor is needed to convert to mg/liter. (3) A measurement of concentration on a weight or volume basis. This term is equivalent to milligrams per liter (mg/L), which is the preferred term.
Pascal: A unit of pressure equal to 1/100,000 of a bar.
Passivation (Corrosion): Reduction of the anodic reaction rate.
Passive: A condition when the metal shows a marked decrease in corrosion rate.
Pass-Through: The passage of untreated pollutants through a publicly owned treatment works (POTW), which could violate applicable water quality standards or National Pollutant Discharge Elimination System (NP-DES) effluent limitations.
Patch (Tubular): An in-place, downhole repair of part of a tubing string.
Pathogenic: Disease causing or harmful to man.
Pathogenic Organisms: Organisms, including bacteria, viruses, or cysts, capable of causing diseases (giardiasis, cryptosporidiosis, typhoid, cholera, dysentery) in a host (such as a person). There are many types of organisms that do not cause disease. These organisms are called nonpathogenic.
Pattern Water Flood: A series of injection and production wells in a regular arrangement.

P

Payoff: When the well has produced sufficient net revenue to pay the cost of drilling and equipping the well.
Payout: (1) When the costs of drilling, producing, and operating have been recouped from the sale of products on a well. (2) The point where the capital cost has been earned.
Pay Zone: (1) The stratum of rock in which oil and/or gas is found. (2) Rock in which oil and gas are found in exploitable quantities. (3) Hydrocarbon-producing interval.
PB: Pump bailer.
PBR: See *Polished bore receptacle*.
Pb (Reservoir Fluids): Saturation pressure or bubble point pressure.
PBTD: Plug back total depth.
PBU: See *Pressure buildup*.
PC: Production casing.
PCL (SSSV): Premature valve closure.
PCP: Permanent completion perforating.
PCP: Progressive cavity pump.
PCT (Brine): Pressure crystallization temperature.
PDC: Polycrystalline diamond compact drill bit or cutter.
PDC Log: Perforating depth control log.
PD (Gas Lift): Bellows gas pressure at 60°F.
PDG, PDHG: Permanent downhole gauge.
PDM: Positive displacement motor.
PDNP (Reserves): Proved developed nonproducing.
PDP: Professional development plan.
PD (Reserves): Proved developed.
PE: Petroleum engineer or production engineer.
Peak-Day Sendout: The largest volume of natural gas delivered on any 1 day during the year.
Peak Demand: The maximum momentary load placed on a water treatment plant, pumping station, or distribution system. This demand is usually the maximum average load in 1 h or less but may be specified as the instantaneous load or the load during some other short time period.
Peaking Factor: Ratio of a maximum flow to the average flow, such as maximum hourly flow or maximum daily flow to the average daily flow.
Peak Shaving: Using sources of energy, such as natural gas from storage, to supplement the normal amounts delivered to customers during peak-use periods. Using these supplemental sources prevents pipelines from having to expand their delivery facilities just to accommodate short periods of extremely high demand.
Peak-Shaving Facility: A facility that stores natural gas to be used to supplement the normal amount of gas delivered to customers during peak-use periods.
Peak-Shaving LNG Facility: A facility for both storing and vaporizing LNG intended to operate on an intermittent basis to meet relatively short-term

peak gas demands. A peak-shaving facility may also have liquefaction capacity, which is usually quite small compared to vaporization capacity at such facility.

Peak Shaving (or Peak Lopping): The process of drawing natural gas during peak-use periods from storage or peak load plants to supplement the normal amounts delivered to customers.

Peak-Shaving Plant: Industrial plant where natural gas is liquefied into LNG, stored as liquid, and regasified back to natural gas again. These plants allow adapting changes in the demand to the transportation capacity of the pipelines that feed a market. Typically, these plants liquefy gas when demand is low and regasify it when it is high.

Peak-Use Period: The period of time when gas use on a particular system is at its maximum. This is the period when gas supply is most likely to be suspended for interruptible service customers. Distributors also employ techniques such as peak shaving to soften the impacts of high demand on the pipelines.

Peat: An organic deposit, which, with time and burial stresses, would become coal.

PEEK: Polyetheretherketone (Victrex™, Arlon™).

PEI: Production efficiency improvement.

PEL: See *Permissible exposure limit*.

Penetration: (1) A measure of the hardness and consistency of bitumen and lubricating greases in terms of the distance in 1/10th of a millimeter by which a weighted special needle or cone will penetrate the sample in 5 s, the temperature, unless otherwise stated, being 25°C. (2) The depth, expressed in units of 0,1 mm, to which a standard needle placed vertically on the surface of the sample of bitumen enamel and loaded with a 100 g weight under the specified conditions of temperature (25°C) and time (5 s) will enter.

Penetration Rate (Drilling or Well Cleanout): A rate measured in distance per time or the penetration of a bit or cleanout sub through a formation or a deposit.

Pennsylvanian: (1) Pertaining to Pennsylvania. The geologic epoch known as the Carboniferous (286–360 years before present (YBP)), in which many of the world's major coal deposits were deposited, is divided into the Mississippian (286–320 YBP) and Pennsylvanian (320–360 YBP) in American-speaking countries. (2) A geologic time period from 290 to 320 million years ago.

Penny Frac: A frac that grows up and outward.

Pensky–Martens Closed Cup: The apparatus for determining the closed flash point of fuel oils, lubricating oils, and other petroleum products.

Pentane: A five-carbon-chain alkane. Used in the lab to check for asphaltenes (precipitates them).

Pentanes Plus: A mixture of hydrocarbons, mostly pentanes and heavier, extracted from natural gas. Includes isopentane, natural gasoline, and plant condensate.

PE (Plastic): Polyethylene.

P

Peptize: Disperse into a colloid.
Percent Saturation: The amount of a substance that is dissolved in a solution compared with the amount that could be dissolved in solution, expressed as a percent.
Perched Water Table: A water-saturated area that lies within a zone of aeration.
Percolation: The flow of liquid through a filtering medium.
Percussion Hammer (Drilling): A device that delivers rapid thrust or blows to the assembly containing the drill bit.
PERF: Petroleum Environmental Research Forum.
Perforated Completion: A completion where the well is cased and cemented and then perforated in the zone of interest.
Perforated Liner: A liner with holes drilled for fluid entry. Not usually for sand control but may be useful for increasing hole stability or access.
Perforating Charge: A shaped explosive charge used for penetrating casing and cement.
Perforating Debris: Pieces of charge cases, loading tubes, and alignment equipment generated by firing the gun. They may or may not be left in the well.
Perforating Density: Shots per unit length.
Perforating Depth Control: The process by which a perforating gun is lined up to fire at the correct depth.
Perforating Gun: (1) A special tool used downhole for shooting holes in the well's casing opposite the producing formation. The gun, a steel tube of various lengths, has steel projectiles placed at intervals over its outer circumference, perpendicular to the gun's long axis. When lowered into the well's casing on a wire line opposite the formation to be produced, the gun is fired electrically, shooting numerous holes in the casing that permit the oil or gas to flow into the casing. (2) A carrier for shaped charge explosives that punches holes through the casing and cement and into the formation. Guns may be run on wire line or tubing.
Perforation: A hole made through the casing and cement and into the formation. It has a characteristic entrance hole and penetration. It is the flow path from the formation to the wellbore in a cased and cemented completion.
Perforation Breakdown: The fracturing of a perforation tunnel. Often used to bypass damage or increase permeability.
Perforation Carrot: A piece of the copper liner that forms a cylindrical slug.
Perforation Crush Zone: The area of crushed rock surrounding the perforation. Usually 30%–70% of initial permeability and ½ in. or about 1 cm thick.
Perforation Density: The number of perforations per unit length of pipe in an interval.
Perforation Entry Hole: The diameter of the hole in the first string of pipe penetrated by the perforator.
Perforation Penetration: The total depth of penetration including the casing thickness, the cement, and the formation.

Perforation Phasing: The angle between the shots. The phasing can have an impact on pipe strength, formation strength, and productivity.
Perforation Prepacking: Packing the perforation with gravel to prevent tunnel collapse.
Perforation Shot Density: The number of perforations per foot or per meter.
Perform™: Nodal analysis program.
Period: A geologic timescale that is less than an era and greater than an epoch.
Periodic Table: A logical way of writing down all the 111 elements so that the connections between their properties and their electronic structure is "obvious." I think 111 is the right number this week…. There are many fantastic periodic tables on the web, such as WebElements.
Permafrost: A type and structure of frozen soil found in cold areas of the world. May extend to depths in excess of 1000 m.
Permanent Packer: A reliable packer designed and intended to be left in place for a long period of time that seals and holds pressure or resists movement from both directions.
Permeability: (1) The capacity of a rock or stratum to allow water or other fluids, such as oil, to pass through it; symbolized as *k*. (2) A measure of the resistance of rock to the movement of fluids. Rocks may have holes or void spaces in them (porosity), but if these holes do not connect, the permeability can be drastically reduced. (3) The capacity of a reservoir rock to transmit fluids; how easily fluids can pass through a rock. (4) A measure of the resistance offered by a rock to the movement of fluids through it. (5) The property of a formation that quantifies the flow of a fluid through the pore spaces and into the wellbore. (6) A measure of the ability of a rock to transmit fluid through pore spaces. (5) Permeability is one of the important properties of sedimentary rock containing petroleum deposits. The oil contained in the pores cannot flow into the wellbore if the rock in the formation lacks sufficient permeability. Such a formation is referred to as "tight."
Permeability Barrier: A barrier to movement of a fluid through the rock. This may be a change in the rock where the pores are no longer connected or even present or secondary mineral growth that fills in the pore throats and natural fractures. In one sense, a permeability barrier may be another rock that acts as a seal.
Permeability Contrast: A comparison of permeabilities of a fracture proppant and the formation.
Permeability Correlation: A mathematical permeability correlation, normally based on porosity and rock type.
Permeability or k: A measurement of the ability of a fluid to flow through a rock.
Permeability Trap: Occurs when a change of permeability within a trap seals off hydrocarbons in a portion of the rock layer. The changes may be

caused by the uneven distribution of sand and clay as the sediment was deposited. This type of stratigraphic trap is also called a lenticular trap.

Permeation: (1) Flowing into the pores and gaps of a substance; why you can pour water into a cup that is already full of sand and pour a lot of water into a cup that is already full of popcorn. (2) Movement of gas to and through an elastomer.

Permian: A geologic time period from 250 to 290 million years ago.

Permissible Exposure Limit: The maximum 8 h time weighted average of any airborne contaminant (such as dust, mist, vapor, gas, noise) to which an operator may be exposed. At no time may the exposure level exceed the ceiling concentration for that contaminant. Ceiling levels of regulated contaminants are listed in the Code of Federal Regulations (CFR) Title 29 Part 1910, Subparts G and Z. Also see *Time weighted average (TWA).*

Permit-Required Confined Space: A confined space that has the potential for some sort of serious hazard, like a hazardous atmosphere, electric hazard, or drowning danger, that may cause serious injury or death.

Persian Gulf: The countries that comprise the Persian Gulf are Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

Personal Hygiene: Personal health habits, like hand washing, which prevent infection.

Personal Protective Equipment: Clothing, like hard hats, safety glasses, and gloves, that are designed to protect workers from hazards.

PES: Production engineering supervisor.

PET: See *Poly(ethylene terephthalate).*

Petajoules: 1,000,000,000,000,000 J. 1 kJ = 0.9478 BTU.

Petal Basket (Cementing): An attachment to tubing or a plug that looks like an upside-down umbrella. It helps hold cement or sand as a plug is started. It has metal ribs and a tough fabric between the ribs.

Petal Basket Flowmeter (Logging): A petal basket that reroutes all the fluid over the diameter of the wellbore into a single flow stream near the middle so an accurate measurement with a flowmeter can be made.

PETN: A low-temperature explosive used in perforating charges.

Petrochemical: An intermediate chemical derived from petroleum, hydrocarbon liquids, or natural gas: ethylene, propylene, benzene, toluene, and xylene.

Petrochemical Feedstock: Feedstock derived from petroleum, used principally for the manufacture of chemicals, synthetic rubber, and a variety of plastics.

Petrochemical Feedstocks: Chemical feedstocks derived from petroleum principally for the manufacture of chemicals, synthetic rubbers, and a variety of plastics. The categories reported are "naphtha less than 401°F" and "other oils equal to or greater than 401°F."

Petrochemical Industry: Industries based on petroleum and chemicals derived from petroleum.

Petrochemicals: (1) Value-added products made from crude oil or natural gas. Most of the chemicals we use to keep civilization rolling along. (2) Are

a class of chemicals that are derived from crude oil and natural gas. The primary petrochemical "building blocks" are benzene, toluene, and xylene (BTX), and ethylene. Over 3000 chemical products are synthesized from these chemicals. (2) Chemicals derived from oil or gas.

Petrolatum: (1) A semisolid substance obtained from petroleum and consisting essentially of microcrystalline waxes in specially refined oil. Also called petroleum jelly. (2) Petrolatum is petroleum jelly used for impregnation. (3) A semisolid product, ranging from white to yellow in color, composed of heavy residual oils and paraffin wax produced by filtration of cylinder stocks. Has varied pharmaceutical and industrial uses.

Petroleum: (1) A generic term applied to oil and oil products in all forms (such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and finished petroleum products). (2) A sticky, oily, flammable liquid that is a complex mixture of organic compounds (mostly hydrocarbons), and others may vary in color from nearly colorless to black. Basically, it is another word for crude oil. "Petr" means something like "rock," and "oleum" means something like "oil." (3) A generic name for hydrocarbons, including crude oil, natural gas liquids, natural gas, and their products. (4) A naturally occurring mixture composed predominantly of hydrocarbons in the gaseous, liquid, or solid phase. (5) The Latin origin is rock oil.

Petroleum Administration for Defense Districts: Geographic aggregations of the 50 states and the District of Columbia into five districts by the Petroleum Administration for Defense in 1950. These districts were originally defined during World War II for purposes of administering oil allocation.

Petroleum Bitumen: A mixture of high molecular mass hydrocarbons derived from petroleum by oxidation of suitable selected bases to a varying extent, possibly by adding fillers, in order to produce a material conforming to one of the grades.

Petroleum Coke: (1) A residue high in carbon content and low in hydrogen that is the final product of thermal decomposition in the condensation process in cracking. This product is reported as marketable coke or catalyst coke. The conversion is 5 barrels (of 42 US gallons each) per short ton. Coke from petroleum has a heating value of 6.024 million Btu/barrel. (2) Is a solid carbon substance that is deposited on the catalyst in fluid catalytic cracking and is isolated in the thermal coking process.

Petroleum Geologists: They study the earth and as such they are important in the search for mineral resources and petroleum. Petroleum geologists are employed by oil companies to determine whether a region may produce oil or gas.

Petroleum Jelly: Petroleum jelly is a purified mixture of semisolid hydrocarbons obtained from petroleum.

Petroleum Products: Petroleum products are obtained from the processing of crude oil (including lease condensate), natural gas, and other hydrocarbon compounds. Petroleum products include unfinished oils, liquefied petroleum gases, pentanes plus, aviation gasoline, motor gasoline, naphtha-type

jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.

Petrophysics: The study of reservoir rocks and their reactions.

Pf: Friction pressure—may be annulus or tubing.

PFO: Pressure falloff test—a common injector test or a test after pumping in.

Ph: Hydrostatic pressure.

pH: (1) The negative logarithm of the hydrogen ion activity. pH = –log 10 (aH+). Measurement of acid (<7), basic (>7), and neutral = 7. pH measures the acidity or alkalinity of water. (2) pH is an expression of the intensity of the basic or acidic condition of a liquid. The pH may range from 0 to 14, where 0 is most acidic, 14 most basic, and 7 neutral. Natural waters usually have a pH between 6.5 and 8.5.

Phase: (1) If you call a "system" anything that is in a bucket, then a "phase" is a part of the system that can be (at least in theory) separated mechanically without any chemical reaction and is of uniform composition. You could have ice and water mixed in a bucket (two phases) ice and soda water (three phases, if you count the bubbles) or ice and salad dressing (three phases—ice, oil, and vinegar). (2) A homogeneous body of material that differs in properties from other phases (immiscible)—for example, gas, liquid, and solid.

Phase Converter: A device that derives three phase power from single-phase power. Used extensively in areas (often rural areas) where only single-phase power is available to run three-phase equipment.

Phi: ϕ, porosity.

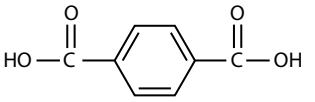
Phosphate Esters: Derivatives of phosphoric acid and alcohols. Used for scale inhibitors in process flow.

Phosphonates: Organophosphorus compounds that form the basis for many scale inhibitors that are squeezed into a formation and provide long-term protection.

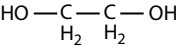
Phosphoric: Phosphoric acid, H_3PO_4, is a weak acid found in many soft drinks.

Phosphorus: A nutrient that exists in both dissolved and solid form that, when present in excess, leads to poor water quality, including algal blooms and poor aquatic habitat.

Photosynthesis: (1) A nifty reaction carried out inside green plants and by a number of different kinds of bacteria, which basically uses energy from the sun to run the combustion reaction backward. (2) A process in which chlorophyll-containing organisms convert carbon dioxide (CO) and inorganic matter to oxygen (O) and new cell material, utilizing sunlight as energy.



Terephthalic acid



Ethylene glycol

PHPA: Acrylamide polymer mud.
Physical Contract: A natural gas contract where delivery and receipt are expected.
Physical Waste Treatment Process: Physical waste treatment processes include the use of racks, screens, comminutors, clarifiers (sedimentation and flotation), and filtration. Chemical or biological reactions are important treatment processes but not part of a physical treatment process.
PI: See *Productivity index*.
Pi Bond: A chemical bond formed by the indirect overlap of two atomic orbitals. "I don't think I actually want to get into this, but the two bonds in a double bond are not the same; one is a sigma bond, formed by the direct 'head-to-head' overlap of two atomic orbitals, and this is considerably stronger than the second one, which is a pi bond."
Pickett Plot: A log–log plot of resistivity (x-axis) vs. porosity. Helps determine which zones contain hydrocarbon.
Pickle: A chemical treatment of the tubulars to remove pipe dope, mill scale, and mud or cement residue.
Pick (Seismic): A selected event on a seismic record.
Pickup Load: Actual load for heating the system following setback.
Pickup Weight: The surface weight measurement when pulling a pipe string or wire line out of the hole. Includes both string weight and frictional drag.
PID: Perforation inflow diagnostic.
Pig: (1) A cylindrical device that is inserted into a pipeline to clean the pipeline wall or monitor the internal condition of the pipeline. Also called a go-devil. (2) Device for cleaning a pipeline or separating two liquids being moved down pipeline. (Intelligent pig—fitted with sensors to check for corrosion or defects in pipelines.) (3) A flow line clearing device, pumped through the line with normal flow. (4) Refers to a poly pig that is a bullet-shaped device made of hard rubber or similar material. This device is used to clean pipes. It is inserted in one end of a pipe, moves through the pipe under pressure, and is removed from the other end of the pipe.
Pilings: Long steel piles driven into the seabed to anchor fixed offshore structures solidly in place.
Pill: A volume of gelled fluid mixed for a specific purpose. A fluid loss pill, for example.
PILOT: A joint program involving the government and the UK oil and gas industry: operators, contractors, suppliers, trade unions, and SMEs, aiming to secure the long-term future of the industry in the United Kingdom.
Pilot: A small scale test or trial used to assess the feasibility of a process to a reservoir or field.
Pilot Hole: A small (sometimes) diameter hole drilled through a pay zone to determine the pay top and bottom or various contacts, before the main well position is selected. May also use a pilot hole to better control influx rate.

P

Pilot Mill: A step-diameter mill that makes a pilot hole and then enlarges it with the upper diameter.
Pilot Scale Study: A method of studying different ways of treating wastewater and solids or to obtain design criteria on a small scale in the field.
PINC (Department of the Interior): Potential Incident of Noncompliance.
Pinch Out: (1) Loss of permeability in a reservoir rock. Often so severe that the pinch out becomes a barrier or a seal. (2) The disappearance or "wedging out" of a porous, permeable formation between two layers of impervious rock. The gradual, vertical "thinning" of a formation, over a horizontal or near-horizontal distance, until it disappears.
Pinch Out Trap: Is an unconformity where the older, eroded layer of rock is igneous and the newer layer is sedimentary. An unconformity trap can form if part of a porous layer of rock is eroded and then covered with an impermeable cap rock. A good example of this structural trap is the East Texas field.
Pin (in Pipe): The male end of the connector.
Pin (in Wire Line Tools): A small piece of steel, brass, and aluminum bar stock that is designed to break on a certain impact or pressure load and enable another tool function.
Pinj: Bottom-hole injection pressure.
Pinnacle Reef: (1) A conical-shaped reef-type deposit, usually with good permeability and porosity. (2) A conical formation, higher than it is wide, usually composed of limestone, in which hydrocarbons might be trapped.
PI or J: See *Production index*.
PIP: Trademarked name for a pinpoint injection packer.
Pipe Capacity: In a gravity-flow sewer system, pipe capacity is the total amount in gallons a pipe is able to pass in a specific time period.
Pipe Cleaning: Removing grease, grit, roots, and other debris from a pipe run by means of one of the hydraulic cleaning methods. See *Balling*, *hydraulic cleaning*, and *kite*.
Pipe Diameter: The nominal or commercially designated inside diameter of a pipe, unless otherwise stated.
Pipe Dope: A lubricant, antigall, and sealer applied to the pin threads when making a connection in the pipe.
Pipe Heavy: A hydraulic workover/snubbing tubing running term—when the weight of the pipe is sufficient to pull the pipe into a well against the surface pressure.
Pipe Joint: A place where two sections of pipe are coupled or joined together.
Pipe-Lay Barge: A flat-bottom, ship-shape, or semi-submersible vessel for the offshore installation of subsea pipelines. Individual pipe joints are welded together on the vessel (to make a continuous string) and subsequently laid onto the seabed in a controlled manner. In medium water depths, the pipe-lay barge is anchor moored. In deepwater areas, the barge is dynamically positioned.

Pipe-Lay Down: Removing pipe from the well or from standing in the derrick and laying in on the pipe racks away from the rig.

Pipe Light: Hydraulic workover/snubbing tubing running term—when the weight of the pipe is not sufficient to pull the pipe into a well against the surface pressure and additional force (snubbing) is required.

Pipeline: (1) The principal underground transport of produced gas and oil. (2) A tube for the transportation of crude oil or natural gas between two points, either offshore or onshore. (3) A continuous pipe conduit, complete with such equipment as valves, compressor stations, communication systems, and meters, for transporting natural and/or supplemental gas from one point to another, usually from a point in or beyond the producing field or processing plant to another pipeline or to points of use. Also refers to a company operating such facilities. (4) A pipe through which natural gas, crude oil, or petroleum products are pumped between two points, either onshore or offshore. (5) A string of interconnected pipe providing a route for natural gas to travel from the wellhead to market. Without pipelines, natural gas cannot be transported and sold at market to provide royalty payments, clean energy, and economic benefits to the community. (6) All parts of those physical facilities through which gas is moved in transportation, including pipe, valves, and other appurtenances attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies. (7) Pipe that transports combustible gas—usually natural gas.

Pipeline Capacity: The maximum quantity of gas that can be moved through a pipeline system at any given time based on existing service conditions such as available horsepower, pipeline diameter(s), maintenance schedules, and regional demand for natural gas.

Pipeline Constrained: A condition in which the capacity of gas pipelines is less than the demand for throughput.

Pipeline Fuel: Gas consumed in the operation of pipelines, primarily in compressors.

Pipeline Gas: (1) Produced gas within pipeline spec and under sufficient pressure to enter the pipeline against the pressure of the fluid in the pipeline. (2) Gas under sufficient pressure to enter the high-pressure gas lines of a purchaser; gas sufficiently dry so that liquid hydrocarbons—natural gasoline, butane, and other gas liquids usually present in natural gas—will not condense or drop out in the transmission lines.

Pipeline Interconnection: A point at which facilities of two or more pipelines interconnect.

Pipeline (Petroleum): Crude oil and product pipelines used to transport crude oil and petroleum products, respectively (including interstate, intrastate, and intracompany pipelines) within the 50 states and the District of Columbia.

Pipeline-Quality Natural Gas: Natural gas that meets the specifications of a pipeline.

P

Pipeline-Quality Oil: Oil with the BS&W removed and the contaminates brought within the contract specifications.
Pipelines: Tubular arrangement for the transmission of crude oil, refined products, and natural gas from the wellhead, refinery, and storage facility to the customer. Pipeline measures 14–42 in. in diameter but is usually 20–36 in. It is often composed of 40 ft lengths but lengths may be as long as 60 or 80 ft. The pipe is wrapped and coated for protection against corrosion, especially since it runs underground. About half of all gas and oil is moved by pipeline.
Pipe Rack: Storage racks.
Pipe Ramp: An angled ramp or track for bringing pipe from the rack to the rig floor.
Pipe Rams: The rams in a BOP that seal around the pipe diameter for which they were sized.
Pipe Section: A single length of pipe between two joints or couplers.
Pipe Tongs: Tools used in making up pipe connections.
Pipe Upset: (1) An increased diameter of the pipe body, which allows for a thicker coupling and an increased diameter at the coupling. (2) The thicker part of a pipe where threads are machined for the coupling.
Pip Tag: A radioactive tag or marker in the casing threads or the perforation that can quickly and positively be found with a gamma-ray log.
PISS: Pump in spinner survey.
PISTL: Pump in spinner temperature log.
PIT: Pressure integrity test.
PIT: See *Packer integrity test*.
PITA: Perforation inflow test analysis.
Pitch (Drilling): Deviation from a horizontal plane. Down is negative and up is positive.
Pit (Drilling): A temporary (earlier use) or permanent containment for circulated fluids.
Pit Level: The level of mud in the pits.
Pitman: The connecting rod from the rotating counterweights to the beam on a beam lift pumping unit.
Pitot Tube: (1) A small tube used for sensing pressures in a flowing stream. (2) Small-bore tube inserted perpendicular to a flowing stream with its orifice facing the stream to measure total pressure.
PITS: Pump in temperature survey.
Pitting: Extremely localized attack that results in holes in the metal. Will accelerate after start.
Pitting Resistance Equivalent Number: A relative measure of a material's pitting resistance in corrosive service.
PJ: See *Petajoules*.
PJTHA: Prejob task hazard analysis.
Pkr: See *Packer*.
PL: See *Pipeline*.

Placer Deposit: A deposit of heavy or durable minerals found where runoff water slows.
Planning Area: A subdivision of an offshore area used as the initial basis for considering blocks to be offered for lease.
Plant Condensate: One of the natural gas liquids, mostly pentanes and heavier hydrocarbons, recovered and separated as liquids at gas inlet separators or scrubbers in processing plants.
Plant Fuel: Natural gas used as fuel in natural gas processing plants.
Plant Hydraulic Capacity: The flow or load, in millions of gallons per day (or portion thereof), that a treatment plant is designed to handle.
Plan View: A diagram or photo showing a facility as it would appear when looking down on top of it.
Plastic: (1) What most people think of when they think of polymers. Strictly speaking, a plastic is a polymeric material that can be molded into different shapes when heated (a thermoplastic)—this is true for most of the materials mentioned on this website, including poly(styrene), nylon 66, PVC, and PET. Some misguided people say nasty things about plastic, but it wouldn't be everywhere if it wasn't (a) incredibly useful and (b) incredibly cheap. (2) A generic term for a range of high-molecular-weight polymers that can be used to produce a variety of items.
Plastic Deformation: A stress level, beyond the elastic limit, that produces yielding in tubulars.
Plastic Fluid: A complex, non-Newtonian fluid whose shear force is not proportional to the shear rate. Pressure is necessary to start circulation of the static fluid. Main low-rate flow is plug flow. Yield point is greater than zero.
Plasticizer: A compound added to a polymer to make it softer and more flexible. These are usually small molecules with dangling bits that can disrupt the packing of polymer chains. A common plasticizer used to soften PVC is dioctyl phthalate:

$$6CO_2 + 6H_2O \longrightarrow C_6H_6O_{12} + 3O_2$$

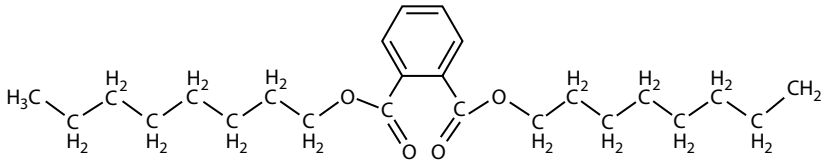
Plastic Resins: A class of petroleum-based materials that can be molded to form plastic items or used as the basis of adhesives.
Plastic Viscosity: An absolute flow property indicating the flow resistance of certain types of fluids. A measurement of shear stress.
Plateau: (1) Level of peak oil or gas field production; it is always followed by declining level of production. (2) The best producing time of a field, before the decline of total production rate begins.
Plateau Level: The level of peak production reached by an oil or gas field; it is always followed by declining level of production.
Plate Heat Exchanger: Fixed plates that separate and keep separate the hot and cold fluids.
Platform: (1) An offshore structure from which development wells are drilled; see *Drilling installation and Production installation*. (2) An offshore

structure that is permanently fixed to the seabed. (3) An offshore structure from which a well may be drilled or produced.
Play: A pay zone or set of pay zones with proven commercial reserves.
Playa: A dry lake basin found in a desert.
Playa Lakes Joint Venture: Phillips was one of the founding partners of this cooperative partnership of government and private organizations to preserve the playas of Oklahoma, Texas, New Mexico, Colorado, and Kansas. Playas, which are small, shallow basins, serve as critical habitat for some 4 million ducks, geese, and sandhill cranes. An important part of the effort is providing teachers in the playa region with educational materials that stress the importance of playas. In 1991, the joint venture was awarded a Presidential Citation by President George H.W. Bush.
PLC: Programmable logic controller.
Plenum: In an air distribution system, that part of the casing to or from which the air duct system delivers conditioned air.
PLET (Subsea): Pipeline end terminal.
PLT: Production logging tool.
Plug: (1) To fill a well's borehole with cement or other impervious material to prevent the flow of water, gas, or oil from one stratum to another when a well is abandoned; to screw a metal plug into a pipeline to shut off drainage or to divert the stream of oil to a connecting line to stop the flow of oil or gas. (2) A permanent plug, usually cement, set in a borehole to block the flow of fluids, to isolate sections of the well, or to permanently plug a dry hole or depleted well. (3) Any device, object, or material that blocks a flow passage.
Plug and Cage: A type of choke that is suitable for high volume and can stand some solids.
Plug and Seat Choke: A high-volume flow choke.
Plug Back: To set a plug (usually permanent) in a wellbore, giving a new bottom.
Plug Back Depth: The depth of the well to the top of the last permanent plug.
Plug Container or Dropper (Cementing): The housing with valves and bails that controls the position and dropping of the plugs used in cementing.
Plug Flow: (1) Fluid moves as a unit. (2) A type of flow that occurs in tanks, basins, or reactors when a slug of wastewater moves through a tank without ever dispersing or mixing with the rest of the wastewater flowing through the tank.
Plugged and Abandoned: (1) A depleted well or dry hole that has been (typically) filled with cement and marked, with all surface equipment removed. (2) Wells in which casings have been removed and the wellbore sealed with mechanical or cement plugs. (3) Setting cement and mechanical plugs to seal off pays, potential leak points, freshwater zones, and the surface.

Plugging: The process whereby a well is filled with concrete and abandoned. Often referred to as "p&a"—plugged and abandoned.
Plugging a Well: To fill up the borehole of an abandoned well with mud and cement to prevent the flow of water or oil from one stratum to another or to the surface. In the industry's early years, wells were often improperly plugged or left open. Modern practice requires that an abandoned well be properly and securely plugged.
Plug Valve: A high-pressure valve with a rotatable plug that allows or denies flow.
Plunger (Beam Lift): The traveling bar in beam lift pump internals.
Plunger (Gas Wells): A tool that is dropped without attachment through the tubing and standing water in the well and then seals against the tubing using the pressure of the incoming gas to raise the plunger and the water above it to the surface. A very common deliquification tool.
Plutonic Igneous (Rock): Magna extruded into overlying rock that is not exposed to atmospheric conditions during cooling.
PM: See *Particulate matter.*
PM10: Particulate matter having a size diameter of less than 10 millionths of a meter (10 μm).
PM2.5: Particulate matter having a size diameter of less than 2.5 μm.
PMACS: Portable measurement, alarm, and control system.
PMC: See *Project manager contractor.*
PMCC: See *Pensky–Martens closed cup.*
PML (Perforating): Powdered metal liner.
PNC: Pulsed neutron capture.
PNG: Pipeline natural gas.
PNL: See *Pulsed neutron log.*
PNV: See *Present net value.*
Pocket (Drilling): Old term for rat hole.
Pocket (Gas Lift): A receiving orifice for a gas lift valve in the gas lift mandrel.
Pod Mixer: A tank with an agitation system used to more precisely mix components during a job.
POE: See *Polyoxyethylenated.*
POH, POOH: Pull out of the hole.
Point Sources: Sources of water pollution that may be traced to a single point such as a discharge pipe or channel.
Poiseuille's Law (Flow): In the example or laminar flow for Newtonian fluids, the volume flow rate is given by the pressure differential (inlet to outlet) divided by the viscous resistance. This resistance depends on fluid viscosity and the length but is dominated by dependence on the fourth power of the radius.
Poisson's Ratio: As a rock is compressed axially, the ratio of longitudinal compressive strain to the transverse extension strain (length change over width change). Always between the range 0–0.5.

P

Polished Bore: A slightly smaller ID that the tubing above it is a tool or profile that allows a set of seals to provide isolation.
Polished Bore Receptacle: A polished bore, typical in a packer to accept the seal assembly on the end of tubing.
Polished Nipple: A polished nipple is run below blast joints to allow a pack-off set point when bypassing a damaged joint.
Polished Rod: A surface rod pup joint that slides through the stuffing box on a beam-pumped well. The part is highly polished and generally chrome plated. It must not be exposed to HCl acid.
Polished Rod Clamp (Beam Lift): A device that fastens the polished rod to the bridle.
Pollutant: Any substance that causes impairment (reduction) of water quality to a degree that has an adverse effect on any beneficial use of the water.
Pollutant, Contaminant: Any undesirable solid, liquid, or gaseous matter. A gaseous or liquid medium.
Pollution: (1) Contamination of water with actively or potentially toxic or otherwise harmful materials. (2) The impairment (reduction) of water quality by agricultural, domestic, or industrial wastes (including thermal and radioactive wastes) to a degree that the natural water quality is changed to hinder any beneficial use of the water or render it offensive to the senses of sight, taste, or smell or when sufficient amounts of wastes create or pose a potential threat to human health or the environment.
Polyacrylamide: A polymer with a very stable carbon chain. A good friction reducer in small amounts, but the polymer may cause formation damage. Can be used to gel acid, but the polymer will not break.
Polyelectrolyte: A high-molecular-weight (relatively heavy) substance having points of positive or negative electric charges that is formed by either natural or man-made processes. Natural polyelectrolytes may be of biological origin or derived from starch products and cellulose derivatives. Man-made polyelectrolytes consist of simple substances that have been made into complex, high-molecular-weight substances. Used with other chemical coagulants to aid in binding small suspended particles to larger chemical flocs for their removal from water. Often called a "polymer."
Polyester: (1) Polyesters are a class of polymer that use ester linkages (–C–O–C(O)–) to join the monomer units. Polyesters are condensation polymers. (2) Resin formed by condensation of polybasic and monobasic acids with polyhydric alcohols.
Polyethylene: (1) Plastic made from ethylene; used in manufacturing trash bags, milk jugs, shampoo bottles, water coolers, and cable coating, among other things. (2) A petroleum-derived plastic material used for packaging, plastic household wares, and toys. The main ingredient of polyethylene is the petrochemical gas ethylene.
Poly(Ethylene Terephthalate): A condensation polymer that is commonly used in soft drink bottles. It can be prepared by the reaction between ethylene glycol and terephthalic acid to give polymer and water:



Polyforming: A process charging C_3 and C_4 gases with naphtha or gas oil under thermal conditions to produce high-quality gasoline and fuel oil. Catalytic reforming has mostly replaced polyforming.

Polymer: (1) A large molecule (molecular weight ~10,000 or greater) composed of many smaller molecules (monomer) covalently bonded together. Some of us think that they are much better than any of those little molecules, but the other chemists are always telling us that size doesn't matter. (2) A complex compound formed by the polymerization of one or more monomers. (3) A synthetic or man-made gelling agent that increases viscosity and helps control leakoff. (4) A long-chain molecule formed by the union of many monomers (molecules of lower molecular weight). Polymers are used with other chemical coagulants to aid in binding small suspended particles to larger chemical flocs for their removal from water.

Polymerization: (1) The process in which many small molecules (molecular weight ~100) are joined together to form a few, much larger molecules (molecular weight 10,000–0,000,000). The two ways in which this happens are chain-growth and step-growth polymerization. (2) The process of combining two or more simple molecules of the same type, called monomers, to form a single molecule having the same elements in the same proportion as in the original molecule but having different molecular weights. The product of the combination is a polymer.

Polymer Matrix: A mass of polymer consisting of a number of chains is often described as polymer matrix. In a mass of polymer like this, the chains will often be entangled. If the chains can slide past each other easily, the polymer matrix will be rubbery and flexible; if they cannot, the matrix will be hard and glassy.

Polymer Scientist: A species of selfless professional divided into two subspecies: polymer physicists, who do boring stuff, and polymer chemists, who do exciting stuff. The highest form of sentient life.

Polymorph: A mineral that is identical to another mineral in chemical composition but differs from it in chemical structure.

Polyolefin: A polymer of olefins, molecules that have an alkene (double-bond) functionality. These polymers include polystyrene and poly(vinyl chloride). They are normally formed by free-radical polymerization (a form of addition polymerization).

Polyoxyethylenated: A common surfactant group.

Polyphenylene Sulfide: An engineering plastic with excellent resistance to most chemicals. See *Ryton*.

P

Polypropylene: Basic plastic formed by joining propylene molecules together. Used in the manufacture of synthetic fibers, automotive parts, luggage, safety helmets, and home construction.
Polystyrene: Is a white-colored polymer made from polymerization of a styrene monomer.
Polyvinyl Chloride: Is a hard, amber-colored material; precise properties depend on formulation. It is made from polymerization of vinyl chloride. Heat and light degrade all PVC polymers.
Ponding: A condition occurring on trickling filters when the hollow spaces (voids) become plugged to the extent that water passage through the filter is inadequate. Ponding may be the result of excessive slime growths, trash, or media breakdown.
Pony Rod: A short rod for spacing out a rod string.
Pool: (1) A natural underground reservoir containing an accumulation of petroleum. (2) Generally a petroleum containing reservoir or group of reservoirs.
Pooled Unit: Unit created by combining separate mineral interests under the pooling clause of lease or agreement.
Pooling: A term frequently used interchangeably with "unitization"; more properly, it refers to the combining of small or irregular tracts into a unit large enough to meet state spacing regulations for drilling permits. "Unitization" is a term used to describe the combined operations of all or some portion of a producing reservoir.
Poorly Sorted: A comparison of sand grain sizes in a formation where there are a broad range of coarse to fine particles.
POP: Put on production.
POP (Downhole): See *Pump-out plug.*
Poppet Valve: A type of valve common on early subsurface safety valves, where higher than expected flow through an orifice can move a round ball onto a sealing surface and stops the flow.
POP (Plug): See *Pump-open plug.*
POP (Production): Put on production.
Population Equivalent: A means of expressing the strength of organic material in wastewater. Domestic wastewater consumes, on an average, approximately 0.2 lbs of oxygen per person per day, as measured by the standard BOD test.
Pore: The opening within the rock. Interconnected porosity is linked together and results in permeability.
Pore Pressure Gradient: The formation or reservoir pressure divided by the depth.
Pores: The minute or microscopic voids in porous rock. Rocks containing pores are able to hold oil, gas, and water. If the pores are interconnected, the rock is permeable and a good reservoir rock.
Pore Size Distribution: A range of the pore sizes plotted against frequency of that size. Mercury is injected at stepwise increasing pressures where large

pores fill first, followed by smaller pores at successfully higher pressures. Volumes injected at different pressures indicate the pore size distribution.

Pore Throat: The connection between the pores, often a fraction of the pore size and an obvious restriction.

Porosity: (1) A measure of the relative volume of void space in rock to the total rock volume. These spaces or pores are where oil and gas accumulate; therefore, a formation containing a high percentage of porosity can contain more hydrocarbons. (2) The volume of spaces within rock that might contain oil and gas (like the amount of water a sponge can hold); the open or void space within rock—usually expressed as a percentage of the total rock volume. Thus, porosity measures the capacity of the rock to hold natural gas, crude oil, or water. (3) The open space within a rock, similar to pores in a sponge. (4) The percentage of void in a porous rock compared to the solid formation. (5) A ratio between the volume of the pore space in reservoir rock and the total bulk volume of the rock. The pore space determines the amount of space available for storage of fluids. (6) A measure of the volume contained in a rock. The volume of the pore space expressed as a percent of the total volume of the rock mass and is an important property of hydrocarbon-bearing formations. Good porosity indicates an ability to hold large amounts of oil and gas in the rock. (7) The percentage of the rock volume that is not rock grains and could be occupied by fluids. Pores may or may not be connected.

Porosity Cutoff: The lower limit of porosity that identifies a proven productive part of a particular formation.

Porosity Exponent: The exponent, m, in relating formation factor to porosity in the Archie equation, $F = 1/\phi m$.

Porous Layer: A permeable layer of solid material in any form having interstices of small size, generally known as "pores."

Ported Nipple: A nipple profile with an accessible side port to the annulus.

Portland Cement: A general class of cement that encompasses the most common cements used in construction and the oil field.

Portland Cement Clinker: Hard, approximate marble-sized nodules of calcium silicates and other additives that are the feedstock for making cement.

Port Plug: The sealing plug over a charge on a reusable perforating gun.

Positive Choke: Typically a nonadjustable choke using a flow bean.

Positive Displacement: A pump that creates movement by drawing in a given volume and physically pushing it out the discharge pipe. Flow rate from this type of pump is relatively constant, regardless of head, and if it is operated against a closed discharge valve, something will break.

Positive Pressure: In a building, pressure is greater than the pressure outside.

Possible Reserves: (1) Possible reserves are those unproved reserves that the analysis of geologic and engineering data suggests are less likely to be recoverable than probable reserves. In this context, when probabilistic methods are used, there should be at least a 10% probability that the quantities

actually recovered will equal or exceed the sum of estimated proved, plus probable, plus possible reserves. In general, possible reserves may include

1. reserves that, based on geologic interpretations, could possibly exist beyond areas classified as probable
2. reserves in formations that appear to be petroleum bearing, based on log and core analysis but may not be productive at commercial rates
3. incremental reserves attributed to infill drilling that are subject to technical uncertainty
4. reserves attributed to improved recovery methods when
   a. a project or pilot is planned but not in operation
   b. rock, fluid, and reservoir characteristics are such that a reasonable doubt exists that the project will be commercial
5. reserves in an area of the formation that appears to be separated from the proved area by faulting, and geologic interpretation indicates that the subject area is structurally lower than the proved area

Often referred to as P3 (start of production, SPE). (6) Those reserves that at present cannot be regarded as "probable" but are estimated to have a significant but less than 50% chance of being technically and economically producible.

Possum Belly: An enlarged section of a tank for settling solids.

"Postage Stamp" Rate: Transportation rate for a given area (can be a substantial portion of a pipeline's system) that does not vary according to distance from the source of the power supply. So called because postage stamps for letters are typically at a fixed price, regardless of destination.

Postchlorination: The addition of chlorine to the plant effluent, following plant treatment, for disinfection purposes.

Postdenitrification: Biological wastewater treatment process for nitrogen removal that utilizes an anoxic zone located at the effluent end of an aeration tank. Due to the lack of organic carbon, methanol addition is typically required.

Potable Water: (1) Water suitable for human consumption. (2) Drinkable water. (3) Water that does not contain objectionable pollution, contamination, minerals, or infective agents and is considered satisfactory for drinking.

Potassium Chloride: A salt commonly used in brines to reduce or prevent clay swelling in the formation.

Potassium Chloride Substitute: Generally salt and/or surfactant materials designed to simulate the effect of potassium chloride in preventing clay swelling. Substitutes may work in the wellbore but generally fail in the formation where severe swelling conditions exist.

Potassium K40: One of the natural isotopes that as a trace element may incorporate into the matrix of naturally forming barium or strontium sulfate scale and make it a very-low-level radioactive material (NORM scale).

Potential (Electric): Difference in electric power level.

Potential (Risk Analysis): Actual probability—the likelihood that the impact will occur. Impact (or consequence) is the effect on conditions or people if the hazard is realized (occurs) in practice, and probability is the likelihood that the impact will occur. Risk is a function of probability and impact (consequence).
POTW: See *Publicly owned treatment works*.
Pounds per Square Inch: (1) Pressure measured with respect to atmospheric pressure. This is a pressure gauge reading in which the gauge is adjusted to read zero at the surrounding atmospheric pressure.

A drilling rig receives its ***power*** from a system comprised of the diesel engine–dc generator–dc motor. A typical engine generator motor includes four such sets: two for the mud pumps, one for the draw works and the rotary table, and one somewhat smaller size for the lighting and auxiliary loads. Another type of electric rig uses the same power-flow system but the generators are ac, whose current is converted to dc to drive the dc motors for the variable speed drilling operations.
Pounds per Square Inch Absolute: The total pressure in a system including atmospheric pressure.
Pounds per Square Inch Gauge: (1) The pressure measured by a pressure gauge. The following formula is used to convert gauge pressure to absolute pressure: P(psia) = P(psig) + atmospheric pressure. (2) The pressure within a closed container or pipe measured with a gauge in pounds per square inch.
Pour Point: (1) The lowest temperature at which a liquid petroleum product will flow when it is cooled under the conditions of the standard test method. (2) The lowest temperature at which an oil will pour or flow when chilled, without disturbance, under test conditions in ASTM D97. (3) The lowest temperature that a hydrocarbon fluid can be flowed before gelling or turning solid. Related to pumpability.
Pour Point Depressant: An additive that lowers the pour point of petroleum products by reducing the tendency of waxes present to coagulate into a solid mass.
Pour Stability: The ability of a pour-depressant treated oil to maintain its original pour point when in storage at low temperatures approximating winter conditions.
Power Fluid: A fluid, usually dead oil or water, pumped downhole to operate a pump.
Power Law Fluid: A description of the flow properties (viscosity) of a fluid. Power law fluids are characterized by decreasing viscosity with increasing shear.
Power Swivel (Drilling and Workovers): A rig floor tool that can rotate a string.
Power Tongs: Hydraulic power makeup tools suspended above the rig floor.
Pozzolan: A silica cement additive.
PP: Pulling prong.
PPB: Parts per billion or pounds per barrel depending on the use.
PPE: See *Personal protective equipment*.
PP (Formation): Pore pressure.

P

PPG: Pounds per gallon. Usually used as a measure of additive, slurry, or cleanout. Actually, it is pounds of proppant in a gallon volume with liquid added to make up the gallon "space."
PPGA: Pounds per gallon added. See *PPG*.
PPM: See *Parts per million*.
PPPOT-T: Positive pressure packoff test—tubing.
PPS: See *Polyphenylene sulfide* (e.g., Ryton™).
PPTB: Pounds per thousand barrels.
PR: Pressure.
PRE: See *Pitting resistance equivalent number*.
Preaeration: The addition of air at the initial stages of treatment to freshen the wastewater, remove gases, add oxygen, promote flotation of grease, and aid coagulation.
Precambrian: The geologic time from 570 million years ago to beginning of the Earth. Most rocks in this period have no hydrocarbons.
Prechlorination (Wastewater): The addition of chlorine in the collection system serving the plant or at the headworks of the plant prior to other treatment processes mainly for odor and corrosion control. Also applied to aid disinfection, to reduce plant BOD load, to aid in settling, to control foaming in Imhoff units, and to help remove oil.
Precipitate: A substance separating in solid form from a liquid as the result of some physical or chemical change, differing from a substance held only mechanically in suspension, which is known as sediment.
Precipitated: A solid material that drops out of an over saturated solution. Usually driven by an upset of equilibrium.
Precipitation: (1) An operation in which particles are separated from a gas stream in which they are suspended, by the action of an electric field or a thermal gradient. (2) When a substance dissolved in a liquid passes out of solution and into solid form.
Precipitation Hardening: Hardening caused by precipitation of a material (specific element or alloy) from a supersaturated solution.
Precipitation Number: The basis for classifying steam cylinder stocks and other classes of residual oils as to relative content of asphaltic constituents by a standard test method (ASTM D91).
Precipitation Point: The calculated solubility point of an ion in solution (scale/brine stability calculations).
Precision: The number of significant decimals expressed in a measurement.
Precursor (Trihalomethanes): Natural organic compounds found in all surface- and groundwater. These compounds may react with halogens (such as chlorine) to form trihalomethanes (THMs); they must be present in order for THMs to form.
Predenitrification: Biological wastewater treatment process for nitrogen removal that utilizes an anoxic zone located at the influent end of an aeration tank. Organic matter present in the wastewater serves as a carbon source for denitrifying bacteria.

Preheat Coil: A coil within an air handling unit that preheats incoming air up to a minimum temperature. This coil is usually followed by a second heating coil.
Prehydrated (Clay or Polymer): Already wetted to make easier to disperse and fully wet.
Preliminary Treatment: The removal of metal, rocks, rags, sand, eggshells, and similar materials, which may hinder the operation of a wastewater treatment plant. Preliminary treatment is accomplished by using equipment such as racks, bar screens, comminutors, and grit removal systems.
Prepacked Screen: A sand control screen that uses a captured gravel or resin-coated gravel to assist in restraining formation sand or gravel packing.
Prepacking (perfs): Packing the perforations with gravel to prevent tunnel collapse.
Prescient (Risk): Foreknowledge of events. Human anticipation of the course of events.
Present Net Value: The current time value of an income stream that extends into the future. Various calculation methods and interest rates have been applied.
Present Value of Proved Reserves: The present value of estimated future revenues, discounted at 10% annually, to be generated from the production of proved reserves determined in accordance with Securities and Exchange Commission guidelines, net of estimated production and future development costs, using prices and costs as of the date of estimation without future escalation, without giving effect to (1) estimated future abandonment costs, net of the estimated salvage value of related equipment; (2) nonproperty-related expenses such as general and administrative expenses, debt service, and future income tax expense; or (3) DD&A expense.
Preserved Core: Core removed from the formation and preserved by sealing or freezing to prevent drying or other altering of the rock or fluids.
Pressure: (1) Force per unit area exerted by a fluid. (2) The total load or force acting on a surface, per unit area.
Pressure, Absolute: (1) Gauge pressure plus barometric or atmospheric pressure. Absolute pressure can be zero only in a perfect vacuum. (2) The pressure due to the weight of the atmosphere (air and water vapor) on the Earth's surface. The average atmospheric pressure at sea level has been defined as 14.696 lb/in.^{2} absolute. See *Absolute pressure*.
Pressure, Atmospheric: (1) The pressure due to the weight of the atmosphere (air and water vapor) on the Earth's surface. The average atmospheric pressure at sea level (for scientific purposes) has been defined at 14.696 lb/in.^{2} absolute. (2) The pressure exerted by the atmosphere on a given point. It decreases as the elevation above sea level increases.
Pressure Bomb: A downhole device used to collect reservoir samples at pressure.

Pressure Buildup: The rate at which pressure builds up after a flow period. It is related to permeability, fluid viscosity, pressure differential, hole volume, zone thickness, and time.

Pressure-Dependent Permeability: (1) The permeability that increases as driving pressure increases, such as opening fractures wider at higher pressure. (2) Modifications to the character of the rock through the matrix or natural fractures, where the permeability is a function of the pressure applied to the rock through fluid pressure or earth stresses.

Pressure Depletion: A method of producing a reservoir when water drive is not available. Also a condition that exists when the gas pressure is drawn down before the oil is recovered.

Pressure Falloff: The rate at which pressure decreases at the end of an injection. Related to rock permeability and to fracture closure stresses when above the fracture point.

Pressure Gradient: Change in pressure with depth.

Pressure, Hydrostatic: The pressure, volume per unit area, exerted by a body of water at rest.

Pressure Integrity Test: A pressure test of a vessel formed by the entire well or a part of the well. It usually measures the ability of a pressure vessel to hold pressure without leaking at a given pressure.

Pressure, Negative: A pressure less than atmospheric.

Pressure Reducing Valve: Valve used to reduce a high supply pressure to a usable level.

Pressure Relief Valve: A mechanical valve that opens at a preset pressure to relieve pressure in a vessel.

Pressure Setting Assembly: An E-line tool used to set downhole tools. Normally uses a gas propellant charge.

Pressure Transient Test: An analysis of well flow using a test that shuts the well in following a flow period and measures the rate or pressure buildup.

Pressure Traverse: Calculation of well pressure vs. depth by integrating the pressure gradient for increments of pipe length (MD).

Pressurized Mud Balance (Fluid Density): A cup and bar with a sliding weight, similar to a mud balance, but also having a screw on top with a slide valve through which a small amount of fluid could be added under pressure, collapsing the air dispersed in the fluid. Better accuracy than an unpressurized mud balance.

Pretreatment: Group of processes that natural gas is subjected to prior to its liquefaction. Its purpose is to remove mainstream contaminants or compounds that may cause operational problems in the liquefaction unit.

Pretreatment Facility: Industrial wastewater treatment plant consisting of one or more treatment devices designed to remove sufficient pollutants from wastewaters to allow an industry to comply with effluent limits established by the US EPA General and Categorical Pretreatment Regulations or locally derived prohibited discharge requirements and local effluent limits. Compliance with effluent limits allows for a legal discharge to a POTW.

Pretreatment Inspector: A person who conducts inspections of industrial pretreatment facilities to ensure protection of the environment and compliance with general and categorical pretreatment regulations. Also called an "industrial pretreatment (waste) inspector" and an "inspector."
Preventative Maintenance: Maintenance carried out prior to unit or system failure.
Preventive Maintenance: Regularly scheduled servicing of machinery or other equipment using appropriate tools, tests, and lubricants. This type of maintenance can prolong the useful life of equipment and machinery and increase its efficiency by detecting and correcting problems before they cause a breakdown of the equipment.
Primacord™: A detonating cord for perforating guns.
Primacy: A right granted to states by the US government that allows state agencies to implement programs with federal oversight. Usually, states develop their own set of regulations to meet a specific goal.
Primary Cementing: The first attempt at creating a cement seal in the annulus.
Primary Clarifier: A wastewater treatment device that consists of a rectangular or circular tank that allows those substances in wastewater that readily settle or float to be separated from the wastewater being treated.
Primary Completion: The first completion in a well.
Primary Natural Fractures: Natural fractures oriented along the same plane as the preferred fracture direction, that is, perpendicular to minimum principal stress.
Primary Production: (1) Digging stuff up and selling it. Also, growing stuff and selling it. Just about the entire Australian economy, really. (2) The oil recovered before pressure maintenance (flooding).
Primary Recovery: (1) Recovery of hydrocarbons from a reservoir using only natural reservoir pressure. (2) The production of oil and gas from reservoirs using the natural energy available in the reservoirs and pumping techniques. (3) Recovery of oil or gas from a reservoir purely by using the natural pressure in the reservoir to force the oil or gas out. (4) The amount of the reserves recovered by primary production, that is, without injected fluid pressure support. (See also *Secondary and tertiary recovery*.)
Primary Term: The period of time that a lease is effective without being renewed.
Primary Treatment: A wastewater treatment process that takes place in a rectangular or circular tank and allows those substances in wastewater that readily settle or float to be separated from the water being treated.
Prime Mover: The main type of power source for an application.
Primer: A liquid material applied as an undercoat directly to the metal in order to assist the bonding of a subsequent coating of bitumen enamel. There are two types of primer: bitumen and synthetic primer.
Primer Cord: Detonation cord for explosives. Primacord™ is a trademarked name for detonation cord. Normally used in a perforating gun.
Priority Pollutants: The EPA has proposed a list of 126 priority toxic pollutants. These substances are an environmental hazard and may be present in water.

Because of the known or suspected hazards of these pollutants, industrial users of the substances are subject to regulation. The toxicity to humans may be substantiated by human epidemiological studies or based on effects on laboratory animals related to carcinogenicity, mutagenicity, teratogenicity, or reproduction. Toxicity to fish and wildlife may be related to either acute or chronic effects on the organisms themselves or to humans by bioaccumulation in food fish. Persistence (including mobility and degradability) and treatability are also important factors.

Probabilistic Estimate (Risk): The probabilistic (risk-weighted) approach of estimating recognizes that, in the real world, there are uncertainties associated with each project component. As such, for each component, there exist probabilities of occurrence within a range of possible values. Likewise, for the total project estimate (being an accumulation of individual components defined by a mathematical mode), there exist probabilities of occurrence within a range of possible values. An estimate using a range of numbers with associated probabilities of occurrence for each of the components or, at least, for each of the components that have substantive certainty.

Probability: The likelihood that the impact or event will occur. Impact (or consequence) is the effect on conditions or people if the hazard is realized (occurs) in practice, and probability is the likelihood that the impact will occur. Risk is a function of probability and impact (consequence). With discrete data, it is determined by taking the number of occurrences for the particular type of event being considered and dividing that by the total number of outcomes for the event. Expressed as a deterministic value (quantitative single value or high, medium, low, etc.) or as a range of values—that is, uncertainty—that is represented by a probability distribution.

Probability Distribution (Risk): A mathematical relationship between the values and the associated probabilities for a variable across the entire range of possible values for that variable. Typically, probability distributions are displayed as frequency or cumulative frequency plots.

Probable Reserves: (1) Probable reserves are those unproved reserves that the analysis of geologic and engineering data suggests are more likely than not to be recoverable. In this context, when probabilistic methods are used, there should be at least a 50% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable reserves. In general, probable reserves may include

1. Reserves anticipated to be proved by normal step-out drilling where subsurface control is inadequate to classify these reserves as proved
2. Reserves in formations that appear to be productive, based on well log characteristics, but lack core data or definitive tests and that are not analogous to producing or proved reservoirs in the area
3. Incremental reserves attributable to infill drilling that could have been classified as proved if closer statutory spacing had been approved at the time of the estimate

4. Reserves attributable to improved recovery methods that have been established by repeated commercially successful applications when
   a. A project or pilot is planned, but not in operation
   b. Rock, fluid, and reservoir characteristics appear favorable for commercial application
5. Reserves in an area of the formation that appears to be separated from the proved area by faulting and the geologic interpretation, which indicates that the subject area is structurally higher than the proved area
6. Reserves attributable to a future workover, treatment, retreatment, change of equipment, or other mechanical procedures, where such procedure has not been proved successful in wells that exhibit similar behavior in analogous reservoirs
7. Incremental reserves in proved reservoirs where an alternative interpretation of performance or volumetric data indicates more reserves that can be classified as proved

Often referred to as P2 (start of production, SPE). (2) Those reserves that are not yet proven but that are estimated to have a better than 50% chance of being technically and economically producible.

Processing: The separation of oil, gas, and natural gas liquids and the removal of impurities.

Processing Gain: The volumetric amount by which total output is greater than input for a given period of time. This difference is due to the processing of crude oil into products, which, in total, have a lower specific gravity than the crude oil processed.

Processing Loss: The volumetric amount by which total refinery output is less than input for a given period of time. This difference is due to the processing of crude oil into products, which, in total, have a higher specific gravity than the crude oil processed.

Processing Plant: A facility designed to separate substances or make new substances through chemical reactions, procedures, or physical actions.

Process Variable: A physical or chemical quantity that is usually measured and controlled in the operation of a wastewater treatment plant or an industrial plant.

Produced Gas/Oil Ratio: Total gas (solution + free) production divided by the oil production volume. Excludes gas lift gas.

Produced Water: (1) Brines that flow or are lifted to the surface with oil. (2) Brines naturally present or injected into reservoir to enhance production. Produced alongside oil production. (3) The water extracted from the subsurface with oil and gas. It may include water from the reservoir, water that has been injected into the formation, and any chemicals added during the production/treatment process. Produced water is also called "brine" (and may contain high mineral or salt content) or "formation water." Some produced water is quite fresh and may be used for livestock watering or irrigation (where allowed by law). (4) Water, ranging from fresh to salty, produced with the hydrocarbons as a result of pressure drawdown and flow through the formation.

P

Producible Lease: A lease where one well or several wells have discovered hydrocarbons in paying quantities but for which there is no production during the reporting period.
Producible Zone Completion: The interval in a wellbore that has been mechanically prepared to produce oil, gas, or sulfur. There can be more than one zone completed for production in a wellbore.
Producing Horizon: The depth or zone in which the well is being currently produced.
Producing Lease: A lease that is producing oil, gas, or sulfur in quantities sufficient to generate royalties.
Producing Well: A well that produces hydrocarbon in commercial quantities.
Production: The phase of oil and gas operations involved with well fluid extraction, separation, treatment, measurement, etc.
Production Capacity: The maximum amount of product that can be produced from processing facilities.
Production Casing: The innermost casing string that straddles and isolates the producing interval.
Production Chemist: A chemist that specializes in hydrocarbon flow and emulsion separation problems.
Production Costs: Costs incurred to operate and maintain oil or gas wells and related equipment and facilities, including depreciation and applicable operating costs of support equipment and facilities and other costs of operating and maintaining those wells and related equipment and facilities. They become part of the cost of oil and gas produced. Also called lifting costs.
Production Drilling: Drilling of wells in order to bring a field into production.
Production Index: A measure of a well's ability to flow. Applies above the bubble point.
Production Index (Shale): An indication of source rock potential measured by the conversion of kerogen into free hydrocarbons (PI, S1/(S1 + S2)): For PI < 0.08, the source is immature; for PI of 0.08 to 0.5, the source is in the oil window; and for PI > 0.5, the source is in the gas window.
Production Installation: An installation from which development wells are drilled that carry all the associated processing plants and other equipment needed to maintain a field in production.
Production License: A document issued by the governing state granting an oil company authority to produce oil and natural gas in a designated geographic area.
Production Log: A technique in which the entry points and the amount of fluid entering the wellbore are identified.
Production Maintenance: The operations necessary to optimize recovery and keep production as high as practical.
Production Packer: Any packer that forms a seal between tubing and annulus during production.
Production Phase: The productive life of an oil or gas field.

Production Platform: A platform from which development wells are drilled that carry all the associated processing plants and other equipment needed to maintain a field in production.
Production Pressure Operated Valve (Gas Lift): Production fluid enters the valve and acts on the effective bellow area, compressing the bellows against the precharge pressure, lifting the needle off the seat, and opening the valve. The injection gas then flows through the seat, through the reverse-flow check valve, and into the tubing.
Production Rig: A mobile servicing or workover unit.
Production Separator: A vessel through which production passes and the multiphase fluids are broken and separated.
Production Sharing Agreement: Contract between a government and an oil and gas company, granting the oil and gas company a contractual right to explore and produce hydrocarbons in a specified area in enabling the company to recover its costs and a certain profit.
Production String: The tubing or piping in a production well through which oil or gas flows from the reservoir to the wellhead.
Production Technical Limits: The maximum potential from the best achievable production practices.
Production Test: A monitored flow test.
Production Tree: The pressure and flow control tree on a producing well.
Production Tubing String: The primary flow path from the pay to the surface.
Production Well: (1) A well used to remove oil or gas from a reservoir. (2) Set of facilities located on an underground hydrocarbon reservoir allowing the transportation of these hydrocarbons from the reservoir to the surface.
Production, Wet after Lease Separation: The volume of natural gas withdrawn from reservoirs less (1) the volume returned to such reservoirs in cycling, repressuring of oil reservoirs, and conservation operations; less (2) shrinkage resulting from the removal of lease condensate; and less (3) nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. *Note*: Volumes of gas withdrawn from gas storage reservoirs and native gas that has been transferred to the storage category are not considered part of production. This production concept is not the same as marketed production, which excludes vented and flared gas.
Production Wing Valve: The valve on the flow cross that controls the exit point as produced fluids flow from the tree.
Productivity Index: (1) Usually measured in bbl/day/psi of drawdown. (2) A comparison of the productivity of a completion to the productivity of an ideal, undamaged open hole. Labeled PI or J.
Productivity Optimization: Comparison of processes, products, or operators by comparison to the rest of the operators in an area.
Products Supplied: Approximately represents consumption of petroleum products because it measures the disappearance of these products from primary sources, that is, refineries, natural gas processing plants, blending plants, pipelines, and bulk terminals. In general, product supplied of each

product in any given period is computed as follows: field production, plus refinery production, plus imports, plus unaccounted for crude oil (plus net receipts when calculated on a PAD District basis), minus stock change, minus crude oil losses, minus refinery inputs, and minus exports.

Product Supplied, Crude Oil: Crude oil burned on leases and by pipelines as fuel.

Product Yield: The percentages of gasoline, jet fuel, kerosene, gas oil, distillates, residual fuel oil, lubricating oil, and solid products that a refinery can produce from a single barrel of crude oil.

Profile: A machined design in a short piece of tubing or casing that allows a plug to set, anchor, and seal.

Project-Financed Pipeline: Pipeline funded by pledging only cash flow generated by the pipeline expected revenues to cover the principal and interest on the debt.

Project Financing: Most commonly used method to finance the construction of industrial infrastructure; typically, the developer pledges the value of the plant and part or all of its expected revenues as collateral to secure financing from private lenders.

Project Manager Contractor: Engineering service company that is in charge of overseeing the EPC contractor work in a liquefaction plant project on behalf of the project owner.

Propane: (1) A normally gaseous straight-chain hydrocarbon; it is a colorless paraffinic gas that boils at a temperature of −43.67°F. It is extracted from natural gas or refinery gas streams. (2) It includes all products designated in ASTM Specification D1835 and Gas Processors Association Specifications for commercial propane and HD-5 propane. (3) A heavy gaseous hydrocarbon found in crude oil and natural gas; used as fuel and in the making of petrochemicals. (4) Is a hydrocarbon that is gaseous at ordinary atmospheric conditions but readily converted to a liquid. When in liquid state, propane must be stored in a high-pressure metal container. Propane is odorless, colorless, and highly volatile. It is used as a household fuel beyond the gas mains. (5) An alkane with a 3-carbon chain.

Propane–Air: A mixture of propane and air resulting in a gaseous fuel suitable for pipeline distribution.

Propellant: A gas generating charge of explosive that is used for perf breakdown.

Propeller Fan: Fan in which the air enters and leaves the impeller in a direction substantially parallel to its axis.

Proppants: Well-sorted and consistently sized sand or man-made materials that are injected with the frac fluid to hold the fracture faces apart after pressure is released.

Propylene: (1) An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. (2) A raw material in the chemicals, plastics, and fiber industries. Major component of the plastic polypropylene. (3) Can be obtained from petroleum oils during the refining of gasoline or by catalytic or thermal cracking of naphtha or natural gas liquids or by catalytic

dehydrogenation of propane; used in the manufacture of plastics, food storage containers, diapers, and children's toys.

Propylene Glycol: Is a clear colorless viscous liquid produced commercially from propylene oxide; has been widely used in pharmaceutical manufacturing as a solvent and vehicle especially for drugs unstable or insoluble in water industrial antifreeze.

Propylene Oxide: Is a colorless liquid with an ether-like odor that is used mainly as a chemical intermediate in the production of polyurethane polyols, which are used to make polyurethane foams, coatings, and adhesives.

Prorationing: (1) Government allocation of demand among pools and wells; pipeline allocation of demand among shippers. (2) Allocation of production among commingled reservoirs according to reservoir production characteristics, tests, etc.

Prospect: A location where a well is to be drilled.

Prosper™: Nodal analysis program.

Protection String: A string of casing used when drilling a well to protect an outer string of pipe from drill string contact or to protect a zone.

Proton: Every uncharged atom has an equal number of positively charged protons (which are relatively big and sit in the nucleus with the neutrons) and negatively charged electrons, which whirl around on the outside and make chemistry. A proton weighs about 1.6726×10^{-27} kg, slightly less than a neutron.

Protozoa: A group of motile microscopic animals (usually single celled and aerobic) that sometimes cluster in colonies and often consume bacteria as an energy source.

Proved Developed Nonproducing Reserves: Reserves that consist of (1) proved reserves from wells that have been completed and tested but are not producing due to lack of market or minor completion problems that are expected to be corrected and (2) proved reserves currently behind the pipe in existing wells and that are expected to be productive due to both the well log characteristics and analogous production in the immediate vicinity of the wells.

Proved Developed Producing Reserves: Proved reserves that can be expected to be recovered from currently producing zones under the continuation of present operating methods.

Proved Developed Reserves: (1) The combination of proved developed producing and proved developed nonproducing reserves. (2) Proved developed reserves are those proved reserves that can be expected to be recovered through existing wells and facilities and by existing operating methods. Improved recovery reserves can be considered as proved developed reserves only after an improved recovery project has been installed and favorable response has occurred or is expected with a reasonable degree of certainty (see *Developed reserves*) (start of production, SPE). Developed reserves are expected to be recovered from existing wells, including reserves behind pipe. Improved recovery reserves are considered developed only after the necessary equipment has been installed or when the costs to do so are relatively

minor. Developed reserves may be subcategorized as producing or nonproducing (start of production, SPE).

Proved Developed Reserves, Nonproducing: Reserves subcategorized as nonproducing include shut-in and behind-pipe reserves. Shut-in reserves are expected to be recovered from (1) completion intervals that are open at the time of the estimate but that have not started producing, (2) wells that were shut in for market conditions or pipeline connections, or (3) wells not capable of production for mechanical reasons (start of production, SPE). Behind-pipe reserves are expected to be recovered from zones in existing wells, which will require additional completion work or future recompletion prior to the SPE.

Proved Developed Reserves, Producing: Reserves subcategorized as producing are expected to be recovered from completion intervals, which are open and producing at the time of the estimate. Improved recovery reserves are considered producing only after the improved recovery project is in operation (start of production, SPE).

Proved Energy Reserves: Estimated quantities of energy sources that the analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions. The location, quantity, and grade of the energy source are usually considered to be well established in such reserves.

Proved Reserves: (1) The quantity of oil and natural gas estimated to be recoverable from known fields under existing economic and operating conditions. This is determined on the basis of drilling results, production, and historical trends. (2) Those quantities of oil and gas, which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be economically producible—from a given date forward, from known reservoirs, and under existing conditions, operating methods, and government regulations—prior to the time at which contracts providing the right to operate expire, unless evidence indicates that renewal is reasonable certain, regardless of whether deterministic or probabilistic methods are used for the estimation. (3) Oil and gas that have been discovered and determined to be recoverable under prevailing economic and technical conditions. (4) Proved reserves are those quantities of petroleum that, by analysis of geologic and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs, and under current economic conditions, operating methods, and government regulations. Proved reserves can be categorized as developed or undeveloped. If deterministic methods are used, the term reasonable certainty is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate. Often referred to as P1, sometimes referred to as "proven." (Reserve definitions are from SPE.)

Proved Undeveloped Reserves: (1) Proved reserves that are expected to be recovered from new wells on undrilled acreage or from existing wells where a relatively major expenditure is required for recompletion. (2)

Proved undeveloped reserves are those proved reserves that are expected to be recovered from future wells and facilities, including future improved recovery projects, which are anticipated with a high degree of certainty in reservoirs, which have previously shown favorable response to improved recovery projects (see *Undeveloped*) (start of production, SPE).

Proven Field: An oil and/or gas field whose physical extent and estimated reserves have been determined.

Proven Reserves: (1) Estimated quantities of hydrocarbons that geologic and engineering data demonstrate will be recoverable from known oil and natural gas reservoirs under existing economic and operating conditions. (2) Oil and gas that have not been produced but have been located and are recoverable. (3) Those reserves that on the available evidence are virtually certain to be technically and economically producible (i.e., having a better than 90% chance of being produced).

Proven Reserves (Society of Petroleum Engineers): Reserves that can be estimated with reasonable certainty to be recovered under current economic conditions. Current economic conditions include processing costs prevailing at the time of the estimate. Proved reserves must have either facilities that are operational at the time of the estimate to process and transport those reserves to market or a commitment of reasonable expectation to install such facilities in the future. Proved reserves can be subdivided into undeveloped and developed.

Proximity Log: Pad contact tool that measures resistivity.

PRP: Premature release of packer.

Pr (Reservoir): Reservoir pressure.

Prussian Blue: A paste or liquid used to show a contact area.

PRV: See *Pressure relief valve.*

Ps: Pressure at the surface.

PS: See *Pump station.*

PSA: See *Pressure setting assembly.*

PSA: See *Production sharing agreement.*

PSASV: Pressure shut annular standing valve.

PSC (Contract): Production sharing contract.

PSC (Gas Lift): Closing pressure at surface for a gas lift valve.

PSD: Particle size distribution.

Pseudogravity (Seismic): A magnetic gravity field expression that is measured at or transformed to the magnetic pole. Susceptibility values are converted to density values and expressed as a vertical integration.

Pseudoplastic Fluid: A complex non-Newtonian fluid without thixotropy. Flow starts with pressure, but apparent viscosity decreases instantaneously with increasing rate of shear.

psi: See *Pounds per square inch.*

psia: See *Pounds per square inch absolute.*

PSIA: See *Pressure, absolute.*

PSIG: See *Pounds per square inch gauge.*

PSL: Product specification level. A rating for wellheads.

P

PSO (Gas Lift): Surface opening pressure of the gas lift valve.
PSP: Premature setting of packer.
PSV: Production swab valve.
PSV: Pressure safety valve.
PS Wave (Seismic): Seismic energy that has traveled partly as a P wave and then as an S wave, having been converted on reflection at an interface.
Psychrophilic Bacteria: A group of bacteria that grow and thrive in temperatures below 68°F (20°C).
PTAC: Packaged terminal air-conditioning system.
PTFE: Polytetrafluoroethylene (e.g., Teflon™).
PT (Gas Lift): Tubing pressure.
PTL: Production technical limits.
PTRO (Gas Lift): Test rack opening pressure for a gas lift valve.
PTS: Pressure temperature survey.
PT (Skills): Petroleum technologist or technician.
PT (Subsea): Pressure temperature.
PT (Well Test): Pressure test.
PU: Pickup.
Public Lands: Any land owned by the government in the United States. May compare to Crown or Federal lands in other countries.
Publicly Owned Treatment Works: A treatment works that is owned by a state, municipality, city, town, special sewer district, or other publicly owned and financed entity as opposed to a privately (industrial) owned treatment facility. This definition includes any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage (wastewater) or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they carry wastewater to a POTW treatment plant. The term also means the municipality (public entity), which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.
PUD: See *Proved undeveloped reserves*.
Puddle Job: A cement job done by spotting a column of cement and then lowering a liner into the cement slurry.
PUD (Reserves): Proved undeveloped.
Pulling Unit (Rig): A well servicing rig used specifically for pulling rods and tubing.
Pulsed Neutron Log: A cased-hole log capable of distinguishing between water and hydrocarbons.
Pulse Echo Tool: Various forms of a tool for bond evaluation, usually an ultrasonic emitter and detector.
Pump: A mechanical device used to create flow.
Pumpability: A measurement of a fluids capability to be pumped. Usually refers to cement slurry and is also called the thickening time.
Pump Barrel (Beam Lift): The tube through which the plunger of a rod pump reciprocates.

Pump, Casing: A sucker-rod pump designed to pump oil up through the casing instead of the more common method of pumping through tubing. A casing pump is run into the well on the sucker rods; a packer on the top or bottom of the pump barrel provides packoff or seal between the pump and the wall of the casing at any desired depth. Oil is discharged from the pump into the casing and out the wellhead.

Pump, Centrifugal: A pump that creates movement by centrifugal force. Flow variation in this type of pump is easily accomplished by throttling the discharge valve. If the valve is shut, the pump will reach its "shut-off head," generally causing no damage.

Pump Down Tool: Any tool that is pumped down the well by injected fluid.

Pump Efficiency: The output of the pump at stated conditions divided by the ideal output.

Pumper: An employee or an operator who is responsible for gauging the oil and gas sold off the leases he has been assigned and who is also responsible for maintaining and reporting the daily production.

Pumping Tee: A tee fitting in the top of a rod pumped well. The side ort allows the pumped fluids to flow into the surface lines.

Pumping Unit: A pump connected to a source of power; an oil-well pumping jack; a pipeline pump and engine.

Pump Jack: The main rocking unit of a rod pumped well. Older uses were in central power units.

Pump Off: Pumping all the fluid out of the wellbore to the point where free gas enters the pump.

Pump-Open Plug: A plug that is opened by pressure that is used for well suspensions.

Pump-Out Plug: A plug run on a work string that is being snubbed into a well that can be pumped out when the tubing is landed.

Pump, Rod: A class of downhole pumps in which the barrel, plunger, and standing valve are assembled and lowered into the well through the tubing. When lowered to its pumping position, the pump is locked to the tubing to permit relative motion between plunger and barrel. The locking device is a hold-down and consists either of cups or of a mechanical, metal-to-metal seal.

Pump Station: Installation of pumps to lift wastewater to a higher elevation in places where flat land would require excessively deep sewer trenches. Also used to raise wastewater from areas too low to drain into available collection lines. These stations may be equipped with air-operated ejectors or centrifugal pumps. See *Lift station*.

Pump Stations: Facilities placed along the route of a pipeline to keep oil or gas moving along with pressure or suction.

Pump-Through Plug: A plug that permits pumping into a well but stops backflow of the well.

Pump Trucks: Pumping units used in bullheading, circulating, or other operations involving liquid and foam pumping.

P

Puncher Charge: A specially designed perforating charge that is designed to punch through only one string of pipe and not damage the outer string. Useful for establishing a circulation path in a well with collapsed or plugged tubing prior to killing the well.
Pup Joint: A short section of casing or tubing used as a depth identifier to a collar locator log or used at the top of the well when spacing out a string prior to hanging the string.
Purge: Removal of unburned gases from a combustion chamber.
Purification: (1) The total or partial removal of unwanted constituents from a gaseous medium. (2) The removal, by natural or other methods, of pollution from a given medium.
Purple K: A fire extinguished powder.
Push Pill: A gelled pill designed for piston-like fluid displacement.
Putrefaction: Biological decomposition of organic matter resulting in the production of foul-smelling products associated with anaerobic conditions.
Putrescible: Putrescible material will decompose under anaerobic conditions and produce nuisance odors.
PVC: See *Polyvinyl chloride*.
PVC (Gas Lift): Closing pressure at depth for a gas lift valve.
PVC (Plastic): Polyvinyl chloride.
PVDF: Thermoplastic fluoropolymer.
PV (Drilling Fluids): Plastic viscosity.
PV (PVT Analysis): Pressure–volume method.
PV (Rock): Pore volume.
PVT: Pressure–volume–temperature data for fluids.
PW: Produced water.
P Wave: Primary or compression wave. A seismic body wave that involves particle motion, alternating compression, and expansion. It is the fastest seismic wave.
PWI: Produced water injection.
PWRI: Produced water reinjection.
PWT: Produced water treatment.
Pyrobitumen: A hard, native asphalt within the pores. Does not ordinarily move or enter into reaction.
Pyroclastics: Particles (to chucks) of molten igneous rock ejected from a volcanic vent during an eruption.
Pyrolysis: Destructive distillation that involves decomposition of coal, woody materials, petroleum, etc., by heating in the absence of air.
Pyrophoric Iron Sulfide: A substance typically formed inside tanks and processing units by the corrosive interaction of sulfur compounds in the hydrocarbons and the iron and steel in the equipment. On exposure to air (oxygen), it ignites spontaneously.
PYX: A very high-temperature perforating explosive.
P/Z Plot: A plot of P/Z vs. cumulative production that indicates compartmentalization if not a straight line.

Q

QA/QC: Quality assurance and quality control.
QN Nipple: A high-pressure (10,000–15,000 psi) profile. N signifies that it is a no-go design.
qo: Flow rate or initial flow rate.
QRA: Qualitative risk assessment.
Quad: An abbreviation for a quadrillion (1,000,000,000,000,000) Btu. For natural gas, roughly equivalent to one trillion (1,000,000,000,000) cubic feet, or 1 Tcf.
Qualified Professional: A person that is knowledgeable in the principles and practices of stormwater management and treatment, such as a licensed professional engineer, licensed landscape architect, or other endorsed individual(s).
Quality (Foam Stimulation Fluid): The percent of the total volume that the internal phase comprises.
Quality (Product): A product providing utility without variability (Taguchi).
Quartz: SiO_2 mineral with a variety of crystal shapes.
Quaternary: A geologic time period from present to 2 million years ago.
Quaternary Ammonium: You are probably aware of the ammonium ion, NH_4^+. A molecule that is NR_4^+, where "R" is any carbon compound, is called a "quaternary ammonium" species.
Quench Crack: A crack in steel resulting from stresses produced during transformation from austenite to martensite.
Quench Hardening: Heat treating requiring austenitization followed by cooling, under conditions that austenite turns into martensite.
Quenching Oil: An oil introduced into high-temperature process streams during refining to cool them.
Quicklime: A granular material, composed primarily of calcium oxide (CaO) or calcium and magnesium oxide (MgO) and capable of slaking with water.

R

R&R: Read and record.
R&W: Reservoir and wells.
Rabbit: A drift dropped through tubulars on the rig floor before joint makeup.
RACI: See *Royal Australian Chemical Institute*.
Rack: (1) A pipe storage rack. (2) Evenly spaced parallel metal bars or rods located in the influent channel to remove rags, rocks, and cans from wastewater.
Racking Back Pipe: To stand pipe in the derrick.
RAD: See *Radioactive densitometer*.
Radial Cutting Torch: A tubing cutting tool that uses thermite plasma.
Radial Darcy Law: The Darcy equation describing radial movement of fluids in laminar flow through porous media.
Radial Stress (Tubular): Stresses inward and outward along the tubing radius.
Radiant Heat Transfer: Heat transfer without convection or conduction. Sunshine is radiant heat.
Radiation: Transmission of energy by means of electromagnetic waves emitted due to temperature.
Radiator: Terminal unit used in hot water or steam systems to deliver heat to a space (but primarily by convection and not radiation).
Radioactive Densitometer: A fluid density measuring device.
Radioactive Log: Any log with a radioactive source, for example, neutron porosity and formation density. A gamma-ray log detects naturally occurring radioactivity and does not emit.
Radioactive Tagging: Applying a washable or non-washable radioactive tracer to equipment or proppant to allow tracking of position of the tagged item in the well. Can be used to determine if radioactive tagged sand entered the formation at a specific set of perforations.
Radioactive Tracer: A very low-strength radioactive isotope used to tag water or other fluid for tracing the path of fluid in the reservoir or in a well.
Radioactive Tracer Log: A log device that emits a burst of tracer and tracks its movement. May "see" a foot or so outside casing in good circumstances. Normal for injection wells.
Radio-Frequency Interference: Refers any undesirable electrical energy with content within the frequency range of radio frequency transmission.
Radiographic Inspection (Pipe Inspection): X-ray inspection.

Radioisotope: An unstable isotope of an element that decays spontaneously, emitting radiation.
Radiolarian: A class of one cell marine animals with siliceous skeletons.
Radionuclide: An unstable form of an element that emits nuclear radiation through radioactive decay.
Radium: R226, one of the natural isotopes that as a trace element may incorporate into the matrix of naturally forming barium or strontium sulfate scale and make it a very low level radioactive material (NORM scale).
Radius of Curvature: The radius of the guide arch, reel, or bend through which a pipe is moved.
Radius of Investigation: The depth of investigation of a tool or logging process.
Raffinate: In solvent refining, that portion of the oil that remains undissolved and is not removed by the selective solvent. Also called "good" oil.
Rag Pump: A rod pump with extremely loose tolerances (loose seals) that may be temporarily run in a well to pump fluid that contains sand. Used for cleanups after a fracture treatment.
RA (Logging): Radioactive.
Ram: One of the hydraulically actuated rams in a blowout preventer (blind, shear, pipe, or slip).
Ramp-Up: The initial operational period of a liquefaction plant, during which the production is not still stabilized. It can be considered part of the commissioning of the plant. During the ramp-up, a large number of operational parameters are adjusted to optimize the production, in order to maximize production volumes and minimize energy consumption. Normally this phase usually lasts between 2 and 4 months.
Range 1 Tubular: A pipe 16 to 25 ft in length.
Range 2 Tubular: A pipe 25 to 34 ft in length.
Range 3 Tubular: A pipe 34 to 48 ft in length.
Range of Load (Beam Lift): The difference in the peak load at the polished rod on the upstroke and the minimum load on the downstroke.
Rank Wildcat: An exploratory well drilled in a basin where no other wells (or too few wells to define the basin) have been drilled. (Some areas use a specific distance between wells.)
Rapid Phase Transitions: LNG undergoes a rapid transition to vapor especially when spilled on water. The volume of the LNG instantly expands 600 times resulting in an RPT or physical explosion that poses a hazard for structures and people close to the site of the incident. This explosion does not involve combustion. When LNG is spilled on water, heat is transferred from the water to the LNG. This results in a rapid transformation of liquid to gas, releasing a large amount of energy.
RAPPS (Policies): Reasonable and prudent practices for stabilization.
RAPPS (Subsea): Riser annulus pressure protection system.
Rasp: A wire line-run, round, rough file-like device useful for scraping hard deposits on tubing walls.

Rate-Dependent Skin: A skin value that increases with flow rate. Generally recognized as a turbulence-induced skin.
Rate of Penetration: The speed of a drill bit or a cleanout nozzle in penetrating a formation or a wellbore deposit.
Rate Sensitive (Damage): A term describing a resistance to flow that increases exponentially with flow and may disappear when the flow rate is dropped.
Rat Hole (Drilling Rig): The hole through the rig floor where the kelly can be stored when it has to be disconnected.
Rat Hole (Well): The hole below the pay zone. Commonly drilled to drop off perforating guns or as a gathering or sump area for liquids to separate from gas prior to being pumped out of the well.
Ratio of Specific Heats: (1) Thermodynamic comparison ($k = c_p/c_v$) of the ratio of a specific heat (k) at a constant pressure (c_p) to a specific heat at a constant volume (c_v). The ratio range for most gases is 1.2–1.4. (2) For gases, it is the ratio of the specific heat at constant pressure to the specific heat at constant volume. The ratio is important in thermodynamic equations, such as compressor horsepower calculations, and is given the symbol k where $k = c_p/c_v$. The ratio k lies between 1.2 and 1.4 for most gases.
Raw Natural Gas: Gas as it is produced from the reservoir. Raw gas may contain methane, heavier hydrocarbons, and other nonhydrocarbon gases such as CO_2, H_2S, nitrogen, or helium.
Raw Wastewater: Plant influent or wastewater before any treatment.
RB: Reservoir barrels.
RBOB: See *Reformulated gasoline blendstock for oxygenate blending.*
R-BOP: Rotating BOP.
RBP: See *Retrievable bridge plug.*
RCA: Root cause analysis.
RCFA: Root cause failure analysis.
RCM: See *Recirculating mixer.*
RCP: Resin-coated proppant.
RCRA: Recourse Conservation and Recovery Act.
RCS: See *Resin-coated sand*.
RCSSP: Resin-coated sand slurry pack.
RCT: See *Radial cutting torch*.
RD: See *Rig down*.
RDDK (Valve): A Weatherford valve, retrievable dummy dump valve. It is a valve that is placed in a standard gas lift mandrel and has a fracture rod for pressure shearing (then has a check valve to prevent tubing to casing communication). It can be used to displace the completion fluid from the "A" annulus during the completion. It can later be pulled like a regular GLV and replaced with a dummy or live valve.
RDFN: Rig down for night.
RDMO: Rig down, move off or out.
RDT: Reservoir description tool.

R

RDX: Perforating charge explosive. Cyclotrimethylenetrinitramine.
re: Reservoir drainage radius.
RE: Reservoir engineer.
Reactor: A vessel, tank, or tower in which a specific chemical reaction takes place.
Reagent: A substance that takes part in a chemical reaction and is used to detect and measure another substance.
Real Estate Investment Trusts: A trust or association that invests in a variety of real estate. REITs are managed by one or more trustees, like a mutual fund, and trade like a stock. No federal income tax needs to be paid by the trust if 75% of the income is real estate-related and 95% of the income is distributed to investors. Individual investors can be taxed.
Real Specific Gravity: The density ratio between a gas and air determined by measurement at the same temperature and pressure.
Real-Time Gauge: A downhole, surface readable gauge.
Reamer: A hole enlargement tool to open up a open hole or a window through the casing.
Reave: Tear apart.
Reboiler: An auxiliary unit of a fractionating tower designed to supply additional heat to the lower portion of the tower.
REC: See *Regional electricity company.*
Recalcination: A lime-recovery process in which the calcium carbonate in sludge is converted to lime by heating to 1800°F (980°C).
Recarbonation: A process in which carbon dioxide is bubbled into the water being treated to lower the pH.
Receipts: Deliveries of fuel to an electric plant; purchases of fuel; all revenues received by an exporter for the reported quantity exported.
Receiving Body: A stream, lake, or other waterway into which treated or untreated waste is discharged.
Receiving Terminal: A coastal plant that accepts deliveries of liquefied natural gas (LNG) and processes it back into gaseous form for injection into the pipeline system. Also known as regasification terminal.
Receiving Water: A stream, river, lake, ocean, or other surface or groundwater into which treated or untreated wastewater is discharged.
RECIP: See *Reciprocate.*
Reciprocate: To move a pipe up and down. Usually done to help remove mud or cuttings during well cleanup or placement of cement.
Reciprocating Pump: (1) A piston pump. (2) A pump with an up- and downstroke or motion.
Recirculated Air: Air taken from a space and returned to that space, usually after being passed through a conditioning system.
Recirculating Mixer: Any mixing device that circulates the fluid through one or more tanks with the intent of more evenly blending the fluid.
Recirculation: The return of part of the effluent from a treatment process to the incoming flow.

Reclamation: Restoring land to its predevelopment condition or to a condition specified by regulations.
Recomplete: (1) To move the primary completion from one zone to another. May involve reperforating, running other tubulars, or setting a new packer. (2) An operation involving any of the following: (a) Deepening from one zone to another zone. (b) Completing well in an additional zone. (3) Plugging back from one zone to another zone. (4) Sidetracking to purposely change the location of the bottom of the well but not including sidetracking for the sole purpose of bypassing obstructions in the borehole. (5) Conversion of a service well to an oil or gas well in a different zone. (6) Conversion of an oil or gas well to a service well in a different zone.
Recompletion: (1) Occurs when we reenter a well to complete (i.e., perforate) a new formation different from that in which a well has previously been completed. (2) An action that changes the equipment or intake point in a well.
Recoverable Gas Lift Gas: The gas lift gas produced from a well that is transferred into the pipeline.
Recoverable Gas Reserves: The quantity of natural gas determined to be economically recoverable from a reservoir or reservoirs over a specific period of time.
Recoverable Oil: The percentage of hydrocarbons that can be recovered from the formation under planned production methods. Often depends strongly on the revenue received from the oil and the operating cost.
Recoverable Reserves: (1) The portion of reserves that can be recovered by currently available technologies. (2) That proportion of the oil and/or gas in a reservoir that can be removed using currently available techniques.
Recovery Efficiency: The percent of the initial in-place hydrocarbon that can be recovered in the project.
Recovery Factor: (1) The percentage of the hydrocarbon in place that can be produced with each production plan: primary, secondary, and tertiary. (2) That proportion of the oil and/gas in a reservoir that can be removed using currently available techniques. (3) The ratio of recoverable oil and/or gas reserves to the estimated oil and/or gas in place in the reservoir. Determined by various factors such as reservoir dimensions, pressure, nature of hydrocarbons, and development plan. See also *Primary, secondary, and tertiary recovery*.
Recrystallization: The growth of new mineral grains in a rock at the expense of existing grains that supply the material for the new grains.
Recycle Gas: High hydrogen content gas returned to a unit for reprocessing.
Recycling: The process undertaken to regain material for human use. To reuse; to make ready for reuse.
RED: Restriction enhancement drill (under reamer).
Redetermination: Retroactive adjustment to relative percentage interests of joint venturers in a field.
Redress: To reequip a tool to be run back into the well.

R

Reduced Crude: A residual product remaining after the removal by distillation of an appreciable quantity of the more volatile components of crude oil.
Reduced Volatility Alkylation Process: An environmental innovation that cuts by 60%–90% the airborne hydrogen fluoride (HF) emissions in the event of an accidental release. Phillips and Mobil jointly developed the process in 1994.
Reducing Agent: Any substance, such as base metal (iron) or the sulfide ion, that will readily donate (give up) electrons. The opposite is an oxidizing agent.
Reduction: The addition of hydrogen, removal of oxygen, or the addition of electrons to an element or compound. Under anaerobic conditions (no dissolved oxygen present), sulfur compounds are reduced to odor-producing hydrogen sulfide (HS) and other compounds.
Reduction (Chemical): Gain of electrons in a reaction.
Reduction to Equator (Seismic): A mathematical transformation of the total magnetic intensity field at its observed inclination (I) and declination (D) to that of the magnetic equator. $I = 0°$.
Reduction to Pole (Seismic): A mathematical transformation of the total magnetic intensity field at its observed inclination (I) and declination (D) to that of the north magnetic pole. $I = 90°$, $D = 0$.
Reef: Coral reef built deposits. Among the highest permeability reservoirs because of connected voids if there has not been extensive chemical modification.
Reef Reservoir: A type of reservoir trap composed of rocks, usually limestone, made up of the skeletal remains of marine animals. Reef reservoirs are often characterized by high initial production that falls off rapidly, requiring pressure maintenance techniques to sustain production.
Reel: A take up real for hose, coiled tubing or cable.
Reenter: To enter a previously abandoned well.
Reentry: Actions taken to enter a well after it has been plugged or otherwise isolated.
Reentry Spool: An upper tree connection profile that allows remote connection of a tree running tool.
Reeve (Rigging): String wire or cable through a pulley.
Reference Point: The point on the logging tool that is the depth reference.
Refined Products: The various hydrocarbons obtained as a result of refining process separation from crude oil. Typical refined products are LPG, naphtha, gasoline, kerosene, jet fuel, home heating oil, diesel fuel, residual fuel oil, lubricants, and petroleum coke.
Refiner: A company involved in upgrading hydrocarbons to saleable products.
Refinery: (1) An installation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and oxygenates. (2) A plant used to separate the various components present in

crude oil and convert them into usable fuel products or feedstock for other processes. (3) A large plant composed of many different processing units that are used to convert crude oil into finished or refined products. These processes include heating, fractionating, reforming, cracking, and hydrotreating.
Refinery Gas: A non-condensate gas collected in petroleum refineries.
Refinery Input (Crude Oil): Total crude oil (domestic plus foreign) input to crude oil distillation units and other refinery processing units (cokers).
Refinery Input (Total): The raw materials and intermediate materials processed at refineries to produce finished petroleum products. They include crude oil, products of natural gas processing plants, unfinished oils, other hydrocarbons and oxygenates, motor gasoline and aviation gasoline blending components, and finished petroleum products.
Refinery Production: Petroleum products produced at a refinery or blending plant. Published production of these products equals refinery production minus refinery input.

Negative production will occur when the amount of a product produced during the month is less than the amount of that same product that is reprocessed (input) or reclassified to become another product during the same month. Refinery production of unfinished oils and motor and aviation gasoline blending components appear on a net basis under refinery input.
Refinery Yield: Represents the percent of finished product produced from input of crude oil and net input of unfinished oils (expressed as a percentage). It is calculated by dividing the sum of crude oil and net unfinished input into the individual net production of finished products. Before calculating the yield for finished motor gasoline, the input of natural gas liquids, other hydrocarbons and oxygenates, and net input of motor gasoline blending components must be subtracted from the net production of finished motor gasoline. Before calculating the yield for finished aviation gasoline, input of aviation gasoline blending components must be subtracted from the net production of finished aviation gasoline.
Refining Margins: The difference in value between the products produced by a refinery and the value of the crude oil used to produce them. Refining margins will thus vary from refinery to refinery and depend on the price and characteristics of the crude used.
Refluxing: In fractional distillation, the return of part of the condensed vapor to the fractionating column to assist in making a more complete separation of the desired fractions. The material returned is reflux.
Reformed Gasoline: Gasoline made by a reforming process.
Reforming: (1) The mild thermal cracking of naphthas to obtain more volatile products, such as olefins, of higher octane values, or catalytic conversion of naphtha components to produce higher octane aromatic compounds. (2) A refining process used to change the molecular structure of a naphtha feed derived from crude oil by distillation.

R

Reformulated Fuels: Gasoline, diesel, or other fuels that have been modified to reflect environmental concerns, performance standards, government regulations, customer preferences, or new technologies.

Reformulated Gasoline: (1) A gasoline whose composition has been changed (from that of gasolines sold in 1990) to (a) include oxygenates, (b) reduce the content of olefins and aromatics and volatile components, and (c) reduce the content of heavy hydrocarbons to meet performance specifications for ozone-forming tendency and for release of toxic substances (benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and polycyclic organic matter) into the air from both evaporation and tailpipe emissions. (2) Is a cleaner-burning gasoline that reduces smog and other air pollution. Federal law mandates the sale of reformulated gasoline in metropolitan areas with the worst ozone smog. Some other cities voluntarily require reformulated gasoline. (3) Finished motor gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the US Environmental Protection Agency under Section 211(k) of the Clean Air Act. *Note*: This category includes oxygenated fuels program reformulated gasoline (OPRG) but excludes reformulated gasoline blendstock for oxygenate blending (RBOB). (4) See *Motor gasoline (finished)*.

Reformulated Gasoline Blendstock for Oxygenate Blending: A motor gasoline blending component that, when blended with a specified type and percentage of oxygenate, meets the definition of reformulated gasoline.

Refrac Efficiency: The ratio between the production of the well (or the initial or max production) to the production after the well is refractured.

Refrac (or Refracture): When we stimulate the present producing zone of a well to increase production, using hydraulic, acid, gravel, etc., fracture techniques.

Refractive Index: For a particular substance, the speed of light in a vacuum divided by the speed of light in that substance. This gives rise to the bending of light as it travels from one transparent material to another.

Refractory: A material having the ability to retain its shape and chemical composition when subjected to high temperatures, or the area of an incinerator or similar equipment that contains the high temperatures.

Refracture: To fracture a zone after the initial attempt. Refracs may be to correct a problem during the initial frac or to expose new pay after stresses in the rock have been modified by production.

Refrigerant: (1) In a refrigerating system, the medium of heat transfer that picks up heat by evaporating at a low temperature and pressure and gives up heat on condensing at a higher temperature and pressure. (2) It is the fluid that performs an inverse thermodynamic cycle, generating the low temperature required for natural gas cooling and liquefaction.

Refrigerant Compressor: A component of a refrigerating system that increases the pressure of a compressible refrigerant fluid and simultaneously reduces its volume while moving the fluid through the device.

Refrigerating System: A system that, in operation between a heat source (evaporator) and a heat sink (condenser), at two different temperatures, is able to absorb heat from the heat source at the lower temperature and reject heat to the heat sink at the higher temperature.
Refrigeration: The process used to remove the natural gas liquids by cooling or refrigerating the natural gas until the liquids are condensed out. The plants use Freon or propane to cool the gas.
Refrigeration (or Cooling Cycle): Inverse thermodynamic cycle whose purpose is to transfer heat from a medium at low temperature to a medium at higher temperature.
Regasification: The process by which LNG is heated, converting it into its gaseous state.
Regasification Plant: A plant that accepts deliveries of LNG and vaporizes it back to gaseous form by applying heat so that the gas can be delivered into a pipeline system.
Regasification Terminal: (1) A facility for receiving, unloading, storing, and regasifying LNG, usually including breakwaters, tanker berthing, and other marine facilities. (2) Industrial facility that receives LNG from LNG vessels and perform a re-vaporization process to restore the natural gas to its gaseous state prior to its distribution.
Regeneration: In a catalytic process, the reactivation of the catalyst, sometimes done by burning off the coke deposits under carefully controlled conditions of temperature and oxygen content of the regeneration gas stream.
Regional Electricity Company: A term used in the United Kingdom to describe electricity distribution companies.
Regional Gravity Field (Seismic): Long-wavelength component of field density variations that are usually deeper than general exploration interest.
Regulation: The governmental function of controlling or directing economic entities through the process of rulemaking and adjudication; a rule or law established by the federal or state government that sets procedures.
Regulator: A device used in combined sewers to control or regulate the diversion of flow.
Regulatory Out Clause: A contractual provision whereby a party is excused from performance due to the actions of a jurisdictional regulatory agency.
Reheat Coil: Heating coil installed downstream of cooling coil.
Reid Vapor Pressure: Usually used in reference to gasoline, it is the vapor pressure of a sample at 37.8°C, determined by a prescribed method.
REITs: See *Real estate investment trusts*.
Relative Permeability: The permeability to a specific fluid based on permeability at 100% saturation of that fluid, when two or more fluids occupy the pore space. The relative permeability may change with changing fluid saturation.
Relative Permeability Modifiers: Chemicals that attempt to change the permeability of a pore if another fluid tries to flow. A common approach in water control but with very mixed results.

R

Releases: Is an instantaneous tearing or fracturing of the pipeline material that immediately impairs the operation of the pipeline. Leaks can be an opening, crack, or hole in a pipeline causing some product to be released but not immediately impairing the operation of the pipeline.
Release Sub: A part of the BHA designed to separate on rate, pull, or a ball drop.
Reliability: (1) The ability to perform a design function at a specified set of conditions over a target time period. (2) A measure, expressed as a percentage, of the time (excluding routine maintenance time) a facility (e.g., process plant, pipeline, transmission line, or generating unit) is capable of providing service.
Relief Valve: A valve in a pressurized system that is set to open and relieve pressure at a certain pressure level.
Relief Well: A close offset well drilled to intersect a well that is flowing out of control and cannot be killed with conventional methods.
Remaining Established: Initial established minus cumulative production.
Remedial Cementing: Repair cementing.
Remote Gas: A natural gas in fields where the infrastructure for transportation of gas is some distance away, making production of the gas field more complex. See *Stranded gas*.
Remotely Operated Vehicle: (1) Usually an unmanned diving vehicle that performs repairs or maintenance on a subsea well. (2) An underwater robot. Usually an unmanned underwater work vehicle.
Rent: Periodic payments made by the holder of a lease, during the primary lease term for the right to use the land or resources for purposes established in the lease.
Repeater: An electronic device that receives, amplifies, and transmits the signal.
Repeat Formation Tester: A tool that isolates small sections of the pay and removes fluid samples and takes pressures.
Repeat Section: A section of a log that is repeated.
Replacement Fuel: The portion of any motor fuel that is methanol, ethanol, or other alcohols, natural gas, liquefied petroleum gases, hydrogen, coal derived liquid fuels, electricity (including electricity from solar energy), ethers, or any other fuel the Secretary of Energy determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits.
Reporting Limit: The lowest required reporting level for a material.
Representative Sample: A sample portion of material, water, or waste stream that is as nearly identical in content and consistency as possible to that in the larger body of material or water being sampled.
Repressuring: The injection of gas into oil or gas reservoir formations to effect greater ultimate recovery.
Request for Information: Similar to a contracts tender but has less strict legal constraints.

Research: Finding out stuff that has never been found out before is the most exciting kind of research. The more stuff you have found out, the more power you have to do good things and bad things. The country that finds out the most stuff wins. Also, it takes money to find out stuff, especially stuff that has never been found out before.

Research Octane Number: The octane number of a motor gasoline determined in a special laboratory test engine under mild "engine-severity" conditions, giving a measure of the low-speed knock properties of a gasoline.

Reserve Extension: Any added reserves to an already described reservoir, due to drilling, testing, production, etc., that establishes new data on reserves or production limits outside the previously known limits of the reservoir(s).

Reserve Lifetime Ratio: The ratio of the reserves of crude oil or natural gas in units of barrels or cubic feet to the annual production in barrels per year or cubic feet per year. The units of this ratio are years and are equivalent to the number of years of production left in the reserve at the current production rate.

Reserve Pit: A tank or pit for used/discarded mud or a secondary mud supply.

Reserve Replacement: (1) Calculated by dividing the sum of reserve additions from all sources (revisions, extensions, discoveries, and other additions and acquisitions) by the actual production for the corresponding period. We use the reserve replacement ratio as an indicator of our ability to replenish annual production volumes and grow our reserves, thereby providing some information on the sources of future production. It should be noted that the reserve replacement ratio is a statistical indicator that has limitations. As an annual measure, the ratio is limited because it typically varies widely based on the extent and timing of new discoveries and property acquisitions. Its predictive and comparative value is also limited for the same reasons. In addition, since the ratio does not imbed the cost or timing of future production of new reserves, it cannot be used as a measure of value creation. (2) The ratio of additions to reserves divided by production. It is a measure of the extent to which production is being replaced.

Reserves: (1) Estimated remaining quantities of oil and gas and related substances anticipated to be economically producible, as of a given date, by application of development projects to known accumulations. In addition, there must exist, or there must be a reasonable expectation that there will exist, the legal right to produce or a revenue interest in the production, installed means of delivering oil and gas or related substance to market, and all permits and financing required to implement the project. (2) Volumes of hydrocarbons (measured in Bcf, Tcf, or billion of barrels) that are considered to be economically recoverable using current technology. (3) The supply of an oil or gas resource. Reserves are qualified to show a degree of certainty such as proven reserves to possible and speculative reserves. (4) The amount of an oil or gas resource. Reserves are qualified to show degree of certainty such as proven reserves to possible and speculative reserves. (5) A calculation of the

amount of hydrocarbon reserves that are in the formation. Proven reserves have a very high degree of recovery with wells in place and techniques that are proven.

Reserves, 1P: Proved reserves.

Reserves, 2P: Proved plus probable reserves.

Reserves, 3P: Proved, probable, plus possible reserves.

Reserves (Behind Pipe): Are expected to be recovered from zones in existing wells, which will require additional completion work or future recompletion prior to the start of production (SPE).

Reserves (Developed): Are expected to be recovered from existing wells, including reserves behind pipe. Improved recovery reserves are considered developed only after the necessary equipment has been installed or when the costs to do so are relatively minor. Developed reserves may be subcategorized as producing or nonproducing (SPE).

Reserves (Entitlement): Reserves consistent with the cost recovery plus profit hydrocarbons that are recoverable under the terms of the contract or lease are typically reported by the upstream contractor (SPE).

Reserves (Nonproducing): Reserves subcategorized as nonproducing include shut-in and behind-pipe reserves. Shut-in reserves are expected to be recovered from (1) completion intervals that are open at the time of the estimate but that have not started producing, (2) wells that were shut in for market conditions or pipeline connections, or (3) wells not capable of production for mechanical reasons (SPE).

Reserves (Possible): (1) Are those unproved reserves that, by analysis of geological and engineering data, are less likely to be recoverable than probable reserves. In this context, when probabilistic methods are used, there should be at least a 10% probability that the quantities actually recovered will equal or exceed the sum of estimated proved, plus probable, plus possible reserves. In general, possible reserves may include (a) reserves that, based on geological interpretations, could possibly exist beyond areas classified as probable; (b) reserves in formations that appear to be petroleum bearing, based on log and core analysis but may not be productive at commercial rates; (c) incremental reserves attributed to infill drilling that are subject to technical uncertainty; (d) reserves attributed to improved recovery methods when (i) a project or pilot is planned, but not in operation, and (ii) rock, fluid, and reservoir characteristics are such that a reasonable doubt exists that the project will be commercial; and (e) reserves in an area of the formation that appears to be separated from the proved area by faulting and geological interpretation indicates the subject area is structurally lower than the proved area. Often referred to as P3 (SPE). (2) Reserves at present that cannot be regarded as "probable."

Reserves (Probable): (1) Are those unproved reserves that, by analysis of geological and engineering data, are more likely than not to be recoverable. In this context, when probabilistic methods are used, there should be at least a 50% probability that the quantities actually recovered will equal or exceed

the sum of estimated proved plus probable reserves. In general, probable reserves may include (a) reserves anticipated to be proved by normal step-out drilling where subsurface control is inadequate to classify these reserves as proved; (b) reserves in formations that appear to be productive, based on well log characteristics, but lack core data or definitive tests and that are not analogous to producing or proved reservoirs in the area; (c) incremental reserves attributable to infill drilling that could have been classified as proved if closer statutory spacing had been approved at the time of the estimate; (d) reserves attributable to improved recovery methods that have been established by repeated commercially successful applications when (i) a project or pilot is planned, but not in operation, and (ii) rock, fluid, and reservoir characteristics appear favorable for commercial application; (e) reserves in an area of the formation that appears to be separated from the proved area by faulting and the geologic interpretation indicates the subject area is structurally higher than the proved area; (f) reserves attributable to a future work over, treatment, retreatment, change of equipment, or other mechanical procedures, where such procedure has not been proved successful in wells that exhibit similar behavior in analogous reservoirs; and (g) incremental reserves in proved reservoirs where an alternative interpretation of performance or volumetric data indicates more reserves than can be classified as proved. Often referred to as P2 (SPE). (2) Reserves not yet "proven" but are estimated to have a better than 50% chance of being technically and economically producible.

Reserves (Producing): Reserves subcategorized as producing are expected to be recovered from completion intervals that are open and producing at the time of the estimate. Improved recovery reserves are considered producing only after the improved recovery project is in operation (SPE).

Reserves (Proved): Are those quantities of petroleum that, by analysis of geological and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs, and under current economic conditions, operating methods, and government regulations. Proved reserves can be categorized as developed or undeveloped. If deterministic methods are used, the term reasonable certainty is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate. Often referred to as P1, sometimes referred to as "proven" (reserve definitions are from SPE).

Reserves (Proved Developed): Are those proved reserves that can be expected to be recovered through existing wells and facilities and by existing operating methods. Improved recovery reserves can be considered as proved developed reserves only after an improved recovery project has been installed and favorable response has occurred or is expected with a reasonable degree of certainty. See *Developed reserves* (SPE).

Reserves (Proved Undeveloped): Are those proved reserves that are expected to be recovered from future wells and facilities, including future improved

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recovery projects that are anticipated with a high degree of certainty in reservoirs that have previously shown favorable response to improved recovery projects. See *Undeveloped* (SPE).

Reserves (Proven): Reserves that on available evidence are virtually certain to be technically and economically producible.

Reserves (Recoverable): The portion of reserves that can be recovered by currently available technologies.

Reserves-to-Production Ratio: (1) An estimate used to project the productive life of an oil or gas field based upon the size of the field compared to the annual production capacity. (2) A ratio of size of the field to the annual production capacity of that field. (3) Is used to estimate the field's productive life.

Reserves (Undeveloped): Are those expected to be recovered: (1) from new wells on undrilled acreage, (2) from deepening existing wells to a different reservoir, or (3) where a relatively large expenditure is required to (a) recomplete an existing well or (b) install production or transportation facilities for primary or improved recovery projects (SPE).

Reserves (Unproved): Are based on geologic and/or engineering data similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved. Unproved reserves may be further classified as probable reserves and possible reserves. Unproved reserves may be estimated assuming future economic conditions different from those prevailing at the time of the estimate. The effect of possible future improvements in economic conditions and technological developments can be expressed by allocating appropriate quantities of reserves to the probable and possible classifications (SPE).

Reservoir: (1) An independent hydrocarbon holding rock. (2) A porous, permeable sedimentary rock formation containing oil and/or natural gas enclosed or surrounded by layers of less permeable or impervious rock; a structural trap; a stratigraphic trap. (3) A subsurface, porous, permeable rock formation in which hydrocarbons are present. (4) The portion of a resource, such as natural gas, that has been discovered and that is technically and economically extractable. (5) The underground formation where oil and gas has accumulated. It consists of a porous rock to hold the oil or gas and a cap rock that prevents its escape.

Reservoir Characterization: The continuing process of integrating and interpreting geological, geophysical, petrophysical, fluid, and performance data to form a unified, consistent description of a reservoir.

Reservoir Drive: Powered by difference in pressures within reservoir and well.

Reservoir Drive Method: One of several reservoir drive methods including volumetric, depletion, gravity, gas cap, solution gas expansion, and water drive.

Reservoir Energy: The driving force in the reservoir, usually gas cap, dissolved gas, water drive, gravity, or compaction of sediments.

Reservoir Engineering Model: Used to predict reservoir behavior during production to enable selection of the most efficient method of recovery.
Reservoir Pressure: The pore pressure in the reservoir, usually at current value unless otherwise specified.
Reservoir Rock: (1) A rock containing porosity, permeability, sufficient hydrocarbon accumulation, and a sealing mechanism to form a reservoir from which commercial flows of hydrocarbons can be produced. (2) A layer of rock with interconnected holes and voids, into and out of which petroleum can flow. (3) Formation of the Earth's crust with some porosity where hydrocarbons are stored in a reservoir.
Reservoirs: Discrete sections of porous rock containing an accumulation of oil/gas, either separately or as a mixture.
Reset Control: Control method using a remote or external signal to modify the set point of a controller.
Residence Time: A reference to the amount of time that a given volume of fluid spends in a location. Related to fluid holdup and separation. Used in both surface separators and mud removal times.
Residential Consumption: Gas used in private dwellings, including apartments, for heating, air-conditioning, cooking, water heating, and other household uses.
Residual Bend: A permanent deformation in metal caused by taking the stress loading past the maximum elastic point.
Residual Chlorine: The amount of free and/or available chlorine remaining after a given contact time under specified conditions.
Residual Fuel: (1) A fuel composed mainly of un-evaporated materials after the atmospheric distillation of crude oil. (2) Very heavy fuel oils produced from the residue from the fractional distillation process rather than from the distilled fractions.
Residual Fuel Oil: (1) A general classification for the heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. It conforms to ASTM Specifications D396 and D975 and Federal Specification VV-F-815C. No. 5, a residual fuel oil of medium viscosity, is also known as Navy Special and is defined in Military Specification MIL-F-859E, including Amendment 2 (NATO Symbol F-770). It is used in steam-powered vessels in government service and inshore power plants. No. 6 fuel oil includes Bunker C fuel oil and is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes. (2) A low grade of fuel oil; used in the industry as boiler fuel; also known as bunker fuel in large ocean-going tankers.
Residual Gravity Field (Seismic): Short-wavelength component of field density variations within high-density basement and/or low-density overburden. Anomalies in the residual field are usually of interest in general exploration.
Residual Water: Connate water that will not be displaced. See also *Irreducible water.*

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Residue Gas: (1) That portion of the natural gas stream that remains after the extraction of ethane and heavier liquids and liquefiable hydrocarbons and impurities during processing, minus fuel, incidental losses, bypassed natural gas, and natural gas reserved by a seller under a gas purchase agreement. (2) The gas that remains after natural gas is processed and the liquids removed.
Residuum: Residue from crude oil after distilling off all but the heaviest components, with a boiling range greater than 1000°F.
Resieved Sand: A sand that has been run through sieves a second time to remove fines and course particles.
Resin: A solid or semisolid mixture of organic substances of complex composition having no definite melting point, as in plastic resins made from hydrocarbon feedstocks.
Resin (Asphaltene Micelle): A cyclic material that, along with maltenes, helps keep asphaltenes tied up a micelles in suspension.
Resin-Coated Sand: Frac sand that has been coated with a bonding or nonbonding sand.
Resin Consolidation: Using an injected plastic to increase the grain-to-grain bond strength in the formation.
Resin (Sand Control): One of several plastic compositions.
Resistivity: Measurement of a substance (or rock) to resist the flow of electric charge. Opposite of conductance.
Resistivity Log: One of various logs that measure some component of resistivity.
Respiration: The process in which an organism uses oxygen for its life processes and gives off carbon dioxide.
Respirator: A device designed to protect the wearer from a hazardous atmosphere.
Restoring Force: The force exerted by a centralizer against the casing to keep it away from the wellbore wall.
Retained Interest: A fractional interest in a project retained by a previous owner.
Retarder: A chemical that slows a reaction. In cementing, retarders slow the set time of the cement and prolong the pumpability of the cement.
Retention Time: (1) The time based on the separator volume and shape and the fluid flow rate that produced fluids spend in a separator. It is based on the time needed to separate an emulsion. (2) The time water, sludge, or solids are retained or held in a clarifier or sedimentation tank. See *Detention time*.
Retrievable Bridge Plug: A retrievable plug set in a non-profile segment of the downhole pipe string.
Retrievable Packer: A nonpermanent packer meant to be retrieved.
Retrieving Tool: A tool used to locate, equalize, and retrieve a plug or other settable downhole device.
Retrograde Condensate: A condensate that precipitates in the pore space of the rock in a previously dry gas (single phase) reservoir as the pressure

drops below the dew point. The building condensate severely reduces the permeability to gas.
Return Air: Air entering a space from an air-conditioning, heating, or ventilating apparatus.
Return Permeability: The comparison of permeability after testing with the additive compared to initial permeability.
Returns: Fluids and solids flowing out of a well during circulating.
Return Sludge: The recycled sludge in a POTW that is pumped from a secondary clarifier sludge hopper to the aeration tank.
Return Sludge Ratio: The ratio of the return sludge flow to the wastewater flow.
Reuse: The use of water or wastewater after it has been discharged and then withdrawn by another user. See also *Recycle*.
REV: Reverse.
ReVAP: See *Reduced volatility alkylation process.*
Rev Dust™: A friction-reducing material composed of very small particles. Also used in lab tests to simulate mud cutting fines.
Reverse Circulate: Circulating down the annulus and up the tubing.
Reverse Osmosis: A semipermeable membrane that will allow water to pass but not salt. Saltwater is pressured into the face of the membrane; the water passes through but the salt cannot pass. The filter has to be backwashed regularly to remove the accumulated salt. The process is relatively slow.
Reverse Out: Removing gravel or cement by shifting the packer or opening the sleeve and circulating out of a well by reverse circulating.
Revs (Engine): Revolutions per minute.
Reworking a Well: Restoring a well's productivity by cleaning out accumulations of sand, silt, or other substances that clog the production tubing.
Rework Operations: Any major operation performed on a well after its completion in an attempt to restore or improve its ability to produce.
Reynolds Number: An experimental number used in fluid flow to predict the flow velocity at which the flow regime moves from laminar flow through a transition range and into turbulent flow. It is the dimensionless ratio of inertial forces to viscous forces in flowing fluids. It may be viewed as a ratio of the shear stress due to turbulence to the shear stress due to viscosity. Flow with a Reynolds number less than 2000–4000 is laminar flow; that with a Reynolds number greater than 2000–4000 is turbulent flow.
RF: See *Recovery factor.*
RFG: See *Reformulated gasoline*.
RFI: See *Request for information*.
RFP: Request for proposal.
RFQ: Request for quote.
RFT: See *Repeat formation tester.*
RFV: Radial flow valve.
Rheology: The study of the deformation and flow of matter. Real fluids include nonelastic solids, non-Newtonian fluids, and viscoelastic substances.

The added materials that provide viscosity range from clays to polymers to complex surfactant chemistry.

RH (Pipe): Right-hand thread.

Rich Gas: Methane gas containing other low-carbon chain alkanes such as ethane, propane, and butane.

Rig: (1) Typically a well drilling or service unit capable of pulling and running joined tubing. (2) A structure that contains all the necessary equipment for drilling.

Rig Barge: A drilling rig mounted on a barge-like vessel for drilling in shallow water or swampy locations. Barge rigs are not self-propelled and must be towed or pushed by a towboat. In addition to all necessary drilling equipment, barges also have quarters for the drilling crew.

Rig Down: To disassemble the equipment that was placed around a well for a specific work operation.

Right Angle Set: A term usually meaning flash setting of a cement or other material. May be intended or unintended.

Right of First Refusal: A process that allows any long-term firm gas transportation customer, including formerly bundled city-gate sales customers, to continue receiving firm gas transportation service by paying up to the maximum rate and matching the length of a term offered by another customer who is seeking service.

Right of Way: The strip of land, usually 50 feet wide, that is the route of a pipeline and for which the company pays for the legal right of passage.

Right-to-Know Laws: Employee "right-to-know" legislation requires employers to inform employees (operators) of the possible health effects resulting from contact with hazardous substances. At locations where this legislation is in force, employers must provide employees with information regarding any hazardous substances that they might be exposed to under normal work conditions or reasonably foreseeable emergency conditions resulting from workplace conditions. OSHA's Hazard Communication Standard (HCS) (Title 29 CFR Part 1910.1200) is the federal regulation and state statutes are called worker right-to-know laws.

Rigid Centralizer: A centralizer with ribs that do not bow or flex.

Rigless: Without a drilling or workover rig (may involve a wire line unit, snubbing unit, or coiled tubing unit).

Rig Up: To assemble equipment at the wellsite for work on a well.

RIH: Running pipe in the hole.

Ring Gaskets: A not reusable, metal-to-metal seal. Used between spools of a wellhead and in other equipment such as flanges.

Ring Sticking: The "freezing" of a piston ring in its groove, in a piston engine or reciprocating compressor, due to heavy deposits in the piston ring zone.

R/P: See *Reserves to production ratio.*

Riprap: Materials (boards, rocks, etc.) arranged to mark a walkway or a barrier.

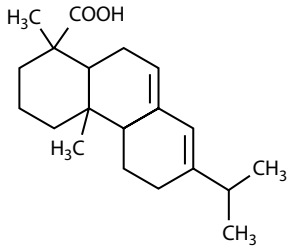
Riser: (1) Pipe through which liquid travels upward. (2) Steel or flexible pipe, which transfer well fluids from the seabed to the surface.

Riser (Drilling): A pipe between a seabed BOP and a floating drilling rig.
Riser (Production): The section of pipe work that joins a seabed wellhead to the Christmas tree.
Rising Sludge: Occurs in the secondary clarifiers of activated sludge plants when the sludge settles to the bottom of the clarifier, is compacted, and then starts to rise to the surface, usually as a result of denitrification.
Risk: The probability of an event happening times the impact of its occurrence on operations. (Impact is the effect on conditions or people if the hazard is realized (occurs) in practice and potential is the likelihood that the impact will occur.)
Risk Analysis: A decision-making tool that allows examination of the level and significance of workplace risk for humans, equipment, weather, operations, or other conditions. Determines the probability of risk occurring, the impact the risk will have, and how to mitigate the risk.
Risk Assessment: The process of identifying and evaluating the technical and nontechnical risks associated with a project. It includes the amount or degree of potential danger perceived (by an assessor) when determining a course of action to accomplish a given task. Risk assessment may be qualitative or quantitative.
Risk Premium: The additional financial return that shareholders expect to be earned in order to compensate for taking additional risk.
Risk Weighted: The result of impacting one or more potential outcomes from an uncertainty assessment with risk. Risks might take the form of specific losses (i.e., costs), the impact of the failure (failure to achieve a goal), or other representation. Risk weighting is expressed in a risk-weighted value such as net risk-weighted value and economic risk-weighted resource value, other number of risk-weighted parameters, and/or by impacting the y-axis (probability) intercept of a cumulative-frequency curve on a cumulative-frequency plot.
River Frac: A description of a large-volume water frac (ungelled water) where proppant sand is pumped at ¼–½ lb/gal. Normally at very high rates (25 to 50 + bpm). For very low permeability, non-water-sensitive formations.
RKB: Reference kelly bushing or rotary kelly bushing.
Rmf (Logging): Resistivity of the mud filtrate.
Road Oil: Any heavy petroleum oil, including residual asphaltic oil used as a dust palliative and surface treatment on roads and highways. It is generally produced in six grades from 0, the most liquid, to 5, the most viscous.
ROCE: Return on capital employed.
Rock Density: Ranges from 125 to 200 lb/ft^3.
Rocking: Pressuring up with supply gas and then opening the well. This works for wells without packers where the annulus can be used as a pressure charge chamber. When a well has a packer, the effect may also work if the liquids are pushed into the formation and then brought back with the extra gas for lift.
Rock Mechanics: The study of mechanical rock behaviors under changing loads and stresses.

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Rock Properties: Properties that describe the physical state of a rock: porosity, permeability, UCS, density, etc.
Rock Salt: A diverter that is used in acids. Best for high permeability and fractures.
Rock Shear Strength: The stress level at which rock fails under shearing or distorting load. Generally the same as compressive strength.
Rockwell Hardness: Hardness measuring scales relating penetration of a small indentation ball to ultimate yield strength, used to establish steel harness. Rockwell C scale is used in determination of metal hardness limit to control stress chloride cracking.
Rod Box: The female coupling on sucker rods.
Rod Pound: A beam lift term where the pump is filled with gas from pump-off or too fast of an operating speed (rod speed).
Rod Pump: A beam lift artificial lift method. Useful for low-rate wells (to 1,200 BPD) of moderate depth (to 12,000 ft). One of the few lift systems to be able to remove all but a gas gradient of back pressure from the reservoir.
Rod String: The string of sucker rods used in beam pumping a well.
Rod Wiper: A wiper placed over the drill pipe to wipe off excess mud as they are pulled from the well.
ROI: Return on investment.
Roller Cone Bit: A bit with multiple rotating cones that bring cutters into contact with the formation as the string is rotated.
Roller Drill Bit: A rock-cutting tool on the bottom of the drill string made with three or four shanks welded together to form a tapered body. Each shank supports a cone-like wheel with casehardened teeth that rotate on steel bearings.
Roller Stem: A wire line stem with wheels to reduce sliding friction in highly deviated wells.
Rolling the Tanks: Circulating the contents of a surface tank.
Roll-On Connector (Coiled Tubing): A type of connector (with grooves around its diameter on one end and threads on the other) is slipped inside the coiled tubing and the wall of the coiled tubing is deformed by a roller-type device into the grooves, securely connecting the BHA to the coiled tubing.
Rollover Clause: A contract clause that permits a contract to extend beyond the initial term.
RON: See *Research octane number.*
Roof Rock: A layer of dense (sealing) rock above a permeable strata.
Root Cause (in Failures): the most basic reason for a failure.
ROP: See *Rate of penetration*.
ROPE: Really overbalanced perforating. See EOP or extreme overbalanced perforating.
Rope Socket: The connection of the wire line to a threaded.
Roping: Sand and proppant falling through a vertical pipe faster than the downflow of fluid during placement of propping. Bridging may occur.

Rosin: Also colophony, hard, brittle, translucent, usually amber-colored resin, which is obtained as the residue in the distillation of turpentine. The rosin prepared from exuded, or gum, turpentine is called gum rosin; that obtained from extracted, or wood, turpentine is called wood rosin. Rosin has a specific gravity of about 1.08. It is soluble in alcohol, ether, and other organic solvents and is insoluble in water. Rosin softens when heated to about 80°C (about 176°F) and melts between 120 and 135°C (248 and 275°F). It is one of the most important resins commercially and is used extensively in making varnishes, paints, and soaps; in the manufacture of linoleum; in sizing paper; as a drier in oils; as a flux for solder; and as an adulterant of more costly resins. It is also used to treat violin bows and dancing slippers.



Abietic acid, the chief constituent of rosin

Rosita Beati Natta: Inventor of the nomenclature used to describe the stereochemistry of polymers—atactic, for polymers with no long-range order; isotactic, for polymers in which all the side groups are on the same side of the backbone chain; and syndiotactic, for polymers in which the side groups alternate from one side to another.
Rotary Bushing: The drive bushing on the rotary table that turns the kelly.
Rotary Drilling: A rig that spins a drill string with a bit on bottom.
Rotary Hose: The connection from the mud pump to the stand pipe. Also called the mud hose or kelly hose.
Rotary Pump: A type of displacement pump consisting essentially of elements rotating in a pump case that they closely fit. The rotation of these elements alternately draws in and discharges the water being pumped. Such pumps act with neither suction nor discharge valves, operate at almost any speed, and do not depend on centrifugal forces to lift the water.
Rotary Rig: A modern drilling unit capable of drilling a well with a bit attached to a rotating column of steel pipe.
Rotary Speed: String RPM.
Rotary Steerable: A deviation drilling method where the BHA is turned through a steerable component at the bottom of the well that directs the path of the bit.
Rotary Table: (1) The assembly of gears and connections that spins the kelly. (2) A heavy, circular structure mounted on a steel platform just above the

derrick floor with an opening in the center through which the drill pipe and casing must pass. The table is rotated by power transmitted from the draw works and the drilling engines. In drilling, the kelly joint fits into the square opening of the table. As the table rotates, the kelly is turned, rotating the drill column and the drill bit.

Rotary Tongs: The massive, counter-weighted tongs used on the drill floor to screw joints of drill pipe, tubing, or casing; the generic term for the heavy wrenches used by the rough necks on the rig floor.

Rotating Head: A circulating connection that allows pipe rotation. Used in cementing with non-top drive rigs.

Rotating ROP: The rate of penetrating while rotating the pipe.

Rotifer: Microscopic multi-celled animal characterized by short cilia on the front end.

Rotor: The portion of an electrical motor or generator that rotates.

Rotor (PDM Motor): The rotating shaft in a PDM motor.

Roughnecks: (1) Members of the drilling crew who work on the derrick floor and up in the derrick racking pipe. They operate and maintain the drilling engines and the mud pumps. They operate the pipe tongs to break out or unscrew the stands of the drill pipe during "trips." (2) A floor hand in an oil-drilling operation. These workers used to have a reputation for rowdiness. (3) Drill crew members who work on the derrick floor, screwing together the sections of drill pipe when running or pulling a drill string. (4) Members of the rig crew.

Roughness: The interior surface metal roughness of a pipe. Rough pipes have higher friction.

Round Trip: Pulling a string of pipe from a well and returning to bottom.

Roustabout: (1) General laborer in the field. (2) A drill crew member who handles the loading and unloading of equipment and assists in general operations around the rig.

ROV: See *Remotely operated vehicle*.

Royal Australian Chemical Institute: The professional body for chemists in Australia. The institute gives accreditation to people based on training and experience, organizes conferences and career workshops, and produces a monthly magazine *Chemistry in Australia*. Have a look at their website: http://www.raci.org.au/.

Royalty: (1) A share of the revenue from the sale of oil, gas, or other natural resources paid to a landowner of grantor of a lease or license. (2) A percentage interest in the value of production from a lease that is retained and paid to the mineral rights owner. (3) Payment, in value (money) or in kind, of a stated proportionate interest in production from mineral deposits by the lessees to the lessor. The royalty rate may be an established minimum, a sliding scale, or a step scale. A step-scale royalty rate increases by steps as the average production on the lease increases. A sliding-scale royalty rate is based on average production and applies to all production from the lease. (4) An interest in an natural gas and oil lease that gives the owner of the interest the right to receive a portion of the production from the leased acreage

(or of the proceeds of the sale thereof) but generally does not require the owner to pay any portion of the costs of drilling or operating the wells on the leased acreage. Royalties may be either landowner's royalties, which are reserved by the owner of the leased acreage at the time the lease is granted, or overriding royalties, which are usually reserved by an owner of the leasehold in connection with a transfer to a subsequent owner. (5) A percent interest paid to the mineral owner on the value of fluids produced from a lease. (6) The owner's share of production or revenues retained by government or freehold mineral rights holders. In natural gas operations, the royalty is usually based on a percentage of the total production.

Royalty Interest: A share of production free from the costs of production, when and if there is oil and gas production on the property.

Royalty (Landowner's): A share of gross production of oil and gas, free of all costs of production. Occasionally, the term is used to describe an interest in production created by the landowner outside the lease and distinguished from the conventional lessor's royalty. In this case, the landowner's royalty, outside of the lease, may have any specified duration. In general usage, landowner's and lessor's royalty are synonymous.

Royalty Oil: (1) The mineral owners' share of production, taken in oil rather than in cash. (2) The landowner's share of net oil production, taken in the form of crude oil rather than in cash.

Royalty Payment: The cash or kind paid to the owner of mineral rights.

RPM: See *Relative permeability modifier.*

RPM (String Rotation): Revolutions per minute.

RP (Policy): Recommended practice.

R/P Ratio: See *Reserve lifetime ratio.*

RPT: See *Rapid phase transitions.*

RQ: Reportable quantity.

R/Q Ratio: See *Return sludge ratio.*

RSMD: Resumed.

RSS (Drilling): Rotary steerable system.

RTD: Resistive thermal device, used for temperature measurement.

RTE (Seismic): See *Reduction to equator.*

RTG (Perforating): Retrievable thru-tubing gun.

RTJ: Ring tool joint or ring tool joint flange.

Rt (Logging): True formation resistivity.

RTNS: Returns.

RTP (Seismic): See *Reduction to pole.*

RTS: Ready to service; time for a service company to be on location.

RTTGP: Reenterable through tubing gravel pack system.

RTTS: A brand name for a retrievable squeeze tool. Retrievable, test, treat, squeeze.

RTU: Remote telemetry unit.

RU: Rig up.

Rubblize: Break up the formation into pieces to improve the flow path.

Rugose: Roughness of a hole.
Rugosity: A measurement of roughness of the surface of a passage.
Runaway (Coiled Tubing): Uncontrolled run-in of coiled tubing into a wellbore.
Run In: Go into the hole.
Running Squeeze: A cement squeeze that injects cement until a resistance is built.
Running Tool: A tool used to run and set a plug or other device.
Runoff: That part of rain or other precipitation that runs off the surface of a drainage area and does not enter the soil or the sewer system as inflow.
Runoff Reduction: The process whereby practices are implemented to minimize the quantity of stormwater runoff generated and/or attenuate runoff near its source using storage, infiltration, and/or uptake by vegetation.
Run Ticket: (1) A record of the oil moved from a storage tank or through a pipeline to custody of another company. (2) Used in buying and selling crude oil. When the ownership or custody of oil changes, a run ticket is prepared for the receiver and the shipper to record the transaction. The ticket is made in triplicate by the gauger and is witnessed by the lease owner's representative, usually the pumper. The run ticket, an invoice for oil delivered, shows opening and closing gauge, API gravity and temperature, tank temperature, and BS&W. The original of the ticket goes to the purchaser; copies go to the pumper and one for the gauger.
Rupture Disc: A frangible seal that can isolate a section of a well while the tubing is isolated and then be broken to bring in the well.
RVP: See *Reid vapor pressure*.
rw: Wellbore radius.
Rw (Logging): Resistivity of the formation water at the formation temperature.
RWO: Rig workover.
Rxo (Logging): Shallow formation resistivity, usually of the flushed zone, from a very shallow reading device.
Ryton: Brand of high-performance resins used in applications requiring resistance to heat or abrasive chemicals, such as automotive components.

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S1, S2, S3: Rock evaluation pyrolysis parameters.
Saccharide: A simple saccharide, or sugar, is a molecule that is simply lousy with alcohol groups so that it has the general chemical formula $C_nO_nH_{2n}$. There are big chemical differences between them depending on the exact geometry of the hydroxyl groups, so there are a lot more different kinds than you think. We tend to give them trivial names, like "glucose" and "galactose," since all their structures look pretty much the same and their systematic names would be too… These "monosaccharides" can join together to form disaccharides (two sugars joined together) or larger chemical structures.
Sack (Cement): 94 lb of dry cement.
Sacrificial Anode: A metal slug, lower in the electromotive series than steel that is hard wired to the casing and buried in a bed of wet soil or below the surface of the water. The corrosion cell in the well then transfers the current to the new anode and the steel in the well is protected. Common offshore.
Saddle: A pipe fitting made in parts to weld or clamp onto a line to create a junction.
Saddle Bearing: A bearing that allows the walking beam to move atop the Sampson post in a beam lift pump.
SAE Number: An arbitrary number indicating the viscosity range of crankcase, transmission, or rear axle lubricants, according to systems designed by the Society of Automotive Engineers (SAE).
Safeing Out: Securing a well such that the well is not capable of flowing hydrocarbons to surface.
Safe Shutdown Earthquake: Earthquake used for the design of facilities, structures, and foundations. It is such that it should be possible to bring the system to safe stop without spillage or leakage, even though the system becomes inoperative. Earthquake is characterized by acceleration and displacement spectra.
Safety Clamp: A clamp for flush joint pipe. Also any clamp for securing pipe above the rotary table, even when the slips are set.
Safety Factor: The derating factor applied to a pressure test limit or weight limit to set a maximum operating load condition.
Safety Head: BOP.
Safety Joint: A joint above a piece of equipment that is designed to fail and allow recovery of the upper string.
Safety Release: A section in a downhole tool string than can be actuated by ball or pressure to allow recovery of the pipe string if the tool is stuck.

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Safety Slide: The line from derrickman's platform to the ground, used in an emergency. Also called a Geronimo line.
Safety Valve: (1) Various. Generally used in describing a surface or subsurface safety valve. (2) Pressure relief valve actuated by inlet pressure and characterized by rapid opening or pop action.
Sag: Settling of particles in a fluid.
SAGD: See *Steam-assisted gravity drainage*.
Sail Angle: The planned inclination of the tangent section of a directional well. In a horizontal well, it would be 90° (±10°); in a build and hold or S well, it would be the tangent section; and in a slant well, it would be the inclination throughout.
Salamander: Various, usually a heater.
Sale for Resale: A sale of natural gas to a customer who will in turn sell that gas to someone else.
Sales and Purchase Agreement: A definitive contract between a seller and a buyer for the sale and purchase of a quantity of natural gas or LNG for delivery during a specified period at a specified price. See *Annual delivery program (ADP)* and *heads of agreement (HOA)*.
Sales Gas: (1) Natural gas treated and conditioned to meet gas purchaser specifications. (2) Various, but generally the gas sent to the pipeline after dehydrating, stripping, and sweetening.
Sales Value: The proceeds received for the sale of the mineral.
Saline Water: Water that is generally considered unsuitable for human consumption or for irrigation because of its high content of dissolved solids. Commonly expressed as milligrams per liter (mg/L) of dissolved solids, with 35,000 mg/L defined as equivalent to seawater, slightly saline as 1,000–3,000 mg/L, moderately saline as 3,000–10,000 mg/L, very saline as 10,000–35,000 mg/L, and brine has more than 35,000 mg/L (after USGS, 1984).
Salinity: One of many tests that measures, either directly or indirectly, the concentration of salt in a sample of water.
Salinity Gradient: A plot of increasing salinity with depth to spot anomalies such as uplift and migration paths.
Salinity Log: A type of log that measures salinity by use of gamma ray emission measurements from collisions of neutrons with chloride ions.
SALM: See *Single anchor leg mooring*.
Saltation: A particle movement method where the particle is carried in a series of short hops along a flow path.
Salt Bed Storage: Storage of fluids in a chamber mined or leached out of a salt deposit.
Salt Bridging Material: Rock salt or granulated salt sized to construct a filter cake to control fluid loss.
Salt (Brine): Specifically sodium chloride but also may be a generic term for most water-soluble salts.
Salt Cavern: (1) An underground cavern, developed usually by solution mining, for storage of gas or liquid products. (2) Solution mined in sufficiently

thick salt formations—bedded salt or salt domes—penetrated by boreholes down to depths of 2000 m. The dimensions of the caverns normally extend to 300 m in height and 60 m in diameter, with volumes that generally range from 100, 000 to 800,000 m^3.

Salt Dome: (1) A subsurface mound or dome of salt. Two types of salt domes are recognized: the piercement and non-piercement. Piercement domes thrust upward into the formations above them, causing faulting; non-piercement domes are produced by local thickening of the salt beds and merely lift the overlying formations to form an anticline. (2) A usually large movement or intrusion of salt that gradually flows through the rock. Can create reservoir traps and can create casing collapse problems.

Salt Dome Storage Field: A subsurface storage facility that is a cavern hollowed out in either a salt "bed" or "dome" formation.

Salt Water Disposal Well: Many wells produce salt water while producing oil. The disposal of this water is a problem to an operator because of pollution. The best solution to the problem is to pump the waste back into a formation that is deep enough not to pollute shallow water sands. Many stripper wells that are no longer commercial are converted for this purpose.

Salt Water (Production): Any non-freshwater flow. Saturated NaCl brine has a density of 9.9 lb/gal.

Sample: A portion of a larger quantity used as representative of the whole.

Sample Log: A record of rock cuttings (and some properties) that is made as the rock is being drilled.

Sample Rate: The rate that data or samples are taken per unit of time.

Sampson Post: The uprights on a beam lift (rod) pump jack that hold the bearing housings.

SAM™: Sensor-activated module.

Sand Bailer: A slickline tool used to place or remove sand or similar small grains from a wellbore.

Sand Consolidation: One of various methods of consolidating the grains of an unconsolidated or weakly consolidated formation. Typically resin consolidation (epoxy, furan, or phenol formaldehyde) but may also include sodium silicate, coking, and mineral or metal precipitates.

Sand Control: One of various mechanisms for controlling formation sand movement during fluid production from a weakly consolidated sandstone.

Sand Control Screen: A sand-restraining device that is a mesh or wire wrapped screen wound over a base pipe with holes.

Sandface: The downhole completion interface.

Sand (Formation): Specifically a sandstone but is also used in some texts as a general term for the pay zone.

Sand Frac: A propped hydraulic fracture.

Sand Free Rate (Production): The maximum production flow rate that a weakly consolidated pay zone will produce without producing sand.

Sanding Back: Laying a sand plug over the lower perfs to cover and protect them from another operation.

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Sand Line: The braided line on a rig, normally used for lifting and deploying tools. May also be used in some instances downhole.
Sand Line Drill: A chisel-like tool run on the rig's sand line to break up junk or stuck tools downhole.
Sand Production: Free grains of sand pulled loose by flow, brittle failure, or formation disaggregation and produced with the hydrocarbon production.
Sand Screen: A downhole screen designed to stop sand production before the flow enters the pump or tubing.
Sand/Shale Ratio Map: A map that uses contours to show the ratio of sand to shale in a formation. Useful for determining clean sand trends and permeability channels.
Sandstone: (1) Granular sedimentary rocks with grain sizes between 0.0625 and 2 mm. The pore space where hydrocarbons may be held is between the grains. (2) A compacted sedimentary rock composed mainly of quartz or feldspar; a common rock in which oil, natural gas, and/or water accumulate. (3) Generally considered the most porous and permeable rock and is therefore where scientists usually find oil and gas.
Sand Trap: A surface vessel in the production line with the specific task of capturing sand before the production goes through a point where the sand may damage equipment.
Sandy Service: A rating indicating improved performance in erosive environments.
Sanitary Collection System: The pipe system for collecting and carrying liquid and liquid-carried wastes from domestic sources to a wastewater treatment plant. Also see *Wastewater collection system*.
Sanitary Sewer: A pipe or conduit (sewer) intended to carry wastewater or waterborne wastes from homes, businesses, and industries to the Publicly owned treatment works (POTW). Storm water runoff or unpolluted water should be collected and transported in a separate system of pipes or conduits (storm sewers) to natural watercourses.
Saponification: A saponification reaction is the reverse of the esterification reaction. The term "saponification" is normally only used in the context of the making of soaps from the reaction.
Saponification Number: The number of milligrams of potassium hydroxide that is consumed by 1 g of oil under the conditions of the test.
Saprophytic: Living on dead or decaying organic matter.
Saprophytic Organisms (Saprophytes): Organisms living on dead or decaying organic matter. They help natural decomposition of the organic solids in wastewater.
SARA: Superfund Amendments and Reauthorization Act of 1986. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted in 1980. The superfund amendments increase superfund revenues to $8.5 billion and strengthen the EPA's authority to conduct short-term (removal), long-term (remedial),

and enforcement actions. The amendments also strengthen state involvements in the cleanup process and the agency's commitments to research and development, training, health assessments, and public participation. A number of new statutory authorities, such as Community Right-to-Know, are also established.

SAS: Stand-alone screen completion.

Satellite Field: An adjacent field to larger, host, field facilities.

Satellite Installation: An offshore structure that depends on another installation for materials or services.

Satellite Platform: An offshore structure that depends on another platform for materials or services.

Satellite Well: An offshore well that is separate from the main group of wells but in the same field. May be a subsea well or a single platform well with a flow line tie back.

Saturated Solution: A solution containing the maximum concentration of a specific ion that it will hold at a certain temperature and pressure without precipitating.

Saturation: (1) The extent to which the pore space in a formation contains hydrocarbons or connate water. (2) The extent to which gas is dissolved in the liquid hydrocarbons in a formation.

Saturation Exponent: The exponent, n, in the water saturation term in the equation that relates resistivity to water saturation.

Saturation Pressure: Pressure at which vapor and liquid are in equilibrium. For oils, equal to the bubble point. For condensates, the dew point.

Saturation (Reservoir): The fraction of the effective porosity filled with a specific fluid.

Saucier Criteria: A gravel sizing method that takes the 50% intercept of a cumulative percent retained of the formation sand against a log particle size and then multiplies by 6 to get the median gravel size for the pack.

Saver Sub (Drill String): A threaded coupling under the kelly to which the joints of drill string are made up. Save wear on the kelly threads.

SBHP: See *Static bottom-hole pressure*.

SBHT: Static bottom-hole temperature.

SBM: Synthetic oil-based mud.

SBR (Elastomer): Copolymer of styrene and butadiene.

Scab Liner: A casing or tubing repair technique that uses a packer at the top and bottom with a smaller diameter pipe in between to isolate a breach in the pipe or seal off old perfs. Also used for a liner set in open hole to isolate an unstable zone or loss zone rather than to increase the pressure containment capability of the well.

SCADA System: See *Supervisory control and data acquisition system.*

Scale: (1) A combination of mineral salts and bacterial accumulation that sticks to the inside of a collection pipe under certain conditions. Scale, in extreme growth circumstances, creates additional friction loss to the flow of water. Scale may also accumulate on surfaces other than pipes. (2) One

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of several mineral precipitates that crystallize out of waters at or above the saturation of the ions.

Scale Converter: A chemical that converts an acid insoluble scale to an acid soluble material.

Scale Dissolver: A product that chemically dissolves scale.

Scaled Off: Plugged by scale.

Scale Inhibition Squeeze: Placement of a scale inhibitor chemical by injecting it into the formation. The material may absorb, adsorb, or precipitate.

Scale Inhibitor: A chemical that prevents scale from forming in scale mineral saturated produced waters.

Scale Prediction: Prediction of where in the wellbore that scale minerals are oversaturated in solution and could form scale. Not necessarily where the scale will form.

Scallop Gun: A hollow carrier perforating gun with relief ports drilled part way through the gun body to provide an exit point for the perforation charge and to provide a recess to minimize damage from the burr that forms around the exit hole in the perforating gun.

Scavenger: A material that takes another material out of solution or the flow stream. Among the most common are oxygen and H_2S scavengers.

SCBA: See *Self-contained breathing apparatus*.

SCC (Corrosion): Stress Chloride Cracking.

SCC (Sand Control): Sand control completion.

Scf: Standard cubic foot, a measurement at standard conditions of gas volume.

Scfm: Standard cubic foot per minute.

Schedule (Pipe): A sizing system of numbers that specifies the inside diameter (ID) and outside diameter (OD) for each diameter pipe. The schedule number is the ratio of internal pressure in psi divided by the allowable fiber stress multiplied by 1000. Typical schedules of iron and steel pipe are schedules 40, 80, and 160. Other forms of piping are divided into various classes with their own schedule schemes.

Scheduling: Process by which nominations are first consolidated by receipt point and by contract and verified with upstream and downstream parties. If the verified capacity is greater than or equal to the total nominated quantities, all nominated quantities are scheduled. If verified capacity is less than nominated quantities, nominated quantities will be allocated according to scheduling priorities.

Schist: A crystalline metamorphic rock that can be split into thick layers because of the bedded mineral arrangements.

Schmutzdecke: A layer of trapped matter at the surface of a slow sand filter in which a dense population of microorganisms develops. These microorganisms within the film or mat feed on and break down incoming organic material trapped in the mat. In doing so, the microorganisms both remove organic matter and add mass to the mat, further developing the mat and increasing the physical straining action of the mat.

Scintillation Detector: A device that measures radiation output (Geiger counter).
SCL: Slickline collar locator.
SCM (Subsea): Subsea control module.
Scooter: A sewer cleaning tool whose cleansing action depends on the development of high water velocity around the outside edge of a circular shield. The metal shield is rimmed with a rubber coating and is attached to a framework on wheels (like a child's scooter). The angle of the shield is controlled by a chain-spring system that regulates the head of water behind the scooter and thus the cleansing velocity of the water flowing around the shield.
Scorpion Plot: A graph or the production performance of wells against the cost of operations to achieve that production—particularly useful for comparing the effectiveness of workovers.
Scour: Removal of part of seabed by current, storm, or ice.
Scout: A person that reports on competitor leasing and drilling activity.
Scout Ticket: A brief report on well information from drilling through initial completion.
Scout Tickets: A written report of wells drilling in the area. The reports contain all pertinent information—all that can be found out by the enterprising oil scout: operator, location, lease, drilling contractor, depth of well, formations encountered, results of drill stem tests, logs, etc. On tight holes, the scout is reduced to surreptitious means to get information. Talks to water hauler, to well-service people who may be talkative, or landowner's brother-in-law. The bird-dogging scouts estimate the drill pipe setbacks for approximate depth; they note the acid trucks or the shooting (perforating) crew; and through their binoculars, they judges the expressions on the operator's face: happy or disgruntled.
SCP: Sustained casing pressure.
SCR: See *Steel catenary riser.*
SCRAMS™: Surface-controlled reservoir analysis and management system.
Scraper: (1) A device used to remove downhole deposits. (2) Device that is inserted into a pipe in order to run through its bore. Several purposes can be accomplished: check the status of the pipe, drag any dirt inside, remove fluids from hydraulic tests, etc. (3) A device that cuts through paraffin, asphaltenes, etc., inside the pipe. Run on wire line.
Scraper Trap: Terminal fitting of a main pipeline that allows the insertion and removal of scrapers from the pipeline.
Scratcher: A device with bristles or wires that is used to remove mud cake, soft deposits, etc.
Scratchers (Cementing): Mechanical methods of physically removing mud cake from the borehole wall.
SCR (Completions): Subsea completion riser.
Screen: (1) A device used to retain or remove suspended or floating objects in wastewater. The screen has openings that are generally uniform in size.

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It retains or removes objects larger than the openings. A screen may consist of bars, rods, wires, gratings, wire mesh, or perforated plates. (2) A sand exclusion device.

Screen Analysis: Particle-size distribution of a sand sample made by running the sample through a set of screens.

Screen Centralizer: A blade-type centralizer, usually mounted at the connection, which holds the screen off the casing wall to assist in gravel packing and flow.

Screening Effect: The tendency of proppants to segregate in the fluids due to density effects when the fluid velocities drop below turbulence.

Screenless Frac: A sand control method where the sand is held in place with closure pressure, resin, or other methods and no screen is run.

Screen Only Completion: A completion that uses a screen without a gravel pack, allowing the formation to cave in around the screen.

Screen Out: To dehydrate a sand slurry to a point where the sand is no longer moveable.

Screen Table: A platform and handling system to make up screens without damaging the screens.

Screw Port Gun (Perforating): A reusable, reloadable perforating gun with port plugs over the perforating charges.

Scrub: Removal of components (gas, liquids, or solids) from the methane achieved by surface equipment (scrubbers).

Scrubber: (1) A reactor that removes various components from produced gas. (2) Equipment that causes the separation of liquid and gaseous phases in a fluid stream. The separation is usually based on density differences of the two phases and can take place using gravity force, induced centrifugal force, etc. (3) System to reduce noxious substances from a flowing stream of air, usually filled with plates or packing, through which scrubbing fluid flows countercurrent or cross-current to the path of the contaminated air.

Scrubbing: Purification of a gas or liquid by washing it in a tower.

SCSFS: Surface-controlled selective flow system.

ScSSV: See *Surface-controlled subsurface safety valve*.

ScSSV Leak Rate (Acceptable to Pass): <900 scf/h.

Scum: A layer or film of foreign matter (such as grease, oil) that has risen to the surface of water or wastewater; a residue deposited on the ledge of a sewer, channel, or wet well at the water surface; a mass of solid matter that floats on the surface.

SCVF: Surface casing vent flow.

SD: Shutdown.

SDFN: Shutdown for the night.

SDR: See *Size diameter ratio*.

SDR (Downhole Gauge): Signal drift.

SDV: Shutdown valve.

SDWA: Safe Water Drinking Act.

Seal Assembly: A short section with external seals on the end of tubing to stab into a polished bore receptacle and achieve a seal. The seal assembly may be allowed to move in the PBR when tubing temperature and/or pressure changes.
Seal Bore Extension: A seal bore receptacle below the packer. Used where a longer seal assembly is needed.
Seal Bore Packer: A packer with the seal bore through the body of the packer.
Seal (Geologic): A rock seal that is sufficiently impermeable to prevent leakage of hydrocarbons from a trap.
Sealing Fault: A fault that effectively seals a compartment.
Seal (Mechanical): An elastomer or metal-to-metal device that isolates one pressure region from another.
Seal Ram: A ram in the BOP that seals around the pipe.
Seal Rock: Is a layer of rock through which oil and gas cannot flow. When the demand for a product changes during different periods of the year, the product is said to be *seasonal*. The consumption of natural gas is seasonal. We use more gas in the winter to heat our homes than we do in the summer.
Seal Swelling: A reaction of an elastomer seal by absorbing gas or a liquid and increasing its volume. May or may not be detrimental.
Seal-Tite: A trademarked name of a leak stopping material.
SeaStar®: See *TLP + mini TLPs*.
Seating Nipple: A machined profile in a heavy wall short tubing section that allows a plug to be set and the seal on the plug to effectively isolate the well.
Seawater Composition (ASTM D1141): 19359 mg/L chloride, 2702 mg/L sulfate, 142 mg/L bicarbonate, 11155 mg/L sodium + potassium, 1297 mg/L magnesium, 408 mg/L calcium, TDS = 35169 mg/L, and pH = 8.2.
Seawater Composition (Typical): pH 8.0, oxygen 6–8 ppm, sodium 11,000 ppm, potassium 380 ppm, calcium 400 ppm, magnesium 1,300 ppm, chloride 19,000 ppm, sulfate 2,600 ppm, and carbonate 142 ppm. Seawater composition may be fresher near rivers and melting ice caps and more concentrated near desert areas.
Seawater Density: 65 lb/ft^3 or 8.68 lb/gal (1.04 g/cc).
Seaworthiness: Statement on the condition of the vessel for the trade or service in which it is employed.
Seaworthiness Certificate: Certificate issued by a classification society surveyor to allow a vessel to proceed after she has met with a mishap that may have affected her seaworthiness. It is frequently issued to enable a vessel to proceed, after temporary repairs have been effected, to another port where permanent repairs are then carried out.
Secchi Disk: A flat, white disk that is used to measure the clarity or transparency of water. The disc is lowered into the water by a rope until it is just barely visible. At this point, the depth of the disk from the water surface is the recorded Secchi disk transparency.
Secondary Cementing: An inexact term. Any cementing after the primary cement job. Rarely used.

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Secondary Clarifier: A wastewater treatment device that consists of a rectangular or circular tank that allows those substances not removed by previous treatment processes that settle or float to be separated from the wastewater being treated.

Secondary Element: The secondary measuring device or flow meter used with a primary measuring device (element) to measure the rate of liquid flow. In open channels, bubblers and floats are secondary elements. Differential pressure–measuring devices are the secondary elements in pipes or pressure conduits. The purpose of the secondary measuring device is to (1) measure the liquid level in open channels or the differential pressure in pipes and (2) convert this measurement into an appropriate flow rate according to the known liquid level or differential pressure and flow rate relationship of the primary measuring device. This flow rate may be integrated (added up) to obtain a totalized volume, transmitted to a recording device, and/or used to pace an automatic sampler.

Secondary Fractures: Usually another set of natural fractures in the pay oriented at some angle to the primary natural fractures.

Secondary Market: In the gas industry, this is the market for reselling unneeded pipeline transportation capacity.

Secondary Porosity: Non-intergranular porosity such as fractures and vugs that may contribute sharply to permeability but may not significantly raise the porosity level.

Secondary Recovery: (1) A recovery improvement process such as waterflooding or gas flooding. (2) Enhanced recovery of oil or gas from a reservoir beyond the oil or gas that can be recovered by normal flowing and pumping operations. Secondary recovery techniques involve maintaining or enhancing reservoir pressure by injecting water, gas, or other substances into the formation. See also *Improved (enhanced) recovery* and *Tertiary recovery*. (3) Recovery of hydrocarbons from a reservoir by increasing reservoir pressure by injecting gas or water into reservoir rock. See also *Primary recovery* and *Tertiary recovery*. (4) A broad term encompassing any method of extracting oil from a reservoir after a well or field has exhausted its primary production. (5) The extraction of additional crude oil, natural gas, and related substances from reservoirs through pressure maintenance techniques such as waterflooding and gas injection. (6) Recovery of oil or gas from a reservoir by artificially maintaining or enhancing the reservoir pressure by injecting gas, water, or other substances into the reservoir rock.

Secondary Treatment: A wastewater treatment process used to convert dissolved or suspended materials into a form more readily separated from the water being treated. Usually, the process follows primary treatment by sedimentation. The process commonly is a type of biological treatment process followed by secondary clarifiers that allow the solids to settle out from the water being treated.

Second Mate: Ship's navigation officer; keeps charts (maps) up to date and monitors navigation equipment on bridge. See *Crew*.

SEC PV-10: The present value of proved reserves based on 12-month average commodity prices, discounted at a rate of 10% per annum.

Section (US Land): 640 acres.
Sediment: Soil that had been washed or eroded from a land surface.
Sedimentary: Deposit made up of pieces of other rocks.
Sedimentary Basin: (1) A specific geographical basin of sedimentary rocks. (2) A geographical area, such as the Western Canada Sedimentary Basin, in which much of the rock is sedimentary (as opposed to igneous or metamorphic) and therefore likely to contain hydrocarbons.
Sedimentary Rocks: (1) Rock is generally classified into one of three categories: (a) sedimentary, (b) igneous, and (c) metamorphic. (2) They are formed in horizontal layers when sediments from rivers are washed into lakes or oceans. The weight of the additional sediments compresses the earlier deposits and minerals cement them together into sedimentary rocks such as sandstone, limestone (carbonate), and shale.
Sedimentation Basin: Clarifier, settling tank. A tank or basin in which wastewater is held for a period of time during which the heavier solids settle to the bottom and the lighter materials float to the water surface.
Sedimentation (Wastewater): The process of settling and depositing of suspended matter carried by wastewater. Sedimentation usually occurs by gravity when the velocity of the wastewater is reduced below the point at which it can transport the suspended material.
Seeding: Introducing very small particles in the liquid that accelerate the development of scale or other precipitates.
Seed Sludge: In wastewater treatment, seed, seed culture, or seed sludge refers to a mass of sludge that contains populations of microorganisms. When a seed sludge is mixed with wastewater or sludge being treated, the process of biological decomposition takes place more rapidly.
Seep (Natural Flow): A natural site, generally small, where water or oil percolates slowly to the land surface or into a stream, lake, or ocean.
Seeps: Provide evidence of hydrocarbons. Seeps occur along fractures in reservoirs or at places where the earth's surface cuts the formation.
Seismic: (1) A tool for identifying underground accumulations of oil or natural gas by sending and measuring the return of energy or sound waves. It is a computer-assisted process that maps sedimentary structures to assist in planning drilling programs. (2) An exploration technique that can find structures and potential reservoir traps by reflecting sound waves from the rock strata.
Seismic (2D): Is a 2D picture of the subsurface. It generates a seismic section, which is a 2D slice from the surface of the earth downward. This section is known as 2D seismic because it shows the width and depth.
Seismic (3D): A new technique that scientists are now applying seismic technology to produce 3D images of the earth's subsurface. Three-dimensional seismic or 3D seismic creates an image that includes length, width, and depth. Seismic crews obtain data on a 2 or 3 mile square of the earth's surface. Large, high-speed computers analyze the data and create a picture of the surface. Scientists can then take slices of this in a variety of directions to examine the formation.

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Seismic (4D): Is a technique that is used at different time periods to study the movements of hydrocarbons. This produces a 4D seismic history of the formation with time as the fourth dimension.
Seismic Acquisition (2D, 3D, 4D): Seismic data are used to map subsurface formations. A 2D survey reveals a cross section of the subsurface. In a 3D survey, seismic data are collected in the inline and crossline directions to create a 3D image of the subsurface. In a 4D or time-lapse 3D survey, 3D surveys are repeated over time to track fluid movement in the reservoir (from Baker Hughes).
Seismic Exploration: An exploration technique involving the use of seismic methods.
Seismic Lines: "Shock" waves from an event (explosive, tectonic, impact, etc.) that travel through the earth and reflect off of subsurface structures (rocks) in the same manner as sound echos and water waves and ripples.
Seismic Program (3D): Seismic surveys shot from surfaces to map underground stratigraphy; to profile the underlying strata in search of up-dips, down dips, faults, and other promising anomalies.
Seismic Studies: Refers to studies done to gather and record patterns of induced shock wave reflections from underground layers of rock, which are used to create detailed models of the underlying geological structure.
Seismic Survey: (1) Techniques for determining the detailed structure of the rocks underlying a particular area by passing acoustic shock waves into the strata and detecting and measuring the reflected signals. (2) Geophysical information on subsurface rock formations gathered by means of a seismograph; the investigation of underground strata by recording and analyzing shock waves artificially produced and reflected from the subsurface bodies of the rock.
Seismograph: (1) A device that records vibrations from the earth. In the exploration for oil and gas, a seismograph records shock waves set off by explorations detonated in the shot holes and picked up by geophones. This allows geoscientists to develop a map of the rock formations below the earth's surface. (2) A seismograph amplifies and records the electrical signal and produces a picture or *seismogram*. (3) A device that records vibrations (natural or man-made) in the earth. With interpretation, the data can give information on buried strata.
Seismology: The science of study of the rocks below the surface of the earth.
Selective Firing: A perforating gun initiation that can sequentially fire charges at two or more depths on a single gun run.
Selective Profile: A profile design that can be used at several places in the same string. A plug must pass through the profile and be pulled back into the profile to set.
Selective Solvent: A solvent that, at certain temperatures and ratios, will selectively dissolve more of one component of a mixture than of another and thereby provide partial separation.

Self-Contained Breathing Apparatus. A respirator including an air cylinder that supplies breathing air to the wearer.
Self-Potential Log: See *Spontaneous potential log or SP.*
Self-Referential: Referring to itself; for example, "This sentence no verb," is a good example of a self-referential sentence.
SEM: Scanning electron microscope.
Semisubmersible Rig: (1) A floating drilling installation that is supported by underwater pontoons; generally used for exploration purposes only. (2) A rig supported by attached pontoons. (3) A floating offshore drilling unit that has pontoons and columns that, when flooded, cause the unit to submerge to a predetermined depth. Living quarters, storage space, and so forth are assembled on the deck. Semisubmersible rigs are self-propelled or towed to a drilling site and anchored or dynamically positioned over the site, or both. In shallow water, some semisubmersible can be ballasted to rest on the seabed. Semisubmersibles are more stable than drill ships and ship-shaped barges and are used extensively to drill wildcat wells in rough waters such as the North Sea. Two types of semisubmersible rigs are the bottle type and the column stabilized.
Semisubmersibles: A floating unit, with its deck supported by columns to enable the unit to become almost transparent for waves and provide a favorable motion behavior.
Separately Derived System: A system whose power is derived (or taken) from a generator, transformer, or converter.
Separation: The process of separating liquid and gas hydrocarbons and water. This is typically accomplished in a pressure vessel at the surface, but newer technologies allow separation to occur in the wellbore under certain conditions.
Separation (Fluid Treating): Processes related to separation of gas, water, and hydrocarbons.
Separator: (1) A production treating vessel designed to facilitate the separation of gas, oil, and/or water from a produced fluid stream. (2) A vessel used to separate a multiphase mixture of fluids into its separate phases, for example, vapor, oil, water, and solids.
Separator Gas: Natural gas separated out of the oil by a separator at the well.
Separator Pressure: The pressure at which the separator is operated. This pressure is a direct back pressure on the well.
Sepiolite: Clay mineral used in drilling fluid. Like attapulgite, it creates viscosity by mechanical interference with the clay particles rather than by electrochemical forces.
Septage: The sludge produced in septic tanks.
Septicity: The condition in which organic matter decomposes to form foul-smelling products associated with the absence of free oxygen. If severe, the wastewater produces hydrogen sulfide, turns black, gives off foul odors, and contains little or no dissolved oxygen and the wastewater has a high oxygen demand.

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Septic Tank: A system sometimes used where wastewater collection systems and treatment plants are not available. The system is a settling tank in which settled sludge and floatable scum are in intimate contact with the wastewater flowing through the tank and the organic solids are decomposed by anaerobic bacterial action. Used to treat wastewater and produce an effluent that flows into a subsurface leaching (filtering and disposal) system where additional treatment takes place. Also referred to as an "interceptor"; however, the preferred term is "septic tank."
Septic Tank Effluent Pump System: A facility where effluent is pumped from a septic tank into a pressurized collection system that may flow into a gravity sewer, treatment plant, or subsurface leaching system.
Septic (Wastewater): A condition produced by anaerobic bacteria. If severe, the wastewater produces hydrogen sulfide, turns black, gives off foul odors, and contains little or no dissolved oxygen and the wastewater has a high oxygen demand.
Sequestration: To tie up ions into a complex micelle or molecule and prevent or slow precipitation of materials.
Series Operation: Wastewater being treated flows through one treatment unit and then flows through another similar treatment unit.
Service: Any individual person, group of persons, thing, or groups of things served with water through a single pipe, gate, valve, or similar means of transfer from a main distribution system.
Service Drop: Overhead conductors from the last pole to the building being served.
Service Pipe: The pipeline extending from the water main to the building served or to the consumer's system.
Service Well: (1) A well that does not produce oil or gas but that is used to inject liquids or gas into the main producing formation for such purposes as pressure maintenance, enhanced recovery, and storage or subsurface disposal of salt water and other substances. (2) A well that is used for purposes other than production.
Service Zone Completion: The interval in a wellbore that has been mechanically prepared for service use, usually water or gas injection, to stimulate production from other wells or for water or other waste disposal.
Sessile: Attached masses of bacterial colonies.
Setback: (1) Reduction of heating or cooling during hours when a building is unoccupied. (2) Pulling tubing and stand back in the vertical racks on the rig.
Set Casing: (1) The actions involved in running casing and cementing it in place. (2) To cement casing in the hole. The cement is pumped downhole to the bottom of the well and is forced up a certain distance into the annular space between casing and the rock wall of the drill hole. It is then allowed to harden, thus sealing off upper formations that may contain water. The small amount of cement in the casing is drilled out in preparation for perforating to permit the oil to enter the casing. The decision to set casing (or pipe) is an indication that the operator believes he has a commercial well.

Set Pipe: Run casing and cement. General term that means to start the completion on a well.
Set Point: In process control systems, a point at which the desired value of the controlled variable is set.
Set-Through Completion: A completion with casing set through the interval and cemented.
Set Time: Time for cement (usually construction cement) to become rigid. Pumping time and strength development terms are usually used for downhole cementing.
Settleable Solids: The portion of the suspended solids that are of sufficient size and weight to settle in a given period of time, usually 1 h.
Settled Production: The second phase of production in the producing life of a well. See *IP*.
Settling Tank: A surface vessel where solids are allowed to settle out of a produced or circulated fluid stream.
Set Up: Gel or harden as in cement.
Sewage: The used household water and water-carried solids that flow in sewers to a wastewater treatment plant. The preferred term is "wastewater."
Sewer: A pipe or conduit that carries wastewater or drainage water. The term "collection line" is also used often.
Sewerage: System of piping with appurtenances for collecting, moving, and treating wastewater from source to discharge.
Sewer Gas: Gas in collection lines (sewers) that results from the decomposition of organic matter in the wastewater. When testing for gases found in sewers, test for lack of oxygen and also for explosive and toxic gases. Any gas present in the wastewater collection system, even though it is from such sources as gas mains, gasoline, and cleaning fluid.
Sewer Main: A sewer pipe to which building laterals are connected. Also called a "collection main."
SFLU (Logging): Spherically focused resistivity log. Measures the resistivity of the flushed zone (Rxo). In a hydrocarbon zone, the curve may report higher resistivity than deep (ILD) or medium (ILM) induction curves because the flushed zone contains mud filtrate and residual hydrocarbons.
Sg: Gas saturation.
SG: See *Specific gravity*.
SGR: Spectral gamma ray tool.
Shake-Out Tests: Solids production test accomplished by taking samples of the produced fluids and centrifuging to separate the solids.
Shaker: A piece of drilling equipment, usually with a vibrating screen, where drill cuttings are removed from the flowing mud.
Shale: (1) A common sedimentary rock with porosity but little matrix permeability. Shales are one of the petroleum source rocks. Shales usually consist of particles finer than sand grade (less than 0.0625 mm) and include both silt and clay grade material. (2) A very fine-grained sedimentary rock formed by the consolidation and compression of clay, silt, or mud. It has a

finely laminated or layered structure. Shale breaks easily into thin parallel layers; a thinly laminated siltstone, mudstone, or claystone. Shale is soft but sufficiently hard packed (indurated), so as not to disintegrate upon becoming wet. However, some shales absorb water and swell considerably, causing problems in well drilling. Most shales are compacted and, consequently, do not contain commercial quantities of oil and gas. (3) Rock formed from clay. (4) Gas reserves found in unusually nonporous rock, requiring special drilling and completion techniques.

Shale Control Inhibitor: Materials that slow or prevent the mechanical or chemical disaggregation of shale. These materials include inorganic salts and some organic compounds.

Shale Gas: Methane gas stored in a shale. May be in the pore space, adsorbed to the mineral or rock surfaces, or as free gas in the natural fractures.

Shale Oil: (1) Can be either an immature oil phase, often called kerogen, or actual oil in the crakes or pores of a shale. (2) The liquid obtained from the destructive distillation of oil shale. Further processing is required to convert it into products similar to petroleum oils.

Shale Shaker: (1) A vibrating screen for sifting out rock cuttings from the drilling mud. Drilling mud returning from downhole carrying rock chips in suspension flows over and through the mesh of the shale shaker, leaving small fragments of rocks, and are collected and examined by the geologist for information on the formation being drilled. (2) A solid separation piece of equipment on a drilling rig that uses vibrating screens to remove solids from the returning mud.

Shallow Gas: Natural gas deposit located near enough to the surface that a conductor or surface hole will penetrate the gas-bearing formations. Shallow gas is potentially dangerous because, if encountered while drilling, the well usually cannot be shut in to control it. Instead, the flow of gas must be diverted.

Shaped Charge: A shaped explosive charge for perforating steel pipe.

Shear Dilation: The small movement in a newly fractured formation that results from the formation unloading build in stresses.

Shearing the Pin: An impact or pressure load that shears the pin in a downhole tool and allows another tool function.

Shear Joint: A joint above a piece of equipment that is designed to fail and allow recovery of the upper string.

Shear Load: A loading at a diagonal to the structure.

Shear Modulus (G): Shear stress over angle of deformation.

Shear Pin: A pin in a tool (brass, steel, or aluminum) that is designed to shear or break at a certain pressure that enables a tool function.

Shear Ram: A ram in the BOP that shears off the pipe.

Shear Rate: The rate of shearing of a fluid during a viscosity measurement. The rate of movement between plates.

Shear Stability: The ability of a lubricant such as a grease or VI-improved oil to withstand mechanical shearing without being degraded in consistency or viscosity.

Shear Strength: The minimum shear stress that will produce permanent deformation of the fluid (gel breaking).
Shear Stress (Viscosity): The force required to move a given area of fluid. Units are newtons per sq. meter.
Shear Thinning: A fluid that when sheared, reduces viscosity.
Shear Wave: S wave.
Sheath: A jacket or armor, often around a logging cable, a gauge cable, or a pump cable.
Sheave: A grooved pulley.
Sheen: A visually apparent oil layer on water. Depending on the hydrocarbon type, sheens can develop with as little as 50–100 ppm.
Sheet Sand: A thick sand body without significant vertical or areal barriers.
Shell Storage Capacity: The design capacity of a petroleum storage tank that is always greater than or equal to the working storage capacity.
Shielded: Metallic foil or multiwire screen mesh that is used to prevent electromagnetic fields from penetrating or exiting a transmission cable.
Shifting a Sleeve: Opening or closing a sliding sleeve.
Ship's Agent: Person or firm who transacts all business in a port on behalf of shipowners or charterers. Also called shipping agent or agent.
Ship or Pay Clause: Contract clause requiring payment for the transportation of the natural gas even in case the natural gas is not transported.
Shipper: Any gas market participant that holds a contract to transport gas on a pipeline or local distribution company.
Shmax: Maximum stress direction.
Shmin: Minimum stress direction.
Shock Absorber: A mechanical dampener above a perforating gun that attenuates some of the acceleration force created by firing the gun.
Shock Load (Wastewater): The arrival at a plant of a waste that is toxic to organisms in sufficient quantity or strength to cause operating problems. Possible problems include odors and sloughing off of the growth or slime on the trickling filters media. Organic or hydraulic overloads also can cause a shock load.
Shoe (Casing): The end of the casing, usually called a guide shoe that helps insert the casing through the drilled hole.
Shoe Joint: The casing joint containing the cement float.
Shoestring Sands: Narrow strands of sandstone formation, often from stream deposits.
Shoe Test: A test of the cement seal at the shoe.
Shoe Track: The space between the casing guide shoe and the cement float collar that traps cement contaminated by the top plug displacement.
Shoot Fluid Level: Use a sonic depth measurement device to find the fluid level in a well.
Shooting Nipple: Surface equipment used for quick access to the wellbore.
Shooting the Well: Setting off charges downhole to rubblize the formation and create a stimulation.

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Shootoff (Perforating): Comparison of shaped charge performance in surface targets.
Shootoff (Pipe Recovery): Separating a pipe string with an explosive cutter.
Shore Hardness (Plastics): A plastic's hardness scale. As hardness increases, abrasion resistance tends to increase for some plastics, while impact resistance may decline.
Shore's Hardness: Elastomer rating system.
Short-Circuiting: A condition that occurs in tanks or basins when some of the water travels faster than the rest of the flowing water. This is usually undesirable since it may result in shorter contact, reaction, or settling times in comparison with the theoretical (calculated) or presumed detention times.
Short Radius: Vertical to horizontal direction change in <40 ft vertical travel (approximately 2.2°/ft).
Short String (Dual Completion): Generally, the string leading to the upper completion in a side-by-side dual completion.
Short-Term Supplies: Natural gas purchases usually involving 30-day, short-term contract or spot gas.
Short Trip: Pulling the pipe up the hole several stands and returning to bottom. May be used to check for fill or to clear cuttings out of a section of the well.
Shot Density: Number of perforations per unit length.
Shot Hole: (1) A small-diameter hole, usually drilled with a portable, truck-mounted drill, for "planting" explosive charges in seismic operations. (2) A wellbore where an explosive such as nitroglycerin has been exploded. (3) A shallow wellbore filled with explosives and shot as a seismic signal.
Shot Point: Location of initial seismic signal.
Shoulder: A surface on a downhole tool on which an upper tool or piece of equipment will stop.
Shoulder Off: Set a seal stack all the way down so the locator shoulder on the stinger contacts the packer.
Show: Cuttings or returning fluids with a hydrocarbon content above normal background level.
Shredding: A mechanical treatment process that cuts large pieces of wastes into smaller pieces so they won't plug pipes or damage equipment (comminution).
Shrimp (Testing): Mycid shrimp used for toxicity tests.
Shrinkage: The reduction in volume of wet natural gas due to the removal of natural gas liquids, hydrogen sulfide, carbon dioxide, water vapor, and other impurities from the natural gas.
Shrinkage Factor: The amount to which a reservoir barrel of oil shrinks when gases are removed at surface. Reciprocal of the formation volume factor.
Shroud: A device that directs fluids across a downhole pump motor for cooling or directs gas away from the liquid intake.
SHR (Subsea): Subsea hybrid riser.
Shunt Tube: An Alternate Path™ for gravel packing slurry that routes the flow around a wellbore bridge out during gravel packing.

Shutdown: A production hiatus during which the platform ceases to produce while essential maintenance work is undertaken.
Shut In: (1) Stop a well from flowing and close the valves. (2) To close the valves at the wellhead so that the well stops flowing or producing; also describes a well on which the valves have been closed.
Shut-In Casing Pressure: The pressure on the annulus side when the well is shut in.
Shut-In Payments: Payments made for any producible well on the Federal OCS that is temporarily closed down.
Shut-In Pressure: The pressure at a datum when the well is not flowing. The shut-in pressure is usually either surface shut-in pressure or bottom-hole shut-in pressure.
Shut-In Tubing Pressure: The pressure on the annulus when the well is shut in.
Shut-In Well: (1) A well that is producing or capable of producing but is not produced. Reasons for wells being shut in may be lack of pipeline access to market or economically unfavorable market prices. (2) A well that is capable of producing but is not presently producing. Reasons for a well being shut in may be lack of equipment, market, or other.
Shut Off: The total head at which a centrifugal pump will no longer create flow, though its impeller is still turning in the fluid.
SI: See *Shut in*.
SIBHP: Shut-in bottom-hole pressure.
SIC Code: See *Standard Industrial Classification Code*.
SICP: Shut-in casing pressure.
Side-by-Side Completion: A single borehole completion where there are distinct surface-to-zone tubing strings with isolation from each other.
Side Groups: All the carbon-based polymers you will find mentioned on this site have the structure –C–C–C–C–C–C– etc. Anything hanging off that center chain that is not a hydrogen atom is a side group.
Side Pocket Mandrel: A short, full diameter passage tubing sub with a pocket reachable from the inside where gas lift valves or chemical injection valves can be placed by wire line.
Siderite: Iron carbonate.
Side Stream: Wastewater flows that develop from other storage or treatment facilities. This wastewater may or may not need additional treatment.
Sidetrack: (1) A second (or higher) attempt to drill a wellbore after the first wellbore has been junked. This saves redrilling the top part of the hole but requires drop back to a smaller wellbore size in the sidetrack. Also can be a second wellbore. (2) A wellbore segment extending from a wellbore intersection along a wellbore path to a different wellbore bottom-hole from any previously existing wellbore bottom-holes. (3) The well activity of drilling a new wellbore segment from a wellbore intersection to a new wellbore bottom-hole or target.

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Sidetrack Drilling: A remedial operation that results in the creation of a new section of wellbore for the purpose of detouring around "junk," redrilling a lost hole, or straightening crooked holes.
Sidewall Core: A core sample removed from the open hole borehole wall by an explosive device or rotary drilled with a small tool.
SIDPP: Shut-in drill pipe pressure.
Sieve Distribution: A percent by weight distribution of the particle sizes in a sample.
Sigma Bond: A chemical bond formed by the direct "head-to-head" overlap of two atomic orbitals. I don't think I actually want to get into this, but the two bonds in a double bond are not the same; one is a sigma bond and is considerably stronger than the second one, which is a pi bond formed by the indirect overlap of two atomic orbitals…
Significant Figure: (1) The number of accurate numbers in a measurement. If the distance between two points is measured to the nearest hundredth and recorded as 238.41 ft, the measurement has five significant figures. (2) If you measure one side of a cube with a ruler marked in cm and find it is 26 cm long, then its volume should be 17,576 cm^3, right? Wrong! You have only put two meaningful digits into your calculation—the cube could be anywhere from about 25.50001 to 26.49999 cm long on a side, and if you say it has a volume of 17,576 cm^3 you are claiming accuracy that you don't really have. The correct answer is 1.8×10^4, keeping the same number of meaningful digits in the answer as you started with. The proper name for "meaningful digit" is "significant figure."
Significant Industrial User: A significant industrial user includes all categorical industrial users and any noncategorical industrial user that discharges 25,000 gallons per day or more of process wastewater ("process wastewater" excludes sanitary, noncontact cooling, and boiler blow down wastewaters) or contributes a process waste stream that makes up 5% or more of the average dry weather hydraulic or organic (BOD, TSS) capacity of a treatment plant or has a reasonable potential, in the opinion of the Control or Approval Authority, to adversely affect the POTW treatment plant (inhibition, pass-through of pollutants, sludge contamination, or endangerment of POTW workers).
Significant Noncompliance: An industrial user is in significant noncompliance if its violation meets one or more of the following criteria:

- Chronic violation of wastewater discharge limits, defined here as those in which 66% or more of all of the measurements taken during a 6-month period exceed (by any magnitude) the daily maximum limit or the average limit for the same pollutant parameter.
- Technical review criteria (TRC) violations, defined here as those in which 33% or more of all of the measurements for each pollutant parameter taken during a 6-month period equal or exceed the product of the daily maximum limit or the average limit multiplied by

the applicable TRC (TRC = 1.4 for BOD, TSS, fats, oil, and grease and 1.2 for all other pollutants except pH).
- Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the control authority determines has caused, alone or in combination with other discharges, interference or pass through (including endangering the health of POTW personnel or the general public).
- Any discharge of a pollutant that has caused imminent endangerment to human health, welfare, or to the environment or has resulted in the POTW's exercise of its emergency authority to halt or prevent such a discharge.
- Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance.
- Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules.
- Failure to accurately report noncompliance.
- Any other violation that the control authority determines will adversely affect the operation or implementation of the local pretreatment program.

Significant Wave Height: Common measure of ocean wave conditions, approximately equal to the average of the highest one-third of the waves.
Silica Flour: Very fine mesh sand used as additives and fluid loss.
Silica Gel (Drier): A desiccant for removal of water vapor from gas.
Silica Sand (Cementing): A high purity sand of specific size (0.088–0.210 mm) used in cement slurries to add weight.
Sill (Rock): Horizontal intrusion of igneous rock.
Silt: Small sediment, usually 2–74 μm (200 mesh) particles.
Silt-Stabilized Emulsion: An emulsion, usually breakable only with solvent, that is stabilized by silt accumulation at the surface of the bubbles or droplets.
Silurian: A geologic period of time between 40 and 425 million years ago.
SIMOPs: Simultaneous operations.
Simulfrac: Two or more wells simultaneously fractured to achieve benefits of pressure diversion of fracturing within the formation.
Sine Wave: A waveform corresponding to a single-frequency, periodic oscillation, which can be shown as a function of amplitude against angle and in which the value of the curve at any point is a function of the sine of that angle.
Single Anchor Leg Mooring: The configuration of a single anchor leg mooring (SALM) is highly elastic over a very wide range of water depths. This inherent elasticity enables cargo transfer operations to continue under

adverse weather and sea-state conditions. This built-in resiliency also enables the SALM to yield in the event of collision, thus minimizing impact forces and structural damage. A SALM can also be employed as an unmanned tanker loading or discharge terminal with multiple fluid transfer circuits.

Single-Pole Unit or Rig: A well servicing unit that consists of but one steel tube.

Sinker Bar: A weight stem on a wire line tool assembly.

Sink Hole: A depression in the ground at surface caused by collapse of a cave roof.

Sinusoidal: A repeating shape like a sine wave. May be applied to pipe buckling.

SIP: Shut-in pressure.

Siphon String: See *Velocity string.*

SI/TA: Shut in/temporarily abandoned.

SITHP: Shut-in tubing head pressure.

SITP: Shut-in tubing pressure.

SIU: See *Significant industrial user.*

SIWHP: Shut-in wellhead pressure.

Size Diameter Ratio: A common measurement in plastic liner pipe.

Sized Salt: A salt with a range of sized designed to achieve a low permeability filter cake.

Skid: Move a well to a close-by location with minimum rig down of equipment.

Skin: A dimensionless estimation of obstruction to flow. An undamaged well would have a skin of zero. A damaged well has a positive skin above zero and a stimulated well has a negative skin.

Skin Damage: See *Formation damage.*

Skin Frac: A fracture treatment designed to bypass skin damage.

SL: See *Slickline.*

Slack-Off Weight: The weight reading when the pipe is entering the well. Compared to the pick-up weight to estimate the friction.

Slack Wax: The waxy by-product removed in the solvent dewaxing process.

Slake: To mix with water so that a true chemical combination takes place.

Slate: Metamorphic shale rock with fractures or cleavage planes.

SLB: Schlumberger.

SLD (Wire Line): Slickline depth.

Slick Joint: A pipe section, usually on the bottom of a BHA that is a straight pipe.

Slickline: Small solid wire used for rapid, economic placement and retrieval of small equipment in a well. Comes in several sizes: 0.072, 0.082, 0.092, 0.108, 0.125 in., etc.

Slick Water: A water-base fluid with only a very small amount of a polymer added to give friction reduction benefit.

Sliding ROP: The rate of penetrating while sliding the pipe (not drilling) in a horizontal.

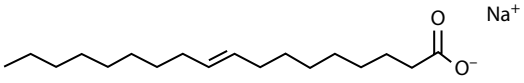
Sliding Sleeve: A downhole piece of equipment in a tubing string that allows flow from annulus to tubing. Usually opened and closed by wire line.

Sliding Time: The time spent sliding the drill pipe along the wellbore when leaving or reentering a well.
Slime Former: A type of bacteria that forms a slick surface.
Slimes: A highly viscous substance formed by microbial growth.
Slim Hole: A smaller well. Thought to be cheaper to drill but much more expensive to repair or workover and often limited on fluid flow rate potential.
S-Line: Slickline.
Slip and Cut: To remove a segment of wire line by pulling wire through the system from the reel, removing the wire that is worn or heavily used in normal operation of the wire line system.
Slip Joint: A tubular joint that allows tubing movement.
Slippage: Where two phases travel in the same direction but at different velocities.
Slip Ram: An element of the BOP that grips and holds the pipe in place.
Slips: Devices (usually containing steel teeth) that hold the pipe. Capable of suspending heavy pipe string loads.
Slip Stop (Wire Line): A wire line set plug with slips and seals much like a small packer.
SLM: Slick line measurement.
Slop Oil: A term designating the small amounts of oil lost in various refining operations that are collected and used as charge stocks.
Slotted Liner: A casing joint with regular pattern slots of a specific phasing, width, and length. Used as a simple sand control method.
Sloughing: The periodic loss of biofilm that occurs in trickling filters and rotating biological contactors. Sloughing occurs when biofilm is sheared from the trickling filter or RBC media.
Sloughing (Shale): Movement of large amounts of shale material into the wellbore, usually caused by chemical reaction or earth shift forces. Typically as clumps of particles.
Sloughing Shale: A shale, usually in the wellbore, that increases size (swells) or casts of particles by reacting with brine or water.
Slow Taper: A shallow bevel or angle that is not steep.
Sludge: (1) A very viscous, usually solids, stabilized emulsion. Often triggered by ferric iron and an asphaltenic oil after an acid job. (2) The soft deposits, usually dark colored, formed in lubrication systems, mainly consisting of oxidized lubricating oil components, water, and in internal combustion engines; carbonaceous residues from fuel combustion. (3) The residue left after treatment in the refinery of petroleum oils to remove impurities. Also an insoluble degradation product of crankcase oils. (4) The settleable solids separated from liquids during processing or the deposits of foreign materials on the bottoms of streams or other bodies of water.
Sludge Digestion: The process of changing organic matter in sludge into a gas or a liquid or a more stable solid form. These changes take place as microorganisms feed on sludge in anaerobic (more common) or aerobic digesters.

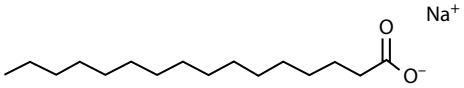
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Sludge Gasification: A process in which soluble and particulate organic matter are converted into gas by anaerobic decomposition. The resulting gas bubbles can become attached to the settled sludge and cause large clumps of sludge to rise and float on the water surface.
Sludge Volume Index: This is a calculation used to indicate the tendency of activated sludge solids (aerated solids) in the secondary clarifier to thicken or to become concentrated during the sedimentation/thickening process. To determine SVI, allow a mixed liquor sample from the aeration basin to settle for 30 min. Also determine the suspended solids concentration for a sample of the same mixed liquor. Calculate SVI by dividing the measured (or observed) wet volume (mL/L) of the settled sludge by the dry weight concentration of MLSS in g/L. When mixed liquor has an SVI well above 100 mL/g of solids, it tends to form a thin slurry or billowing sludge blanket or to form bulky sludge.
Sluff: Sloughing particles into the well.
Slug: (1) A volume of gas or liquids that moves through the well and the production facility. A well that flows alternating volumes of water and gas is slugging. (2) Intermittent releases or discharges of wastewater.
Slugcatcher: (1) Gas–liquid separator installed in the reception of sour natural gas. Its purpose is to remove fluid that has condensed during transport from the reservoir facilities. (2) Plant installed in a gas pipeline system to catch unwanted "slugs" of liquid.
Slug (Drilling): A volume of heavier or more viscous mud that is routed through the circulation system to assist in cleaning, fluid loss, etc.
Slug Flow: Flow of distinct volumes of gas and liquid, often signaling unstable behavior.
Slurry: A mixture of a liquid and solids.
Slurry Packing: Gravel packing with a gel.
Sm^3: Standard cubic meter.
Smart Pig: A pigging device that incorporates instrumentation to measure properties of the pipe (corrosion, wear, etc.).
Smectite: A clay that exhibits water swelling and fines dissociation problems when it occurs in authogenic form and is reactive with the flowing fluid. Smectite clays such as bentonite generate viscosity by forming a colloid suspension in water.
Smoke Point: The maximum height of flame measured in millimeters at which a kerosene will burn without smoking, when tested under specified conditions.
Smoke Test: A method of blowing smoke into a closed-off section of a sewer system to locate sources of surface inflow.
SNAP™: Nodal analysis program.
Snell's Law (Seismic): An expression to predict change of direction of a wave crossing the boundary between two isotropic (no variation in properties with direction) media.
SNG: See *Synthetic natural gas*.

SNS: Southern North Sea.
Snubbing Basket: The snubbing unit control location.
Snubbing Job: A job where the well is worked over without killing the well. Usually accomplished by multiple barriers that seal on the tubulars.
Snubbing (Pipe Running): Forcing pipe into a well against the effects of wellhead pressure.
Snubbing Stack: A set of pipe seal and blind rams used in the snubbing operation.
So: Oil saturation.
SO_2: See *Sulfur dioxide*.
Soak: Allowing a solvent to be in contact with a deposit for a period of time.
Soap: (1) A general term for the salt of a metal and a fatty acid. The soaps of lithium, calcium, barium, and aluminum are the principle thickeners used in grease making. (2) A soap is a type of surfactant that is derived from the saponification reaction (hydrolysis) of a vegetable oil. A soap has a carboxylate group on the end that can form a complex with calcium ions in hard water. (This causes soaps to form precipitates giving rise to "soap scum.") Soaps are often called fatty acid salts. Common soaps are as follows:

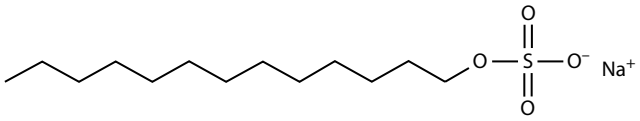


Sodium oleate (from olive oil)



Sodium palmitate (from palm oil)

Soap Stick: A foamer for removing water from a gas well, placed in the form of a solid stick.
SOC: Screen-only completion.
Soda Ash: Sodium carbonate.
Sodium Bicarbonate: Used for treating cement contamination and calcium contamination in muds.
Sodium Dodecyl Sulfate: Sodium dodecyl sulfate is one of the most common surfactants. It can also be called sodium lauryl sulfate, depending on whether it is made from petrochemicals (dodecyl) or plants (lauryl). But they are the same molecule:



Sodium dodecyl sulfate

Sodium Silicate: Water glass, used in sealing permeability channels.
Softening Point: The temperature at which bitumen reaches an arbitrary degree of softness, usually determined by the ring and ball test method.
Softening Point (Ring and Ball): The temperature at which a disk of the material, contained in a ring, undergoes a standard deformation caused by the weight of a ball under standardized test conditions.
Software Programs: Computer programs; the list of instructions that tell a computer how to perform a given task or tasks. Some software programs are designed and written to monitor and control municipal water and wastewater treatment processes.
Soft Water: Water with low calcium and magnesium content.
Soft Yoke Mooring and Offloading: Combines a solid structural mooring with a hard-piped/swivels fluid transfer system. It can be connected and operated in much higher sea states than other LNG offloading systems. The SYMO can be used in a variety of LNG transfer applications:

- The SYMO is used to moor an LNG carrier in tandem to the stern of an Floating LNG production system (FLNG) offshore or at the stern of an FSRU near shore.
- The SYMO is used to moor temporarily an LNG carrier to an import terminal in shallow water. LNG is either transferred to shore via a cryogenic pipeline or alternatively regasification takes place on the terminal, allowing high-pressure gas to be exported.

Soil Mechanics: The rock mechanics related study of unconsolidated and poorly consolidated sands.
Solenoid Valve: Valve that is closed by gravity, pressure, or spring action and opened by the magnetic action of an electrically energized coil, or vice versa.
Solid Body Centralizer: A centralizer with a rigid, solid body with straight or curved veins that hold the pipe off the wall and allow flow. Used in deviated wells and with heavy pipe strings.
Solids (Colloidal): Fine solid particles intermediate between suspended and dissolved solids, or the difference between the total suspended solids and the settleable solids.
Solids Concentration: The solids in the aeration tank that carry microorganisms that feed on wastewater.
Solids (Dissolved): Technically an incorrect term since all the solids are not in true solution. The, as used, is all the solids that pass through the filter mat in a Gooch crucible.
Solids (Inorganic): Solids that are inert and not subject to decay.
Solids (Organic): Solids, generally originating from animals and plants, that contain carbon, hydrogen, oxygen, and other nutrients and are combustible during the volatile solids test.

Solids Retention Time: An expression of the average time that a microorganism will spend in the activated sludge process.
Solids (S): Material not in liquid or gaseous form.
Solids (Settleable): Solids of sufficient size and weight to settle in 1 h in an Imhoff cone.
Solids (Total): All the solids in the wastewater.
Solids (Volatile): Burnable, a measure of organic content.
Solid Waste: Any solid or semisolid material intended for disposal.
Soluble BOD: Soluble BOD is the BOD of water that has been filtered in the standard suspended solids test.
Solution Gas: (1) Natural gas that is found with crude oil in underground reservoirs. When the oil comes to the surface, the gas expands and comes out of the solution. (2) The natural gas that is dissolved in a crude oil.
Solution Gas Drive: A drive mechanism where a drop in pressure releases gas from the oil that helps drive the oil toward the wellbore. It is a poor recovery mechanism.
Solution GOR: The solution GOR of the oil as it resides in the reservoir.
Solvent: A substance that will dissolve a solid. In the oil field, oil-based solvents may range from xylene for asphaltenes and sludges to kerosene and diesel/xylene mixtures for paraffins.
Solvent Dewaxing: A refining process by means of which wax is removed from the lubricating base oil. The waxy oil is mixed with a solvent mixture (usually methyl ethyl ketone and toluene) and heated to ensure complete solution. The mixture is chilled and the precipitated wax removed by a rotary filter, before the solvents are stripped from both oil and wax fractions and reused.
Solvent Refined: Term for lubricating oils that have been solvent treated during the refining process. Most motor, airplane, diesel engine, and steam turbine oils and other high-quality oils are solvent refined.
Solvent Refining: (1) A refining technique to improve the quality of base oils using selective extraction of undesirable components by means of a solvent, usually furfural. (2) The process of mixing a petroleum stock with a selected solvent, which preferentially dissolves undesired constituents, separating the resulting two layers and recovering the solvent from the raffinate (the purified fraction) and from the extract by distillation.
Sonalog: A commercial tool that measures the fluid depth in a well by use of a reflecting sound wave.
Sonde: A term usually referring to a logging instrument.
Sonic Amplitude Log: A log that measures the sonic amplitude of a formation to a sound wave. The log is used to locate fractures.
Sonic Caliper: A wellbore caliper, useful in larger wellbores and washouts that uses sound through thin liquids to map the wellbore.
Sonic Log: A sonic log measures the interval travel time (delta *t*) of compression sound waves moving through one foot of a formation (ms/ft). If matrix velocity is known, porosity can be calculated since sound waves travel slower

in porous media (travel slower in less dense materials such as fluids). Sonic logs are used for porosity determination, pressure determination in shale, as a correlation log, and as a gas detector.
SOP: Standard operating procedures.
SOR: Statement of requirements.
Sorption: The processes of absorption and adsorption.
Sorting: A relative comparison of the formation to determine if there is a large difference between the size of the largest articles and the size of the smallest particles.
SOS: Shear out sub.
Sound Blanket: A sound blanket or a wall sometimes erected in order to reduce the noise emitted from a drilling rig.
Sour: (1) Crude oils containing a large amount of sulfur and sulfur compounds, which break down in refining to liberate troublesome quantities of corrosive sulfur compounds. (2) Gasoline, naphthas, and other refined oils containing hydrogen sulfide or other sulfur compounds. (3) H_2S containing.
Source Potential: Ability of a source rock to yield hydrocarbons to a reservoir rock.
Source Rock: (1) The rock in which hydrocarbons form. (2) Is a layer of rock containing organic material that naturally transforms into petroleum. (3) Generally fine grain rocks such as shales or carbonates that can yield hydrocarbons.
Sour Crude: (1) Crude oil with a high sulfur content. (2) Oil containing a degree of sulfur as hydrogen sulfide and other sulfur compounds. Has a pungent smell and sulfur content is controlled before fractionation of crude oil. (3) Crude oil that contains more than 1% total sulfur content. Typically applied as a label to oils with sour smell.
Sour Gas: (1) Gas rich in hydrogen sulfide, H_2S. (2) Natural gas that contains significant amounts of hydrogen sulfide (usually greater than 16 ppm) and possibly other objectionable sulfur compounds (mercaptans, carbonyl sulfide). Also called "acid gas." (3) Natural or associated gas with a high sulfur content. (4) Natural gas containing chemical impurities, a notable hydrogen sulfide (H_2S) or other sulfur compounds that make it extremely harmful to breathe even small amounts; a gas with disagreeable odor resembling that of rotten eggs. (5) Natural gas at the wellhead may contain hydrogen sulfide (H_2S), a toxic compound. Natural gas that contains more than 1% of H_2S is called sour gas. About 30% of Canada's total natural gas production is sour, most of it found in Alberta and northeast British Columbia. (6) Gas containing an appreciable quantity of hydrogen sulfide. (7) A gas containing sulfur-bearing compounds such as hydrogen sulfide and mercaptans and usually corrosive. (8) Raw natural gas to be processed, that is, gas received at the liquefaction plant before being subjected to any pretreatment.

Sour Service: Defined in NACE MR-0175/ISO 15156 as exposure to oilfield environments that contain H_2S and can cause cracking of materials by the mechanisms addressed by NACE MR-0175/ISO 15156.
Sour Service Rating: A classification of materials that predicts satisfactory performance in hydrogen sulfide.
SOV: Screened orifice valve.
SOx: Sulfur oxides.
SP: See *Spontaneous potential log.*
SPA: See *Sales and purchase agreement*.
SPA (BP): Single point of accountability.
Space Domain (Seismic): A function where distance is the independent variable and another factor (magnetic, density, amplitude) is the dependent variable.
Space Out: Using short pieces of pipe to property position the top of the string to hang off while keeping the bottom of the string in the correct position and with the correct tension.
Space Out Joint (Drilling): The joint of drill pipe used to prevent a tool joint from being in the BOP body (across a ram face).
Spacer (Pumping): A fluid used between two fluids to prevent contamination.
Spacing: (1) The distance between wells producing in the same reservoir. The spacing is actually the area they drain (e.g., 320, 160, or 40 acres). (2) The distance between wells allowed by a regulatory body. Spacing is based on what is deemed to be the amount of acreage that can be efficiently and economically drained by a well.
Spaghetti String: Very small pipe.
Spalling: The chipping, fragmentation, separation, or disbonding of a surface in response to pressure and mechanical or chemical influence.
Spang Jar: A mechanical jar, used commonly on wire line.
Spar: (1) A deep draft cylindrical and vertical floating production unit (single column) with possible storage for crude oil in small quantities inside the column. This facility, although not heave restrained, can accommodate surface completed wellheads. (2) Enables offshore loading with vessel swinging to present least resistance to prevailing wind or current conditions.
Sparge: Using a jet of air or water to stir the contents of a tank.
SPCC: Spill prevention control and countermeasures.
SPDES: See *State pollutant discharge elimination system*.
SPE: Society of Petroleum Engineers.
Spear: A fishing tool that is designed to enter an opening of a fish and grip the ID.
Special Naphthas: All finished products within the naphtha boiling range that are used as paint thinners, cleaners, or solvents. These products are refined to a specified flash point. Special naphthas include all commercial hexane and cleaning solvents conforming to ASTM Specification D1836 and D484, respectively. Naphthas to be blended or marketed as motor gasoline or

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مجری : هم اندیشان انرژی کیمیا

محل برگزاری: تهران، مرکز همایشهای صداوسیما

برخی از محورهای همایش

با توجه به تخصصی بودن همایش، هر آنچه که به عنوان همایش مرتبط میشود را میتوان از محورهای آن دانست. مواردی همچون:

- مهندسی مخازن هیدروکربوری و حفاری
- بهینه سازی فرآیندهای صنایع شمیایی، پالایشی، پتروشیمی و ...
- انرژی و محیط زیست
- پالایش آب، پساب، پسماند و هوا
- ضایعات و استفاده مجدد (بازیافت)
- طراحی / ساخت / انتقال / نصب و بهره برداری از تجهیزات
- مدلینگ و شبیه سازی به کمک نرم افزار
- مانیتورینگ و کنترل پدیده ها
- رسوب، ساییدگی، زنگ زدگی و خوردگی
- بکارگیری فناوریهای نوین و نانوفناوری
- سنتیک، ترمودینامیک و پدیده های انتقال جرم و حرارت
- اقتصاد و سیاست مهندسی
- ایمنی، بازرسی، بهداشت، تعمیرونگهداری
- پایش و جلوگیری از خوردگی، ساییدگی و رسوبگذاری
- بومی سازی و ارتقای دانش
- نانوتکنولوژی و فناوریهای نوین
- و ...

Process
Mechanic
OIL & GAS
Methalorgy
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Chemistry
Petrochemy
Refining

برخی از علوم و صنایع مخاطب:

مهندسی شیمی، مکانیک، نفت موادومتالوژی

انرژی، معدن و ...

به تمامی شرکت کنندگان در همایش چهار گواهی زیر اعطا میگردد

- گواهی پذیرش مقاله (در صورت داشتن مقاله پذیرش شده) توسط دبیرخانه همایش
- گواهی طی دوره توسط موسسه بین المللی IQS انگلستان
- گواهی طی دوره توسط موسسه بین المللی DNW اتریش

نکات مهم:

۱ – اشتراک رایگان سه نشریه: نفت و انرژی، چیلر و برج خنک کن، مبدل گرمایی ویژه شرکت کنندگان در همایش

۲ – چاپ قطعی ده مقاله برتر همایش در نشریات ردیف بالا

۳ – انتشار مقالات در وب سایت همایش، سیویلیکا؛ ایران داک، وب سایت همایش و ...

٤ – انتشار مقالات در برخی از نشریه علمی مصوب همچون فرآیندهای گاز (دانشگاه اصفهان) پس از داوری مجدد توسط نشریه

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برای دریافت اطلاعات همایش بر روی تلفن همراه خود، عدد ۳۰۰ را به شماره ۳۰۰۰۰٤۷۰٤۷۰٤۷۰۰ پیامک نمایید.

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aviation gasoline or those that are to be used as petrochemical and synthetic natural gas (SNG) feedstocks are excluded.

Specialty Chemical: A chemical made in a relatively small quantity for a particular application.

Specific Gravity: (1) A measure of the density of a material usually obtained by comparing it with water. (2) The ratio of the density of a substance to the density of a reference substance, both at specified physical conditions. As applied to gas, air is the reference substance and the physical conditions are a specified temperature and atmospheric pressure. (3) The ratio of the density of a substance to the density of a comparison material, usually at a specific temperature and pressure. (4) The ratio of the weight of a given volume of a substance to the weight of an equal volume of water.

Specific Heat: (1) The amount of heat required to raise 1 kg of a substance 1° in temperature. (2) The heat required to raise one unit mass of a substance by 1°.

Specific Weight: The weight of a volume per unit of volume.

Spectral Gamma Ray: A gamma ray tool capable of spotting the different isotopes used in tracers.

Spectral Gamma Ray Image: Gamma ray tool that splits the spectral range into three parts: uranium, potassium, and thorium.

Spf (Perforating): Shots per foot.

Spherical Tanks: Can withstand higher pressures per square inch; they are used for storage of isobutane and normal butane.

Spider: A round device that holds the slips when supporting a string of drill pipe on a rig.

Spill Point (Reservoir): In a trap, the low point under which hydrocarbons will escape when the trap is full.

Spills: Spills include accidental release of crude oil, produced water, or other hydrocarbon products from well sites, batteries, or storage tanks. These spills can affect land, vegetation, water bodies, and groundwater.

Spindle Oil: A low-viscosity oil intended for the lubrication of high-speed spindles such as those used in textile mills.

Spinner Log: A production log that uses a propeller-like spinner to measure changes in fluid velocity in sections of the well.

Spinning Chain: A chain moved by a counterweight or winch to assist in making up drill pipe joints.

Spiral-Grooved Drill Collar: A drill collar with spiraled grooves down its length to improve circulation of fluids in close clearance well bores.

Spiralizer™: A brand name of a spiral shaped solid body centralizer for casing and screens.

Spiral-Wound Heat Exchanger or Coil-Wound Heat Exchanger: Heat exchanger with a shell containing therein several spiral pipe bundles. Fluids flow inside the pipe bundles and through the section between pipe bundles and the shell.

Split Estate: When mineral rights and surface rights are owned by separate entities.

Split Shot™: A linear explosive cutter that is designed to cut linearly through the pin and box connection during pipe recovery.
Split Skirt (Milling Tool): A slot in a mill or other tool to assist with alignment, cleaning, or entry.
Split System: Air conditioning system with remote condenser or remote condensing unit.
SPM: Single-point mooring system (e.g., CALM).
SPM (Drilling): Strokes per minute. A count of pump strokes times pump volume times plunger # times pump efficiency estimates volume pumped.
Spm (Perforating): Shots per meter.
SPOC: Single point of contact.
Spontaneous Potential Log: One of the oldest and simplest logs. Measures voltage between formations and the fluid in the wellbore. Potential differences arise due to the differences between salinity of the formation and the wellbore fluids. SP is used for qualitative permeability, reservoir quality evaluation, Rw calculations, and zone shaliness estimation.
Spot Gas: Natural gas that is purchased on a short-term basis and is furnished to customers on an as available basis.
Spot Gas Market: Short-term buying and selling of natural gas.
Spot Market: (1) The trading in crude oil and petroleum products that occurs in international commerce, setting the prices that are widely published. Most crude moves from producer to refiner under long-term contracts, so only a small fraction of the world's petroleum is priced and traded on the spot market. (2) A market for short-term transactions of specific volumes of product without a long-term commitment.
Spotting Fluid: Placing fluid at a specific place in the wellbore.
Spot Voyage: A charter for a particular vessel to move a single cargo between specified loading port(s) and discharge port(s) in the immediate future.
SPR: See *Strategic petroleum reserve*.
Spread Cost: The total cost for a rig, crews, and all equipment that goes with operation of the rig for that job.
Spread Mooring: In the case of a spread-moored FPSO/FSO, the tanker or process barge is moored in a fixed heading with up to 12 anchor lines distributed over the bow and stern of the vessel, to anchor points situated on the seabed around the vessel. The chosen heading is determined by the prevailing sea and weather conditions. The spread-moored FPSO/FSO can only be used on locations where currents, waves, and winds are very moderate or normally come from a prevailing direction. With this type of FPSO/FSO, no turret or swivel stack is required, as the vessel does not change heading in relation to the risers connecting the tanker with the wells on the seabed. This means that a greater flexibility exists in the number of risers from the wells and manifolds on the seabed that can be connected onto the FPSO/FSO than would be the case with a turret-moored vessel. One disadvantage is however that for spread-moored FPSOs/FSOs, a separate tanker loading

facility should be provided, as the offtaking tanker cannot safely moor in tandem to the FPSO/FSO, due to changing current, wind and wave direction, possible interference with the FPSO's/FSO's anchor lines, and high risk of collision.

S Profile: A standard profile. Can accept a plug or other tools.

Spud: (1) To start the actual drilling of a well. (2) The commencement of drilling operations. (3) To begin drilling.

Spud Date: The date that drilling operations commenced and were reported to the governing regulatory body.

Spud-In: The operation of drilling the first part of a new well.

Spud Mud: Mud used to drill from the surface to a depth where a more technical mud is needed.

Spurt Loss: The initial loss of fluids from a mud or frac fluid, before the walk cake can be formed.

SPWLA: Society of Petrophysicists and Well Log Analysts.

Squeeze Cementing: A cementing repair technique involving injecting cementing under pressure to fill channels in the primary cementing treatment.

Squeeze Packer: A millable retainer for squeeze cementing.

Squeeze Treating or Job: A designed technique where a treatment is squeezed into a specific zone.

Squeezing a Well: A technique to seal off with cement a section of the wellbore where a leak or incursion of water or gas occurs; forcing to the bottom of the casing and up the annular space between the casing and the wall of the borehole to seal off a formation or plug a leak in the casing; a squeeze job.

SRB: Sulfate-reducing bacteria.

SRBC: Susquehanna River Basin Commission.

SRD: Short radius drilling.

S-Riser: S-shaped flow line off wing valve.

$SrSO_4$: Strontium sulfate.

SRT: Spill response team.

SS: Subsea.

SS: Sliding sleeve.

SS: See *Suspended solids*.

SSC: See *Stress sulfide cracking*.

SSD: Subsea disconnect used during drilling a subsea well in case the floating rig moves to an extreme that begins to threaten the shear resistance of the riser or the drill string.

SSE: See Safe shutdown earthquake.

S-Shaped Well: A well path that starts vertical, then is deviated to reach a target before being turned near vertical again to drop through the pay zone.

SSIV: *Subsurface (or subsea) isolation valve*.

SSP: Static spontaneous potential.

SSSV: See *Subsurface safety valve*.

SSTT: Subsea test tree.
SSV: Surface safety valve (subsurface safety valve is SSSV).
ST: Sidetracked.
ST: See *Ton, short*.
ST&C: Short thread and coupled, a connection description.
Stab: Insert the seal stack or stinger into the polished bore receptacle.
Stabilization: (1) A process for separating the gaseous and more volatile liquid hydrocarbons from crude petroleum or gasoline and leaving a stable (less volatile) liquid so that it can be handled or stored with less change in composition. (2) Processes that convert organic materials to a form that resists change. Organic material is stabilized by bacteria that convert the material to gases and other relatively inert substances. Stabilized organic material generally will not give off obnoxious odors.
Stabilized Waste: A waste that has been treated or decomposed to the extent that if discharged or released, its rate and state of decomposition would be such that the waste would not cause a nuisance or odors.
Stabilizers (Drilling): Near gauge diameter joints that stabilize the drilling BHA.
Stack: Portion of the exhaust system downstream of the draft diverter, draft hood, or barometric draft regulator.
Stack (Seismic): A composite of traces from different seismic records.
Staged Cementing: Sequenced cement jobs that are placed through different entry points into the annulus. Undertaken to place a higher cement column in the annulus when the fracturing gradient of the exposed formations will not tolerate a full column of cement.
Stage Tool (Cementing): An alternate path device that allows access into the annulus when shifted. Used in two-stage cementing operations to pump the upper job.
Stakeholders: Industry activities often affect surrounding areas and populations. People with an interest in these activities are considered stakeholders. They may include nearby landowners, municipalities, Aboriginal communities, recreational land users, other industries, environmental groups, governments, and regulators.
Stall (Fluid Powered Motors): A condition in which the motor stops rotating when more force is required to rotate the shaft than the motor can produce.
Stand: See *Stand of pipe*.
Standard Agreements: State-of-the-art solutions for oil and gas industry agreements and recommended for use by all UKCS licensees. They are user-friendly and easy to implement. In helping to simplify operational and transactional procedures, they focus resources and save costs.
Standard Blue Barrel: bbl—the measurement of a barrel (42 gal) of oil originated by Standard Oil Company (their "standard" barrel was painted blue).
Standard Contracts: Known formerly as CRINE contracts, standard contracts have been developed by the Standard Contracts Committee and are

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issued by LOGIC for use within the industry between clients and their contractors, simplifying procedures, and saving costs.

Standard Industrial Classification Code: A code number system used to identify various types of industries. In 1997, the United States and Canada replaced the SIC code system with the North American Industry Classification System (NAICS); Mexico adopted the NAICS in 1998.

Standardized Measure of Discounted Future Net Cash Flows: Present value of proved reserves, as adjusted to give effect to (1) estimated future abandonment costs, net of the estimated salvage value of related equipment, and (2) estimated future income taxes.

Standard Metering: Base standard conditions, plus agreed corrections, to which all natural gas volumes are corrected for purposes of comparison and payment.

Stand-by Time: The cost of a piece of equipment or a crew to wait when a job is postpone.

Standing Valve: The fixed position valve at the bottom of a beam lift pump.

Standoff: (1) The clearance from casing to the tool face. (2) The distance from the tool to the wall of the hole.

Stand of Pipe: The number of joints of pipe that can be pulled and stood back at one time by the rig, for example, doubles or triples.

Stand Pipe: (1) A vertical pipe on the derrick used for routing injected fluid flow. (2) The pipe in the derrick that delivers mud to the kelly hose.

Starch: Starch is the main source of food energy for most of the world's human population. It can be considered to be a condensation polymer of glucose, like cellulose, although the ether linkages in starch are different to those in cellulose. Starch may be highly branched (amylopectin) or relatively unbranched (amylose).

Stasis: Stagnation or inactivity of the life processes within organisms.

State Pollutant Discharge Elimination System: The system established pursuant to Article 17 of the Environmental Conservation Law and 6 NYCRR Part 750 for issuance of permits authorizing discharges to the waters of the state.

Static Bottom-Hole Pressure: (1) The bottom-hole pressure when the well has been shut in and the well stabilized. (2) May also be called shut-in bottom-hole pressure.

Static Fluid Level: The depth below the surface to where the reservoir fluids will rise by pore pressure.

Static Pressure: (1) Pressure exerted by a fluid at rest. (2) The pressure when the well is not flowing. Can be surface static pressure or bottom-hole static pressure.

Static Seal: Seal where no motion is present.

Stationary Block (Drilling): The crown block on a drilling rig.

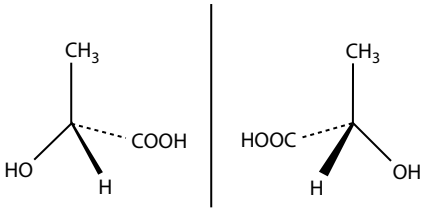
Stationary Slips: The nonmoving slips in a snubbing stack.

Stator: The stationary part of an electric generator or motor.

Stator (PDM motor): The stationary rubber element of a PDM motor.

STB: Stock tank barrel.
Steam-Assisted Gravity Drainage: A recovery technique for extraction of heavy oil or bitumen that involves drilling a pair of horizontal wells one above the other; one well is used for steam injection and the other for production.
Steam Boiler: Enclosed vessel in which water is converted into steam.
Steam Flood: A tertiary oil recovery method involving injection of steam into the reservoir to reduce the oil viscosity.
Steam Injection: An improved recovery technique in which steam is injected into a reservoir to reduce the viscosity of the crude oil.
Steam (Purchased): Steam, purchased for use by a refinery, that was not generated from within the refinery complex.
Steam Trap: Device for allowing the passage of condensate and preventing the passage of steam or for allowing the passage of air as well as condensate.
Steel Catenary Riser: A steel pipe hung in a catenary configuration from a floating vessel in deep water to transmit flow to or from the sea floor.
Steerable Motor (Drilling): A downhole drilling motor with a bent housing that can turn a well's direction in addition to turning the bit.
Stem (Wire Line): A weight bar.
Step Change in Safety: The UK-based partnership with the remit to make the United Kingdom the safest oil and gas exploration and production province in the world. It was founded in 1997 by the oil and gas industry trade associations with the aim of reducing the United Kingdom offshore oil and gas industry injury rate by 50%.
Step Controller: Multiple-switch assembly in which a moving element trips multiple output steps successively.
Step-Feed Aeration: Step-feed aeration is a modification of the conventional activated sludge process. In step-feed aeration, primary effluent enters the aeration tank at several points along the length of the tank, rather than all of the primary effluent entering at the beginning or head end of the tank and flowing through the entire tank.
Step-Out Well: A well beyond the current boundaries of a known field.
Step Rate Breakdown Test: An injection test, plotted pressure against injection rate, where a curve deflection and change of slope indicates the fracture breakdown pressure.
STEP System: See *Septic tank effluent pump system*.
Stereochemical: The geometry of molecules, and the arrangement of their constituent atoms in space, is the subject matter of stereochemistry. What does that actually mean? In the nomenclature section, you would have encountered isomers with the same chemical formula but with the atoms arranged in a different order—such as the various forms of pentane. You would also have seen cis and trans isomers of alkenes—these are compounds with the atoms in the *same* order but with a *different* geometry and are simple examples of stereoisomers. A good general rule to follow is that any compound with a carbon center bearing four different

substituents can exist in different stereoisomers, such a carbon is called a *chiral* center. The original (and still one of the best) examples of stereoisomerism are the two forms of tartaric acid, discovered by Louis Pasteur. It can be hard to see from a picture, so if you can, you should try to make models of the two species as shown and you will discover that they are not the same at all:



Steric: Any effect that is caused simply by a chemical group physically getting in the way, rather than by any particular properties of that group, is called a steric effect. A good definition to keep in mind (Organic *Chemistry*, John McMurry, 1988) is that steric strain is the result of trying to force two objects to occupy the same space. Here is an interesting example of a steric effect.

Sterilization: The removal or destruction of all microorganisms, including pathogenic and other bacteria, vegetative forms, and spores. Compare with "disinfection."

STG (Subsea): Seal test gauge.

Stick Plot: Dip meter results.

Still Gas (Refinery Gas): Any form or mixture of gases produced in refineries by distillation, cracking, reforming, and other processes. The principal constituents are methane, ethane, ethylene, normal butane, butylene, propane, propylene, etc. Still gas is used as a refinery fuel and a petrochemical feedstock. The conversion factor is 6 million BTUs per fuel oil equivalent barrel.

Stimplan™: A fracturing design simulator from NSI, Inc.

Stimulation: Any effort to increase production from a well by the improvement of natural or damaged flowing capability.

Stinger (Well Control): A hollow, tapered rod hooked to the boom of an oil fire-fighting crane. Mud can be pumped through the stinger once it has been stabbed into the remains of a wellhead.

Stinger (Well Tubular): A short prong that slides into a tool. Often a seal assembly.

STL: Submerged turret loading.

Stm³: Stock tank cubic meter.

STO: Stock tank oil.

Stock Change: The difference between stocks at the beginning of the reporting period and stocks at the end of the reporting period. *Note*: A negative

number indicates a decrease (i.e., a drawdown) in stocks and a positive number indicates an increase (i.e., a buildup) in stocks during the reporting period.

Stock Tank Barrel: One barrel of stabilized or dead oil at the surface after the gas has escaped.

Stock Tank Conditions: Atmospheric pressure of 14.696 psi and temperature of 60°F (16°C).

Stoichiometric, stoichiometrically: To paraphrase the IUPAC definition, stoichiometry is the relationship between the amounts of reactants reacted and the amounts of products produced. An equation that says that "Two moles of X reacts with one mole of Y to make three moles of Z" is a stoichiometric equation.

STOOIP: Stock tank oil originally in place.

Stopcocking: Temporarily shut in and reopen well. Shut-in forces free gas into solution and some liquid back into the formation. Opening the well allows gas to breakout of liquids and the formation and lift liquids.

Storage: A means of maintaining a reserve of natural gas supplies to meet seasonal demands.

Storage Additions: Volumes of gas injected or otherwise added to underground natural gas reservoirs or liquefied natural gas storage.

Storage Facilities: Facilities used for storing natural gas. These facilities are generally found as gaseous storage facilities and liquefied natural gas (LNG) storage facilities.

Storage Withdrawals: Total volume of gas withdrawn from underground storage or from liquefied natural gas storage over a specified amount of time.

Storm Choke: A flow controlled shut-in device to control flow in the event of loss of surface well control. Must be reset periodically. Replaced by ScSSVs.

Storm Collection System: A system of gutters, catch basins, yard drains, culverts, and pipes for the purpose of conducting storm waters from an area but intended to exclude domestic and industrial wastes.

Storm Runoff: The amount of runoff that reaches the point of measurement within a relatively short period of time after the occurrence of a storm or other form of precipitation. Also called "direct runoff."

Storm Sewer: A separate pipe, conduit, or open channel (sewer) that carries runoff from storms, surface drainage, and street wash, but does not include domestic and industrial wastes. Storm sewers are often the recipients of hazardous or toxic substances due to the illegal dumping of hazardous wastes or spills created by accidents involving vehicles and trains transporting these substances. Also see *Sanitary sewer*.

Stormwater Management Program: Development of a stormwater management program plan summarizing and documenting all aspects of the MS4 program and providing a runoff history of all progress and compliance efforts is a requirement of the MS4 permit.

S

Stormwater Pollution Prevention Plan: A set of documents that describes the scope of a proposed construction or development project, bodies of water and natural resources to be protected, and erosion and sediment control and stormwater practices that will be utilized to protect the resources during the project. Consists of narrative, maps, construction drawings, and permit documents.
STP: Submerged turret production.
STP: Standard temperature and pressure.
Straddle: A downhole device that isolates a zone, a wellbore, or a piece of equipment.
Straddle Packer: A twin sealing element device with a perforated nipple in between. It is used to selectively inject fluids into a part of the zone.
Straddle Plant: A natural gas processing plant constructed near a transmission pipeline downstream from the fields where the natural gas in the pipeline has been produced.
Straight Hole: An essentially straight hole with less than 5° total deviation from surface to bottom-hole and dogleg severity less than 3°/100 ft.
Straight Mineral Oils: Oils that do not contain compounds or additives.
Straight-Run: Fractions derived from the straight distillation of crude oil and containing no cracked material. Also called virgin stock.
Straight-Run Distillation: Continuous distillation of petroleum oils that separates the products in the order of their boiling points without cracking.
Strain: e = delta L/L.
Strain Gauge: An electronic "Wheatstone-type bridge" element that may form the measurement basis for a load cell or other strain measurement application. The device measures changes in electrical resistance produced by changes in load.
Stranded Gas: (1) Gas that is not near a market and that does not have an economic basis for development and production. (2) Gas field located in an area where there are no transportation services or markets within any economically reasonable distance. See *Remote gas*.
Stranded Utility: A stranded local utility system is typically very small and too far from the pipeline grid to be economically connected.
Strap: Measures the fluid level in a storage tank.
Strategic Petroleum Reserve: Petroleum stocks maintained by the Federal Government for use during periods of major supply interruption.
Stratification (Logging): The sequence of unlike formations penetrated by the borehole.
Stratified Flow: A flow regime in a highly deviated or horizontal well where the fluids are segregated by density.
Stratigraphic Test: A test well drilled to obtain information on the thickness, lithology, porosity, and permeability of the rock layers drilled through or to locate a key bed. Such wells are often drilled to evaluate a potentially productive pay zone.

Stratigraphic Trap: (1) A type of reservoir capable of holding oil and gas, formed by a change in characteristics of the formation—loss of porosity and permeability or a break in its continuity—that forms the trap or reservoir. (2) A reservoir capable of holding fluids created by decreases in porosity, permeability, or disappearance of the reservoir.
Stratigraphy: The succession and age relationship of layered rocks.
Stray Current: The difference in potential between the earth and the well. Measured and minimized before explosive operations may proceed. Also a measure of corrosion potential.
Stray Current Corrosion: Extraneous electrical current in earth. Point of arrival is cathode—departure point is anode.
Stream Bed: A moderate to low-energy deposit with permeability streaks where energy was higher. May be very limited in extent and volume.
Stress: (1) In the science called rheology (the study of how materials flow and deform), stress is the force applied to a material and strain is the resulting movement of the material. A simple practical exercise is to measure the length of a rubber band "at rest," then suspend an object of known weight from it (stress), and measure the change in its length (strain). Try adding bigger and bigger weights, and you may discover something originally discovered by Sir Isaac Newton. (2) Sigma, σ, is the force exerted on an object.
Stress Cage: A shallow zone of (usually) higher strength surrounding a perforation, cavity, or the borehole, caused by explosive effects or other pressure factors and possibly related to the mechanics of work hardening.
Stress Chloride Cracking: A corrosion form generated by high-chloride brine contact.
Stress Corrosion Cracking/Stress Corrosion: Occurs in metal that is subject to both stress and a corrosive environment. May start at a "stress riser" like a wrench mark or packer slip mark.
Stress Crack: An external or internal crack in steel or other material caused by the environment and/or the loads on the material.
Stress Relief: Controlled heating of material to predetermined temperature for the purpose of reducing any residual stresses.
Stress Riser: A disturbance in the metal structure caused by impact or a wrench mark or penetration of slips that is a likely location for increased corrosion or some failures such as hardening or local fatigue.
Stress Sulfide Cracking. Occurs when metal is in tension and exposed to H_2S and water. Generates atomic hydrogen. Hydrogen moves between grains of the metal. Reduces metal ductility.
Stretch Target (Risk): An exceptional outcome that a team will strive for but will probably not achieve.
Striation: A group of roughly parallel marks.
Strike: The compass direction of a feature such as a flood plane or fault.
Strike–Slip Fault: A tectonically induced failure of a section of a formation with the result that one block of the formation moves horizontally to the formation.

S

Stringing Up: The act of threading the drilling line through the pulleys or sheaves of the traveling block and the crown block. One line is connected to the derrick and the other to the winch or hoisting drum.
String Mill: A mill that cuts to the side, opening up windows or cutting out restrictions.
String Shot: One to four strands of explosive detonating cord suspended by wire line in a well and exploded to "rattle" the pipe and drop scale and debris from the sides of the pipe. Used frequently in back-off operations (unscrewing a pipe joint downhole).
Strip Gun: A perforating gun where the charges are mounted on the strip. The strip is recovered after firing.
Strip Over: A recovery method or, less frequently, a wire installation method using pipe.
Stripper: (1) Equipment where regeneration of amines or carbonates used in the acid gas removal unit is achieved, in order to reuse them in the process. (2) The seal at the top of the BOP around coiled tubing or pipe during snubbing.
Stripper Rubber: The elastomer element that completes the seal in a stripper unit.
Stripper Well: (1) A marginal productivity well, usually less than about 10 barrels per day in onshore US fields. (2) An oil well that produces a limited amount of oil, usually no more than 10 barrels a day. (3) The final state in the life of a producing well.
Stripping: In refining, the removal of the more volatile components from a cut or fraction in order to raise the flash point of kerosene, gas oil, or lubricating oil.
Stripping (Pipe Running): Holding back on a pipe as it is run into the well.
Strip (Processing): Removing light hydrocarbons (C2+) from the gas before sale.
Strokes per Minute (Beam Lift): The number of rod strokes per minute of the beam lift unit. Set by depth, viscosity of fluid, gas content, weight of fluid supported, etc.
Strokes per Minute (Drilling): The number of strokes that a mud pump makes in 1 min. SPM times time times pumper chamber volume equals volume displaced. Can be compared to volume recovered.
STRONGER: State Review of Oil and Natural Gas Environmental Regulation, Inc.
Structural Casing: Conductor casing string.
Structural Geology: The study of the geological processes that formed the earth's crust, mountains, etc.
Structural Map: A diagram using contour lines to connect the elevation of similar depth points in a formation.
Structural Model (Seismic): 2D or 2 1/2D, a gravity or magnetic structural model is a density and/or susceptibility model of given or assumed geology in a system. The modeling can be to represent lithologic layers

as equidensity and/or equisusceptability layers or blocks. The layers are contrast boundaries. Best fit where high contrasts exist in nature.

Structural Trap: (1) A combination of a formation structure feature such as a fault with a sealing mechanism that forms a place where oil accumulates or is "trapped." (2) A fold or break (or both) in the earth's crust that creates an impervious trap for oil and gas. Oil will migrate underground through rock until it is "trapped."

Stuck: A stuck digester does not decompose organic matter properly. It is characterized by low gas production, high volatile acid to alkalinity relationship, and poor liquid–solids separation. A digester in a stuck condition is sometimes called a "sour" digester.

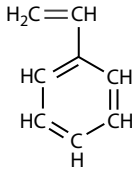
Stuck Pipe (Drilling): Refers to drill pipe stuck in the hole from differential sticking or bridging.

Stuffing Box: A device using an elastomer seal (and sometimes oil or grease injection) that provides a pressure barrier around a moving tubular or wire line.

STV (Subsea): Seal test valve.

Styolite: A pressure-dissolution feature in a layered reservoir, often a vertical permeability barrier.

Styrene: One of the most common monomers used to make chain-growth polymers. It also seems to be the one that everyone studies much: "If it works for styrene it must be true for all monomers…" (famous trap).



Styrene

Sub: A short section of pipe, used to describe tools or to solve spaced-out gaps.

Subcritical (Flow): Subsonic.

Subduction: The sinking of an oceanic plate edge as a result of collision of a less dense plate.

Sublimation: The process by which matter passes from a solid directly to a gaseous state.

Submersible Electrical Pump: See *ESP*.

Submersible Rig: A large rig supported and stabilized by underwater pontoons.

Subsalt: Formations located below a salt layer.

Subsea Completion: A subsea well.

Subsea Facilities: Subsea Xmas trees, manifolds, control boxes, valves, pipelines, risers, umbilicals, cables, etc.

S

Subsea Manifolds: Allow wells to be put on production without need to build a platform to operate and maintain wells.
Subsea Tiebacks: A method of connecting new discoveries to existing production facilities, improving the economics of offshore oil and gas production.
Subsea Well: A well with the wellhead and significant control mechanisms located on the sea floor.
Subsea Wellhead: A wellhead installed on the sea floor and controlled remotely from a platform, a floating production facility, or land.
Subsea (Xmas) Trees: The Xmas tree completing the well is located on the seabed.
Subsidence: Compaction of a zone (vertical height shrinkage) created by compaction of the matrix after some load-supporting fluids have been produced.
Substructure: Support form of an offshore installation on which derrick, engines, helicopter pad, cranes, etc., are installed.
Subsurface (or Subsea) Isolation Valve: Often placed in offshore pipelines within a few hundred meters of the facility to give an emergency stop point in the event of a line rupture or fire.
Subsurface-Controlled Subsurface Safety Valve: A downhole safety valve designed to close when the flow rate reaches a preset level as measured by a pressure drop across a valve.
Subsurface Safety Valve: A downhole safety valve designed to shut the well in case of surface damage to the wellhead.
Sucker Rod: (1) Steel rods that are screwed together to form a "string" that connects the pump inside a well's tubing downhole to the pumping jack on the surface; pumping rods. (2) A string or solid or hollow tubular that is moved by a pump jack at the surface to operate a rod pump at the bottom of the well.
Suction Pit: A steel tank containing mud, where the input line to the mud pump originates.
Sugar Water (Cementing): A contaminate water that will prevent cement slurry from setting.
Suicide Squeeze: A cement squeeze involving injecting into a lower perforation, separated by a packer from an upper perforation while trying to fill a channel.
Sulfamic Acid: A dry acid derivative of sulfuric that is used in very minor acid jobs in the form of acid sticks dropped into the well.
Sulfate: One of several minerals containing sulfur ions bonded to oxygen atoms.
Sulfated Ash: The residue that remains after a sample of oil and sulfuric acid has been ashed to constant mass under prescribed conditions. It is used as a measure of the amount of metallo-organic additives present in new oils. In used oils, the determination may be affected by the presence of incombustible contaminants, dust, and wear metals.
Sulfate Resistance (Cement): The ability of set cement to resist deterioration in contact with water-containing sulfate ions.

Sulfide: One of several minerals containing sulfur ions bonded to metal ions.
Sulfide Stress Cracking: Cracking of a metal under the combined action of tensile stress and corrosion in the presence of water and hydrogen sulfide (a form of hydrogen stress cracking) (NACE).
Sulfonates: A group of petroleum hydrocarbons resulting from treating oils with sulfuric acid.
Sulfur: (1) A yellow mineral extracted from petroleum for making fertilizers, pharmaceuticals, and other products. (2) A nonmetallic element that occurs in association with salt diapirs throughout much of the onshore and offshore Gulf of Mexico region. All offshore sulfur is mined by the Frasch process, which uses hot brine to melt sulfur out of the enclosing rock so the molten sulfur can be recovered. (3) A yellowish white solid. Sulfur appears in oil and gas in the form of hydrogen sulfide or in combination with a hydrocarbon to form a mercaptan. Sulfur is an undesirable component because when the product is burned it forms sulfur oxides, which contribute to air pollution. (4) A yellowish nonmetallic element, sometimes known as "brimstone." It is present at various levels of concentration in many fossil fuels whose combustion releases sulfur compounds that are considered harmful to the environment. Some of the most commonly used fossil fuels are categorized according to their sulfur content, with lower sulfur fuels usually selling at a higher price.
Note: No. 2 Distillate fuel is currently reported as having either a 0.05% or lower sulfur level for on-highway vehicle use or a greater than 0.05% sulfur level for off-highway use, home heating oil, and commercial and industrial uses. Residual fuel, regardless of use, is classified as having either no more than 1% sulfur or greater than 1% sulfur. Coal is also classified as being low in sulfur at concentrations of 1% or less or high in sulfur at concentrations greater than 1%.
Sulfur Dioxide: (1) A major component of a group of airborne contaminants termed "acidifying emissions." (2) Formed during combustion of fuels such as diesel or gas oil. SO_2 contributes to acid rain.
Sulfur-Free Fuels: Term used to describe the latest petrol and diesel fuels with a sulfur content of 10 ppm or less. These fuels are designed to optimize the performance of new engine and exhaust clean up technologies such as gasoline direct injection and deNOx catalysts.
Sulfuric Acid: A strong acid—in water, it decomposes completely to H^+ and HSO_4^- ions; with a little more prompting, HSO_4^- can be persuaded to give H^+ and SO_4^{2-}. When I was young, I had quite a bitter disagreement with a friend of mine about whether the element from which its name arises ought to be spelled "sulfur" or "sulphur" (IUPAC comes down firmly on the side of "sulfur"). We eventually reached a compromise, and for many years, I stuck to a spelling of "sulfhur" that miraculously passed uncorrected through several years of laboratory practical reports.
Sulfurized Oil: An oil in which elemental sulfur is either loosely combined with the oil or is combined with a fatty oil and added to the base oil. Used

in applications where reactive sulfur is desired to provide extreme pressure characteristics, such as in gear oils and cutting oils.

Sulfur Recovery: Sour gas is processed at recovery plants to extract sulfur for sale to fertilizer manufacturers and other industries in Canada and overseas. The average rate of sulfur recovery at Alberta's sulfur recovery plants has improved from 97.5% in 1980 to 98.8% in 2000.

Sump: (1) A low area, usually the area below the perfs. (2) The term "sump" refers to a structure that connects an industrial discharger to a public sewer. The structure (sump) could be a sample box, a clarifier, or an intercepting sewer.

Sump Packer: A bottom packer, commonly used to locate the bottom of a screen assembly in a sand control completion.

Supercharging: Elevating the near wellbore pressure of a formation through leak-off of wellbore fluids during drilling, completion, or workover.

Supernatant (Wastewater): Liquid removed from settled sludge. Supernatant commonly refers to the liquid between the sludge on the bottom and the scum on the surface of an anaerobic digester. This liquid is usually returned to the influent wet well or to the primary clarifier.

Supersaturated: A condition where the liquid is oversaturated with incompatible ions or one ion concentration is above the saturation point. Usually a result of cooling an undersaturated fluid below the saturation point without a sufficient upset to start the precipitation growth.

Supervisory Control and Data Acquisition System: (1) A computerized automation system that brings together the following technologies: telemetry, telecontrol, supervisory control, and data acquisition, analysis and presentation. When a SCADA system is employed in an LNG process plant or pipe line, information from remote data gathering devices is made available to a central location. Moreover, information gathered can be used by a human operator as the basis for issuing commands to the remote locations. (2) A data gathering system. (3) Computer-monitored alarms, response, control, and data acquisition systems used by operators to monitor and adjust their treatment processes and monitor their operations.

Supplemental Gaseous Fuel Supplies: Synthetic natural gas, propane–air, coke oven gas, refinery gas, biomass gas, air injected for Btu stabilization, and manufactured gas commingled and distributed with natural gas.

Supplier: A party that sells the commodity of natural gas.

Supply: The components of petroleum supply are field production, refinery production, imports, and net receipts when calculated on a PAD District basis.

Phillips' proprietary sulfur removal technology (SRT). S Zorb SRT for gasoline can reduce sulfur levels to 5 ppm for some feedstocks, which more than meets the EPA's new standard of 30 ppm. A new plant at Phillips' Borger refinery has demonstrated that S Zorb SRT can remove 99% or more of the sulfur from gasoline, and potentially diesel, streams. S Zorb SRT for diesel is in development.

Supply Aggregators: A description applied to natural gas marketers who collect natural gas production from producers and find markets for the gas.
Surcharge: Sewers are surcharged when the supply of water to be carried is greater than the capacity of the pipes to carry the flow. The surface of the wastewater in manholes rises above the top of the sewer pipe, and the sewer is under pressure or a head, rather than at atmospheric pressure.
SURF: Subsea, umbilicals, riser, flow line.
Surface-Active Agents: Surfactants that exhibit an effect on water or oil by changing fluid properties at the interface of the fluid. May be emulsifiers, demulsifiers, surface tension lowering, flocculants, deflocculants, wetting agents, etc.
Surface Casing: The casing string that protects the fresh water supply. It is always cemented across the water zone and usually extends to surface.
Surface-Controlled Subsurface Safety Valve: A safety valve controlled from the surface through hydraulic or electrical power.
Surface Geology: Uses physical features on the earth's surface to give an indication of the presence of structural traps such as anticlines.
Surface Loading: One of the guidelines for the design of settling tanks and clarifiers in treatment plants. Used by operators to determine if tanks and clarifiers are hydraulically (flow) over- or underloaded. Also called overflow rate.
Surface Location: The location of a well or facility/measurement point.
Surface Pipe: Pipe that is set with cement through the shallow water sands to avoid polluting the water and keep the sand from caving in while drilling a well.
Surface Reclamation: A restoration of the surface as for productivity or usefulness.
Surface Roughness: A consideration in fluid friction calculations. A pipe with a polished surface may have 1/10th the friction and flow 10%–25% more fluid at the same pressure drop (depending on pipe diameter) than a pipe with a corroded or heavily fouled surface.
Surface Runoff: The precipitation that cannot be absorbed by the soil and flows across the surface by gravity. The water that reaches a stream by traveling over the soil surface or falls directly into the stream channels, including not only the large permanent streams but also the tiny rills and rivulets. Water that remains after infiltration, interception, and surface storage has been deducted from total precipitation.
Surface Tension: A measurement of the difficulty of moving a fluid past another fluid (see *Interfacial tension*). The resistance is created by the cohesion forces between the liquid molecules. The forces make it more difficult to pass fluids past a surface. Surface tension is measured in dyne/cm. Untreated water is 72.8 dynes/cm at 20°C. Ethyl alcohol is 22.3 and mercury is 465.
Surface (Xmas) Trees: The Xmas tree completing the well is located either on a fixed platform (shallow water) or on a floating platform (deepwater DCU) such as a SeaStar®, Spar, TLD, or TLP.

S

Surfactant: (1) Abbreviation for surface-active agent. The active agent in detergents that possesses a high cleaning ability. (2) From SURFace ACTive AgeNT. A substance that prefers to exist at the boundary between two other substances—for example, detergents have one end highly soluble in greasy, nonpolar substances and one end soluble in water. Sodium dodecyl sulfate is a common surfactant. See also *Emulsifier*. (3) A chemical that is attracted to the surface of a fluid and modifies the properties such as surface tension. (4) Substances with special properties that are used in detergents, cosmetics, dyes, and dispersants.
Surface-Active Agents: See *Surfactants*.
Surge Tool: A downhole tool that is used to create a sudden pressure decrease at a spot in the well.
Surging (Flow): Opening the well to flow against a significantly underbalanced fluid column. A perf cleaning technique.
Surging (Pipe Movement): A pressure higher than the hydrostatic column, below the BHA produced by rapid movement of pipe into the well. Maximized in cases with large diameter tools, high viscosity, and high pipe speeds. May cause fracturing. Opposite of swabbing.
Susceptibility (Seismic): A measure of the degree to which a rock can be magnetized. It is defined as the ratio (k) of the intensity of magnetization (I) to the magnetic field (H) projected into the rock.
Suspend: Temporarily discontinue operations.
Suspended Gas Discovery: A natural gas field identified by a discovery well but currently not being produced or developed.
Suspended Growth Processes: Wastewater treatment processes in which the microorganisms and bacteria treating the wastes are suspended in the wastewater being treated. The wastes flow around and through the suspended growths. The various modes of the activated sludge process make use of suspended growth reactors. These reactors can be used for BOD removal, nitrification, and denitrification.
Suspended Solids: (1) Solids that either float on the surface or are suspended in water, wastewater, or other liquids and that are largely removable by laboratory filtering. (2) The quantity of material removed from water in a laboratory test, as prescribed in Standard Methods for the Examination of Water and Wastewater, and referred to as total suspended solids dried at 103°–105°C. (3) Solids that are visible and in suspension in the water, or the solids that are retained on the filter mat of a Gooch crucible.
Suspended Well: (1) A well that has been capped off temporarily. (2) A well on which operations have been discontinued. The usual context is an uncompleted well in which operations ceased during drilling but which has not been plugged and abandoned permanently (http://oilgasinformation.com/wp-admin/post-new.php?post_type = post).
Suspension: (1) A solution having small particles dispersed throughout. (2) A mixture of two substances where small pieces of a solid are suspended

in a liquid—for example, milk (blobs of fat and protein floating in water) and orange juice (chunks of plant floating in water).

Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (as defined by United Nations World Commission on Environment and Development).

SVI: See *Sludge volume index*.

SW: Seawater.

Sw: Water saturation.

Swab: (1) A tool that is lowered down the pipe on a wire line. The "swab" is then pulled out of the hole. As it travels up the pipe, rubber elements expand so that the fluid in the pipe is trapped above the swab and pushed to the surface. This operation is necessary when the formation pressure is not high enough to blow the fluids in the pipe to the surface. (2) Reducing the well pressure below the swab tool by rapid upward movement of a tool or equipment in a wellbore. Swabbing may be intentional using a wire line swab cup tool to lift water or unintentional by fast movement of a pipe or wire line conveyed, large diameter tool such as a packer.

Swab Valve: The valve at the top of the tree, above the flow cross or flow tee. The lubricator for interventions may be attached above this valve or the valve may be removed to fit a larger lubricator.

Swage: A smooth faced tool that is used to try to reround ovaled tubing.

Swa (Logging): Water saturation of the uninvaded zone.

Swarf: Milling debris from cutting steel.

S Wave: Secondary wave, shear wave, transverse wave. A seismic body wave that involves particle motion from side to side, perpendicular to the direction of wave propagation. S-waves are slower than P-waves and cannot travel through liquid.

SWC: Side wall core.

SWC (Corrosion): Stepwise cracking. Cracking that connects hydrogen-induced cracks on adjacent planes in steel.

Swcor (Logging): Corrected water saturation of the uninvaded zone.

SWD: Salt water disposal.

SWDA: Solid Waste Disposal Act.

Sweep: A displacement. In the reservoir, a sweep is displacement of a hydrocarbon fluid from a reservoir rock by a flooding fluid. In the wellbore, a sweep is a viscous pill circulated around to help clear the wellbore of cuttings or debris.

Sweep Efficiency: The percentage of original oil in place displaced from a formation by a flooding fluid.

Sweep Pill: A spacer designed to pick up and transport particles from the well.

Sweep Spot: The part of a field that has the best production characteristics (permeability, porosity, hydrocarbon saturation, pressure, etc.).

Sweet: Absence of hydrogen sulfide, H_2S.

S

Sweet Crude: (1) Crude oil containing very little sulfur and having a good odor. (2) Crude petroleum containing little sulfur, with no offensive odor. (3) Gets its name because it has a "sweet" or pleasant smell. Sweet crude has a sulfur content less than 1%. It is more valuable than sour crude because it costs less to process the crude into finished products. (4) Oil containing little or no sulfur, especially little or no hydrogen sulfide.

Sweetening: (1) The process of improving petroleum products in color and odor by converting the undesirable sulfur compounds into less objectionable disulfides with sodium plumbite or by removing them by contacting the petroleum stream with alkalies or other sweetening agents. (2) Removing H_2S from a hydrocarbon stream.

Sweet Gas: (1) Gas sweetened. Gas processed in the acid gas removal unit that no longer contains these gaseous pollutants. (2) Natural gas that contains such small amounts of hydrogen sulfide (and other sulfur compounds) and carbon dioxide that it can be transported or used without purifying, with no deleterious effect on piping and equipment. (3) Natural gas free of significant amounts of hydrogen sulfide (H_2S) when produced. (4) A gas containing no corrosive components such as hydrogen sulfide and mercaptans.

Sweet Oil and Gas: Petroleum containing little or no hydrogen sulfide.

Sweet Wax: A white, moisture-free wax with the oil removed by a sweating process in which the unrefined wax is heated in shallow pans. In a semirefined state, it is known as a sweated-scale wax. It can be filtered or re-run to yield a completely refined commercial product.

Swell Packer: A packer whose seal elements swell in a hydrocarbon, establishing a seal between packer body and casing.

Swept Volume (Circulating): The amount of the wellbore that is circulated by fluid (describes the holdup and upswept volume).

SWHE: See *Spiral-wound heat exchanger.*

SWI (Logging): Initial water saturation.

Swing Gas: Natural gas bought on short notice to meet unexpected daily demands not covered under long-term contracts.

Swirr: Irreducible water saturation.

Switch Loading: The loading of a high static charge retaining hydrocarbon (diesel fuel) into a tank truck, tank car, or other vessels that has previously contained a low flash hydrocarbon (gasoline) and may contain a flammable mixture of vapor and air.

Swivel: A part of the well-drilling system. It is a heavy, steel casting equipment with a bail—held by the hook of the traveling block—containing the wash pipe, gooseneck, and bearings on which the kelly joint hangs and rotates. It is the heavy link between the hook and the drill string onto which the mud house is attached.

Swivel (Drilling): The connection between the traveling block and the hook that allows torque release and rotation.

Swivel Stack: The component on a full weathervaning FPSO that allows for continuous transfer of fluids, gas, controls, and power from the static mooring to the facilities on the rotating part of the FPSO.
SWMP: See *Stormwater management program*.
SWOP: Standard workover procedure.
SWPPP: See *Stormwater pollution prevention plan*.
Swr (Logging): Water saturation of the uninvaded zone.
SWR (Subsea): Subsea wellhead array.
Sw/So (Logging): Movable hydrocarbon index.
SX: Sacks.
Sxo (Logging): Water saturation of the flushed zone.
SYMO: See *Soft yoke mooring and offloading.*
Syncline: (1) A downfold in the rock where the sides tilt upward. Opposite of a trap. (2) A set of rocks that are bent downward.
Syncrude: Synthetic crude upgraded from mined hydrocarbon.
Syneresis: Dehydration of a gelled fluid.
Syngas: Synthetically prepared natural gas.
Synthetic Crude: (1) Oil formed by a chemical process that converts coal or shale to liquids. (2) A mixture of hydrocarbons, similar to crude oil, derived by upgrading bitumen from oil sands. (3) A blend of hydrocarbons similar to light crude oil. It is produced by processing bitumen or heavy oil at a facility called an upgrader. (4) The total liquid, multicomponent mixture of hydrocarbons resulting from a process involving molecular rearrangement of charge stock. Commonly applied to such products from cracking, reforming, visbreaking, etc.
Synthetic Natural Gas: (1) Methane obtained from sources other than naturally occurring reservoirs of natural gas, such as by heating coal, refining heavier hydrocarbons, or processing garbage or other organic materials. Gases other than natural gas or liquid or solid hydrocarbons converted to a gaseous fuel of heat content, compatibility, and quality equivalent in performance to that of natural gas. (2) Also referred to as substitute natural gas. A manufactured product, chemically similar in most respects to natural gas, resulting from the conversion or reforming of petroleum hydrocarbons that may easily be substituted for or interchanged with pipeline-quality natural gas.
Synthetic Oil-Based Mud: A mud with the oil component replaced by a lower toxicity oil such as mineral oil.
Synthetic Rubber: Any synthetic polymer that mimics the properties of natural rubber. One of the earliest was acrylonitrile–butadiene–styrene (ABS) rubber, a copolymer containing long segments of each of those three monomers.
Systematic: According to some kind of system. It does not have to be particularly logical—for example, consistently naming chemicals you don't like after people you don't like would be an example of systematic, but irrational, nomenclature.
System Capacity: The physical limitation of a gas pipeline or gas storage system to flow gas to end users. Also called "normal system capacity."
System Supply: Natural gas supplies purchased, owned, and sold by the supplier.

T

Tachyhydrite: A precipitate of sulfate minerals following acidizing with strong hydrochloric acid.
Tadpole Plot: A plot of dipmeter or drift where the dip angle or displacement is plotted versus depth as a displacement of the dot. Also called a vector plot.
Tag: To touch the top of a tool, fill, water, etc., with wire line, tubing, or CT tool.
Tag Line: A small rope attached to a load being lifted by a crane that allows a person on the ground to help guide or place the load.
TAG (Perforating Gun): Throwaway gun or scallop gun.
Tail: That portion of an oil that vaporizes near the end of distillation, the heavy end.
Tail Cement: The last of the cement slurry, generally the highest strength cement designed to be left across the casing shoe.
Tail End: See *Tail*.
Tail Gas: (1) The exhaust gas from any processing unit that is at a low pressure and is usually vented, treated for contaminant removal, or combusted. (2) A sulfur recovery unit's residue gas; any processing unit's gaseous exhaust that is treated as residue.
Tailing Rods: The act of laying down a rod string when pulling a sucker rod pumped well.
Tailings: Remains, residues, or final by-products from refining crude petroleum or its fractions.
Tail Pipe: The tubing below the packer.
TAI (Shale): Thermal alteration index; an estimate of how maturation has altered the source rock in the creation of hydrocarbons.
Take-or-Pay Clause: Contract clause in a sales and purchase agreement (SPA) requiring a minimum quantity of natural gas to be paid for, whether or not delivery is accepted by the purchaser.
Tall Oil: A fatty acid drilling additive.
Tally: Measuring and recording the length of all pipe and downhole equipment.
Talus: A pile of rock fragments at the base of a cliff from which they have broken off.
TAME: See *Tertiary amyl methyl ether.*
TAML: See *Technical advancement of multilaterals.*
Tamp: The pressure exerted by packing or a fluid column above an explosive charge that helps contain or focus the energy of the explosive or propellant.

T

TAN: See *Total acid number.*
Tangential Stress (Tubing): Stresses around the body of the tubing (hoop stresses).
Tangential Wave: An S wave.
Tangible Costs (Drilling): Items of well construction that have salvage value, ordinarily capitalized on taxes.
Tank: (1) An artificial container in which liquids are held or detained. (2) A number of petroleum tanks that are operated together as a depot in oil storage and distribution activities.
Tank Battery: A group of tanks at a well site used to store oil prior to sale to a pipeline company.
Tank Bottoms: (1) The oil in a tank below the level of the outlet pipe. (2) The near solid or highly viscous residuals at the bottom of an oil storage tank, generally composed of a large amount of paraffins, silt, heavy ends, etc.
Tankers: Used to transport crude oil and refined products in waterborne trade. The tankers can be used in either "clean" (light refined products such as gasoline and diesel fuel) or "dirty" (residual fuel and crude oil) trade. The tankers range in size from the small vessels used to transport refined products to huge crude carriers. Tanker sizes are expressed in terms of deadweight tons (dwt). The smallest tankers are General Purpose that range from 10 to 25,000 tons and the largest are. Tankers are unloaded/loaded at the jetties or the specially built piers.
Tank Farm: An installation used by gathering and trunk pipeline companies, crude oil producers, and terminal operators (except refineries) to store crude oil.
TAP: Trapped annular pressure.
Tap: A valve on a line.
Tapered Bowl: A two-piece fitting placed in the master bushing to hold the slips.
Tapered Mill: A mill with a gradual concave or convex taper designed to enlarge the wellbore.
Tapered String: A tubing string with more than one tubing size. Normally the smallest pipe is on the bottom with larger sizes toward the top. The sizes are set to minimize flowing friction and keep the velocity above the critical level to lift fluid.
Taper Tap: A spear-like fishing device with threads to engage ID threaded fish.
Tar: A deposit of very long carbon chain alkanes. May be associated with asphaltenes.
Target (Risk): A preferred outcome from an activity.
Tariff Gas: Additional natural gas sold to a customer if the total amount of natural gas needed exceeds their original estimate.
Tar Sands: A deposit of heavy oil, usually with API gravity less than about 18°. May have sand content of 50%.

Tax Incentives: In general, a means of employing the tax code to stimulate investment in or development of a socially desirable economic objective without the direct expenditure from the budget of a given unit of government. Such incentives can take the form of tax exemptions or credits.
TBA: See *Tertiary butyl alcohol*.
TBN: See *Total base number.*
TC: Time constant.
Tcf (Trillion Cubic Feet): (1) Volume measurement of natural gas approximately equivalent to one quad. See also *Natural gas (units), Btus, Bcf,* and *Mcf.* (2) One trillion cubic feet of natural gas.
TCP (Chemical Additive): Tricrecyl phosphate; a defoamer.
TCT: True crystallization temperature.
TD: See *Total depth*.
TDH: Total dynamic head.
TDRM: Top-down reservoir modeling/modeling.
TDS: See *Total dissolved solids.*
TDT: See *Thermal decay time log.*
Technical Advancement of Multilaterals: An industry group that has defined multilateral junction levels and terminology.
Technical Limit: A benchmarking comparison to determine how much better a process or a piece of equipment can be improved.
Technically Recoverable Resources: The amount of the resource that is estimated to be recovered by current or proposed technologies.
Tectonic Force: Any one of the several in situ or Earth stress forces. May include classic plate tectonics, salt flows, thrust forces, faults, and folds. Can be either near-field or far-field.
Tectonic Map: A geologic map showing the structure of the Earth's crust.
TEG: Triethylene glycol.
TEL: See *Tubing end locator.*
Telemetry: Conversion of a logging tool measurement to a signal suitable for transmission to the surface.
Telescoping Mast: A portable mast composed of sections nestled inside one another and raised with a winch or a hydraulic cylinder.
Televiewer: Borehole televiewer; a sonic tool that creates a sound reflectance picture of the wellbore.
Tell Tale (Gravel Packing): An upper or lower screen in a gel packing gravel pack. Used to spot annular fill-up by pressure rise.
Tell Tale Screen: Short screens used at the top and bottom of older gravel packing assemblies to help determine where the gravel is within the screen by casing annulus during packing.
Telluric Currents: Natural Earth currents originating as a result of variations in the Earth's magnetic currents.
Temperature Controller: Device that responds directly or indirectly to deviation from a desired temperature by actuating a control or initiating a control sequence.

T

Temperature Gradient: The rate of increase of temperature per unit of depth. Varies in the world with geothermal activity. Usually between 1.1 and 2.2 + °F/100 ft.

Temperature Log: A measurement of temperatures along the wellbore. Useful for determining temperatures at any point, static and circulating temperature and tops of cement column. May also be used to locate the top of a fracture if run soon after the frac.

Temperature Sensor: A device that opens and closes a switch in response to changes in the temperature. This device might be a metal contact or a thermocouple that generates minute electrical current proportional to the difference in heat or a variable resistor whose value changes in response to changes in temperature. Also called a "heat sensor."

Temperature Stability Agents: Products that increase the temperature stability of a material, usually a drilling or workover fluid above its normal expected range.

Temperature Survey: Repeated, regular measurement of temperatures along a unit of depth in a well.

Temporarily Abandoned: (1) The act of isolating the completed interval or intervals within a wellbore from the surface by means of a cement retainer, cast iron bridge plug, cement plug, tubing and packer with tubing plug, or any combination thereof. (2) A well where operations are suspended, that is, shut-in, while awaiting repairs and pipeline engineering analysis, but not permanently abandoned.

Tender (Ship): A support barge, boat, or ship that supplies support to a rig or production facility.

Ten Round: Ten threads per inch.

Tensile Extension: The stretching of a material in pure tension.

Tensile Strength: The greatest lengthwise stress that a substance can bear without failure.

Tension-Leg Deck: A passive system for tensioning risers on floating deepwater production facilities. The concept uses gravity as the tensioning means unlike other systems such as spars or TLPs that use buoyancy. This unique system, proprietary to SBM, is being developed for integration into FPSOs.

Tension-Leg Platform: (1) A floating offshore structure held in position by a number of tension-maintaining cables anchored to the seabed. The cables dampen wave action to keep the platform stationary. (2) A floating platform, positioned and stabilized by at least three separated, vertical tendons anchored to the seabed. The tendons are tensioned using the buoyancy of the underwater hull of the platform. Subjected to wave, wind, and current action, the platform moves sideways but remains horizontal due to the parallel actions of the tendons. The vertical motion (heave) is eliminated and the facility is therefore suitable for surface completion of the wells. SeaStar®, developed by Atlantia Offshore, is the state-of-the-art example of a TLP, using a monocolumn structure as opposed to multicolumn (typically four) developed by ABB, McDermott, Modec, etc.

Tension Set Packer: A packer set by pulling and holding tension in the tubing.
TEOR: Thermal enhanced oil recovery.
Terajoules: 1,000,000,000,000 J. 1 kJ = 0.9478 Btu.
Terminal: (1) Plant and equipment designed to receive and process crude oil or gas to remove water and impurities. (2) Onshore transit installation that receives oil or gas from offshore production facilities via pipeline and/or tankers.
Tertiary: A geologic period 2–65 million years ago.
Tertiary Amyl Methyl Ether: An oxygenate blend stock formed by the catalytic etherification of isoamylene with methanol.
Tertiary Butyl Alcohol: An alcohol primarily used as a chemical feedstock; a solvent or feedstock for isobutylene production for MTBE; produced as a coproduct of propylene oxide production or by direct hydration of isobutylene.
Tertiary Recovery: (1) The third major phase of recovery of oil or gas, the quantities recovered being over and beyond what could be produced by primary and secondary recovery technology; generally involves using sophisticated techniques such as heating the reservoir to reduce the viscosity of the oil. (2) An enhanced recovery process that goes beyond water or gas flooding. It may involve steam, fire, chemicals, miscible gases, bacteria, or other techniques.
Tertiary Treatment: Any process of water renovation that upgrades treated wastewater to meet specific reuse requirements. May include general cleanup of water or removal of specific parts of wastes insufficiently removed by conventional treatment processes. Typical processes include chemical treatment and pressure filtration. Also called "advanced waste treatment."
Testing: When each new well is completed, a series of tests are run on the well. The various tests are used to estimate the daily deliverability, payout, and reserves.
Test Pill: An encapsulated radioactive material that serves as a portable source of gamma radiation for tool calibration.
Test Separator: A smaller separator than the main production separator; used for regular production tests to measure oil, gas, and water rates on a well.
Tettle Tail: A reference mark; also a minute mark.
TFE: Total, final, elf.
TFE (Elastomer): Teflon.
TFL: See *Through the flow line*.
TG: See *Trip gas*.
TGLR: Total gas lift ratio.
TGS: Tight gas sands.
THAI: Toe to heel air injection.
THD (Subsea): Tubing hanger.

T

Theory: This is a word that is frequently misunderstood. Let us say we have a collection of observations ("facts") about something—it preferentially absorbs certain wavelengths of light; is composed largely of oxygen, hydrogen, carbon, calcium, and phosphorus in certain proportions; and absorbs oxygen from the environment while releasing carbon dioxide. A theory is a way of explaining at these observations that allows us to make additional predictions about the behavior of the system. If these predictions are right, we have a theory that is good enough for now. If they are not, we have to change our theory or claim that the additional observations were flawed. For example, the something in our example may be a frog; we could try poking it with a stick to see if it undergoes saltatory motion. If it does, we could claim that as a victory for our theory. If it doesn't, we could claim that some frogs will not jump if poked with sticks or that our measuring equipment was not sensitive enough to pick up the motion of what was undoubtedly a frog.

Therm: (1) One hundred thousand British thermal units. (2) A unit of heating value equal to 100,000 Btus, in common use in the United Kingdom; about 56 therms are derived by setting fire to a barrel of crude oil; one therm has approximately the same heat content as 100 ft^3 of natural gas. (3) A refining process in which heat and pressure are used to break down, rearrange, or combine hydrocarbon molecules. Thermal cracking includes gas oil, visbreaking, fluid coking, delayed coking, and other thermal cracking processes (e.g., flexicoking). See *individual categories for definition*.

Thermal Cracking: A form of cracking that simply uses heat to break up the molecules. The crude oil is heated to 750°C–900°C in the absence of oxygen, and the molecules break up to give free radicals, which start falling apart and rearranging themselves. Catalytic cracking can be done at much lower temperatures but generates different products from the decomposition of the crude oil.

Thermal Decay Time Log: A series of temperature log runs before, during and a sequence of temperature logs to spot channels, and differences in temperature heat up or cool down.

Thermal Decomposition: Breaking down by thermal destruction of the molecule.

Thermal Expansion: Expansion of the volume (length and diameter) of an object as it is heated. In tubing, heat increases the length of the tube or increases axial stress.

Thermal Maturity: A measurement of the processing of kerogen toward dry methane gas. Usually expressed at vitrinite reflectance percent. An immature oil has a Vro value of <0.6; an oil with dissolved gas, 0.6–1.0; a wet gas, 1.0–1.3; and a dry gas, >1.4. Vro over values of about 4.0 are a reflection of all hydrocarbons being cooked off.

Thermal Protection: Refers to an electrical device that has inherent protection from overheating. Typically in the form of a bimetal strip that bends when heated to a certain point. When the bimetal strip is used as a part

of the appliance's circuitry, the circuit will open when the bimetal bends, breaking the circuit.

Thermal Reforming: See *Reforming*.

Thermal Stability: The property of a fuel or lubricant that indicates its ability to resist cracking and decomposition on prolonged exposure to elevated temperatures.

Thermocouple: Junction of two wires of dissimilar materials, not necessarily metal, with the property of generating an electrical voltage related to the temperature of their junction.

Thermodynamic: The word "thermodynamic" comes from roots that mean "heat" and "motion." In a chemical reaction where chemical bonds rearrange to give more stable products, the energy that was stored in the bonds will be released as heat. In many chemical reactions where there are a number of possible products, one will be the most stable (giving the greatest release of heat)—this will be the thermodynamic product. This might not be the product that is actually formed, since another possible product might be formed more rapidly—the kinetic product. Try this dodgy example.

Thermodynamic Cycle: Group of thermodynamic operations or processes performed by a fluid during which its thermodynamic conditions are being modified: temperature, pressure, specific volume, state of aggregation, entropy, enthalpy, etc. Initial and final conditions are the same and variations are repeated cyclically. While the fluid develops the thermodynamic cycle, it exchanges heat and works with the environment. When the cycle provides work to the environment, it is called direct cycle, and when the cycle subtracts work, it is called reverse cycle.

Thermogenic Gas: Natural thermal cracking of sedimentary organic material to oil and gas (C14 isotope is absent).

Thermophilic Bacteria: A group of bacteria that grow and thrive in temperatures above 113°F (45°C). The optimum temperature range for these bacteria in anaerobic decomposition is 120°F (49°C) to 135°F (57°C).

Thermoplastic: A polymer that when heated ("thermo") becomes soft and deformable ("plastic"). Examples are poly(styrene) and poly(ethylene).

Thermoset: A polymer that when heated ("thermo") does not become soft and deformable. This is usually because it is cross-linked, and the molecules comprising it cannot move past one another unless chemical bonds are actually broken—which leads to the decomposition of the polymer. Phenol formaldehyde resin is an example.

Thermos Flask: A container used on logging tools to give temporary protection from the downhole temperature.

Thermostat: Automatic control device responsive to temperature used to maintain constant temperature.

THI: Threshold hydrate inhibitor.

Thickener: A solid matrix that is uniformly dispersed to form the structure of a lubricating grease in which the liquid fluid is held.

T

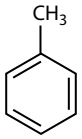
Thickening: Treatment to remove water from the sludge mass to reduce the volume that must be handled.
Thickening Time: The time that a cement slurry will remain pumpable at temperature and pressure.
Thief: (1) A standard device that permits taking a sample from a predetermined location in the body of oil to be sampled. (2) To remove a sample from a tank for analysis.
Thief Hole: A digester sampling well.
Thief Zone: A high-permeability streak that serves as a loss site for wellbore fluids.
Thinners: Materials that change the relationship between solids and viscosity of a fluid to lower the gel strength, yield point, yield strength, or viscosity as it is affected by solids.
Thin Section: A section of the formation forcibly impregnated with epoxy and sliced thin enough to examine with a light from the opposite side.
Thiol: Also called a mercaptan. A carbon compound containing the -SH functional group. Mercaptans are responsible for the distinctive odor of cat urine.
Third-Party Access: Obliges companies operating gas transmission or distribution networks to offer terms for the carriage of gas on their systems by other gas distribution companies or particular customers; subject to capacity availability. See *Open access*.
Thixotropic: Fluid property of being a semisolid gel at rest and liquid when pumped. Thixotropic fluids decrease in viscosity with time at shear.
THM: See *Trihalomethanes*.
Thorium: Th232, one of the natural isotopes that as a trace element may incorporate into the matrix of naturally forming barium or strontium sulfate scale and make it a very-low-level radioactive material (NORM scale).
THP: Tubing head pressure.
Thread Gauge or Thread Form: A pattern template for identifying a specific thread type.
Thread Protector: Plastic or metal storage couplings that are screwed onto a stored tubing string, protecting the threads from impact and sometimes corrosion.
Three-Dimensional Seismic: (1) Commonly shortened to 3D seismic. These are 3D images created by bouncing sound waves off underground rock formations; used by oil companies to determine the best places to drill for hydrocarbons. (2) Seismic maps that show detail in three directions. A network or grid of values that models a geologic surface or structure as a surface of density contrast (gravity) or susceptibility (magnetic).
Three-Way Valve: Valve having either a single inlet and two outlets (diverting) or two inlets and a single outlet (mixing), in which either one or the other of the two inlets or outlets are open or partially open. Usually used for temperature control purposes.

Threshold Velocity: A limit flow velocity for a specific fluid, either minimum or maximum, that would accomplish a task. Threshold velocities are usually minimums to promote liquid lift in a gas well or a minimum velocity to keep a pipe surface clean.
Thribble (Old Drilling Term): A triple, or three, joint of pipe screwed together.
Throttling: Controlling flow with a reduced orifice.
Throughput: The amount of a material that moves through a plant in a set time.
Throughput (Pipeline): The volume of gas flowing (or transported) through a pipeline.
Throughput (Processing): Average amount of raw material that is processed in a given period by a facility, such as a natural gas processing plant, an oil refinery, or a petrochemical plant.
Through the Flow Line: (1) A completion or repair technique that depends on pumping the tools or equipment into a flow line and down the well. (2) A mechanism for well service where the tools are pumped downhole through the flow lines.
Through Tubing: Entering a well for a completion or repair by entering the well without removing the wellhead or the tubing string. Usually done under pressure.
Through Tubing Gun: A perforating gun small enough to be run and recovered through the tubing.
Throw: A fault's vertical displacement.
Throw the Chain: To jump the spinning chain from the box end of the joint to the pin end of the joint after the connection has been stabbed. The chain is pulled by a rope from the cathead to tighten the joint.
Thrust Fault: A type of reverse fault in which the inclination of the plane of the fault is not highly deviated.
THS: Tubing hanger setting.
THT: Tubing head temperature.
Tie: A structure, bed, or identifiable rock feature that allows the correlation of depth control in an area.
Tieback: To connect a downhole liner to the surface with a casing of similar size.
TIFL: Tubing integrity fluid level.
Tiger Tank: A tank for holding treating or flowed back fluids.
Tight Formation: Nonspecific term meaning lower permeability.
Tight Gas: Gas with very low flow rates. Found in sedimentary layers of rock that are cemented together so tightly that it "greatly hinders" the extraction. Getting tight gas out usually requires enhanced technology like "hydraulic fracturing" where fluid is pumped into the ground to make it more permeable. The National Energy Board estimates that Canada has 300 trillion cubic feet (tcf) of tight gas in place.

T

Tight Hole: An exploration well or other project where information is not released to the public.
Tight Sand: (1) Low-permeability formation. (2) A drilling well about which all information—depth, formations encountered, drilling rate, and logs—are kept secret by the operator.
Tight Spot: A restricted place in the borehole, caused by wall cake, dog leg, deviation change, or other factors.
TIH: Trip in hole.
Time Charter: A form of charter party issued when an LNG vessel is chartered for an agreed period of time. A time charter party is the contract between owner and charterer and identifies the salient characteristics of the ship and the obligations of the shipowner; specifically the shipowner provides a ship capable of the specified performance and operates the ship according to that performance standard set by the charterer. The charterer pays the owner for the hire of the vessel at an agreed rate.
Timken OK Load: The maximum load a lubricant will withstand without failure due to the breakdown of the lubricant film, as determined on the Timken EP Tester.
Tip Screen Out: A fracture treatment; common where high fracture flow conductivity is needed. Very high pressures and very high proppant loadings are applied near the end of a fracture treatment where the tip of the fracture has stopped growing due to bridging of proppant at the fracture dip because of dehydration (frac fluid leakoff).
Titrate: Laboratory procedure in which a chemical solution of known strength is added, drop by drop, to a sample until an end point is reached (usually a color change or the formation of a precipitate).
TIV: Tubing isolation valve.
TIW™: Texas Iron Works (manufacturer).
TJ: See *Terajoules*.
TKN: See *Total Kjeldahl nitrogen*.
TLD: See *Tension-leg deck*.
TLP, Mini TLPs: See *Tension-leg platform*.
Tmax (Shale): The temperature in shale maturity at which maximum hydrocarbon release occurs.
TMD: Total measured depth.
TMDL: See *Total maximum daily load*.
TN: See *Tank*.
TNL: Tubing nipple locator.
TOC: Top of cement.
TOC (Shale): See *Total organic carbon*.
Toe: The far end of a highly deviated well.
TOH: Trip out of hole.
TOL (Casing String): Top of liner.
Toluene: (1) Colorless liquid of the aromatic group of petroleum hydrocarbons; made by the catalytic reforming of petroleum naphthas containing

methyl cyclohexane. A high-octane gasoline-blending agent, solvent, and chemical intermediate; base for TNT. (2) The non-systematic name for methylbenzene, like so



Tomography: The 3D display of seismic velocity in a well or area.
Ton (of Refrigeration): (1) Time rate of cooling equal to 12,000 Btu/h. (2) Equals 2000 lb in the United States; in the United Kingdom, a long ton is 2240 lb; a metric ton equals 2000 kg. In most countries, oil and petroleum products are sold by weight instead of liquid quantities, for example, a ton of oil is the equivalent of 6.8–8.5 barrels of oil, depending on temperature, specific gravity, and other physical factors.
Tongs: A wrench, hand, or power suspended above the rig floor to make or break pipe connections.
Ton, Long: A long ton is 2240 lb. Typically used as the unit measure for sulfur sales.
Ton, Metric: A metric ton equals 1000 kg or 2204.6 lb. The capacity of an LNG base load plant is typically expressed in tons, and the unit capital costs for producing LNG are expressed as $/ton.
Tonnage: A shipping term referring to the total number of tons registered or carried or the ship's carrying capacity.
Ton Mile: A measurement used in the economics of transportation to designate one ton being moved one mile; useful to the shipper because it includes the distance to move a commodity in the calculation.
Ton, Short: A short ton is 2000 lb.
TOOH: Trip out of the hole.
Tool Joint: A pipe connection.
Toolpusher: Second in command of a drilling crew under the drilling superintendent. Responsible for the day-to-day running of the rig and for ensuring that all the necessary equipment are available.
TOP Clause: See *Take-or-pay clause*.
Top Drive: A rig with the pipe rotation mechanism in the traveling block section. Usually does not use a kelly.
Top Job: A cement repair job done by running a tube down an annulus and cementing the surface.
Top Kill: A dynamic kill procedure, used in low-pressure wells, good for a short period of time. A typical top kill is to pump 5 bbl of fluid in the tubing, offsetting the tubing pressure as the fluid falls. The well must be monitored for pressure or flow, and the pump truck usually stays connected in the event that another fluid pill is necessary.

Top Lease: A separate lease to a shallower part of the strata.
Topographic Map: A surface elevation map.
Top Plug: In cementing, the last plug pumped in cementing with the two-plug system. It isolates the displacement fluid and cement slurry. It helps keep the heavy cement slurry from reversing or U-tubing back into the wellbore while the cement slurry is still unset.
Topped Crude: A residual product remaining after the removal, by distillation or other artificial means, of an appreciable quantity of the more volatile components of crude petroleum.
Topping: The distillation of crude petroleum to remove the light fractions only. The unrefined distillate obtained is called tops.
Top-Set Completion: A completion with the casing set and cemented above the pay. Usually an open-hole pay zone.
Topsides: Top of an installation positioned on a jacket. See *FPSO*.
Tornado Chart: A resistivity log plot showing the different investigation results based on depth of fluid invasion.
Torpedo: The connection joining the electric line logging cable and the electrical bridle at the reel.
Torque: Resistance to rotation of a string. The turning force applied to the string to cause it to rotate.
Torsion Tester: A slickline tester used to spot slickline fatigue and embrittlement before the run.
Tortuosity: A description of the hindrance caused to flowing fluids as they attempt to enter the wellbore from a fracture or the formation. Also used to describe the deviation of the wellbore from a smooth path.
Total Acid Number: Measurement of natural organic acidity in a compound such as oil.
Total Base Number: The quantity of acid expressed in terms of the equivalent number of milligrams of potassium hydroxide (KOH) that is required to neutralize all basic constituents present in 1 g of sample. (2) A reserve alkalinity number.
Total Depth: (1) Descriptive of a well reaching the intended depth. (2) The maximum depth of a well measured along the wellbore. (3) Total depth measurement or pipe length to the depth. Used for displacement calculations.
Total Dissolved Solids: (1) Conductivity test of ions in the water. The combined dry weight of dissolved materials, both organic and inorganic, expressed in ppm that are contained in the water. (2) Total dissolved solids in a quantity of liquid.
Total Dynamic: The difference between the dynamic head at the pump discharge flange and that at the suction flange, corrected to the same datum plane, plus the velocity head at the discharge flange, minus the velocity head at the suction flange of the pump.
Total Flow: The total flow passing a selected point of measurement in the collection system during a specified period of time.

Total GOR: GOR that includes solution and free gas from the reservoir.
Totalizer: An instrument that maintains a running total of the measured variable.
Total Kjeldahl Nitrogen: Nitrogen contained in organic compounds such as proteins or their decomposition product ammonia, as measured by the Kjeldahl method.
Total Maximum Daily Load: The sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. It is a calculation of the maximum amount of a pollutant that a water body can receive on a daily basis and still meet water quality standards and an allocation of that amount to the pollutant's sources.
Total Organic Carbon: (1) Total organic carbon in wt%. (2) A measure of the amount of carbon contained in organic compounds in water or wastewater.
Total Pressure: In fluid flow, the sum of the static pressure and velocity pressure.
Total Residual Chlorine: The amount of available chlorine remaining after a given contact time. The sum of the combined available residual chlorine and the free available residual chlorine. Also see *Residual chlorine*.
Total Suspended Solids: Total suspended solids in a quantity of liquid. See *Suspended solids*.
TOTP: Turnover to production.
Tour: (Often pronounced as tower) a shift worked by the crew.
Tower: A refinery apparatus used in connection with a still to increase the degree of separation of fractions obtained during the distillation of oil in the still. Also called a column.
Toxic: A substance that is poisonous to a living organism.
Toxicity: (1) The relative degree of being poisonous or toxic. A condition that may exist in wastes and will inhibit or destroy the growth or function of certain organisms. (2) The degree to which a chemical is poisonous to the plant or animal life in specified surroundings.
TPA: See *Third-party access*.
TPC (Lift): See *Tubing performance curve*.
TPC (Production): Theoretical production capacity.
Traceability: The ability to trace the components of a product throughout the supply and manufacturing system from raw material to finished and installed product.
Trace Element (Analysis): An element found only in minor amounts (usually less than 1.0 mg/L).
Tracer (Injector): Chemicals placed in the flow stream of an injector to determine that the water takes from an injector to the producing wells.
Tracer Log (Fluid Movement): A log that uses radioactive tracer to monitor fluid movement in the wellbore or measure losses from the wellbore.
Tracer Log (Fracturing): A log that uses a spectral gamma ray and multiple marked sand tracers to analyze proppant placement.

T

Track: A recording of one measurement from a log.
Tractor: An electrically or hydraulically powered downhole tool with driven wheels or slip and hydraulic extension capability that can pull a tool string along a highly deviated well.
Trader: Gas merchant who purchases natural gas from a producer, supplier, or another trader and resells it to a pipeline, utility, or end user, usually taking title and assisting in arranging transportation. See *Marketer*.
Train: A series of units that together accomplish a complex process.
Transducer: A device for converting energy from one form to another, such as optical energy to electrical energy.
Transformer: A device that uses magnetic force to transfer electrical energy from one coil of wire to another. In the process, transformers can also change the voltage at which this electrical energy is transmitted.
Transient: A short-lived state. Generally used describing reservoirs during production as pressure is progressively drawn down near the wellbore and slowly permeates the rock outward.
Transitional Spacer: A fluid that separates two incompatible fluids during well cleanout and prepares the wellbore for the next fluid.
Transition Zone (Flow): A zone where the flow type or saturation changes due to gas breakout, gas expansion, shear, or turbulence.
Transmissibility: A measure of the conductivity of the formation corrected for the viscosity of the flowing fluid. kh/mu.
Transmission: (1) The transport of large quantities of natural gas at high pressures, often through national or regional transmission systems. (2) The electrical transfer of a signal, message, or other form of data from one location to another.
Transmission Company: Company that obtains the major portion of its operating revenues from the operation of a natural gas transmission system and/or from mainline sales to industrial customers.
Transmission Line: Pipeline transporting natural gas from principal supply areas to distribution centers, large-volume customers, or other transmission lines.
Transportation: The movement of natural gas for third parties through pipeline facilities for a fee.
Transportation Contract: Contract setting forth the terms and conditions applicable to natural gas or electric transportation services.
Transporter: Pipeline company that transports natural gas for a shipper.
Transport-or-Pay Contract: A contract between a natural gas producer and a pipeline company that requires the pipeline company to pay for a set amount of natural gas whether or not the buyer takes delivery of the full amount.
Trap: (1) In the wastewater collection system of a building, plumbing codes require every drain connection from an appliance or fixture to have a trap.

The trap in this case is a gooseneck that holds water to prevent vapors or gases in a collection system from entering the building. (2) Various other types of special traps are used in collection systems such as a grit trap or sand trap.

Traveling and Crown Blocks: The large, heavy-duty block hanging in the derrick and to which the hook is attached. The traveling block supports the drill column and "travels" up and down as it hoists the pipe out of the hole and lowers it in. The traveling block may contain from three to six sheaves depending upon the loads to be handled and the mechanical advantage necessary. The wire line from the hoisting drum on the draw works runs to the derrick's crown block and down to the traveling block's sheaves. The crown block is a stationary pulley located at the top of the derrick.

Traveling Block: The block of sheaves or pulleys that moves with the pipe during running or pulling.

Traveling Valve: The valve at the top of the pump in a beam pump.

Treater: A separator vessel.

Treating Fluid: The fluids used in a kill, stimulation, cleanout, etc.

Treating Iron: Temporary surface piping rigged up for a stimulation or well kill operation.

Treating Plant: Facility that treats raw natural gas to remove undesirable impurities such as carbon dioxide, hydrogen sulfide, and water vapor.

Tree Cap: A blind flange over a valve at the top of the tree.

Tree Saver: An isolation device commonly used in fracturing to protect the tree from pressure and proppant erosion.

Trench Magnet: A magnet in the return trough from wellhead to shaker that removes suspended metal particles from the fluid.

Trend: An indefinite term normally used to identify a producing formation over a large area of production.

TRI: Toxics release inventory.

Triassic: A geologic time from 200 million to 250 million years ago.

Triaxial: Axial, radial, and tangential stress testing.

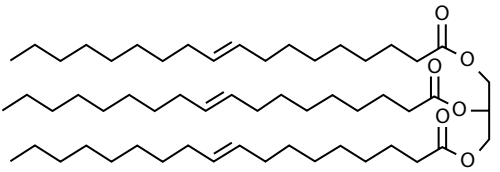
Trickling Filter: A treatment process in which the wastewater trickles over media that provide the opportunity for the formation of slimes or biomass that contains organisms that feed upon and remove wastes from the water being treated.

Trickling Filter Media: Rocks or other durable materials that make up the body of the filter. Synthetic (manufactured) media have been used successfully.

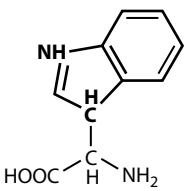
Trihalomethanes: Derivatives of methane, CH_4, in which three halogen atoms (chlorine or bromine) are substituted for three of the hydrogen atoms. Often formed during chlorination by reactions with natural organic materials in the water. The resulting compounds (THMs) are suspected of causing cancer.

T

Triolein: Triolein is the principal component of olive oil. Triolein is a triglyceride—it consists of glycerol with three ester linkages. It may be hydrolyzed (breaking the ester linkages) to form oleate ions in a saponification reaction.



Trip: Pulling all pipe from the well and rerunning the pipe to bottom.
Trip Gas: (1) Mud logging term. (2) Gas that enters the wellbore during a trip of the drilling string. May be due to swabbing and/or lowering the mud equivalent circulating density during pump shutdowns.
Trip In: Run in the hole with tubing or drill pipe.
Trip Margin: Any mud density over the amount needed to balance the formation with a static mud column. Related to overbalance.
Trip Out: Pull a string of tubing or drill pipe out of the hole.
Trip Tank: A smaller tank that holds the fluids from running or pulling a string of pipe. Because of its smaller volume, it is used to quickly spot incoming kicks or fluid losses.
True Vertical Depth: The vertical depth from the surface to the depth of interest. Used for formation comparison and calculation of hydraulic pressures.
Trunk Line: A pipeline for the transportation of oil or natural gas from producing areas to refineries or terminals.
Trunk Line Stations: Receive oil from the gathering station and move the oil to the refineries and shipping terminals. Booster pumps are located along the line to maintain system pressure.
Tryptophan: Any enthusiastic admirer of the Slovenian guitarist Wenceslas Trypto. Actually, it is an amino acid with the useful property of absorbing ultraviolet light, helping to make proteins visible to detectors in chromatographs. Some vitamin suppliers call it "the natural alternative to Prozac." Tryptophan's biochemical symbol is T and it looks like this



TSR: See *Tubing seal bore receptacle*.
TSS: See *Total suspended solids*.
TSTM (Flow Measurement): Too small to measure.
TT: Through tubing.

TTD: Through tubing drilling.
TTFWO: Time to first workover.
TTGP: Through tubing gravel packing.
TTP (Perforating): Through tubing perforating.
TTP (Tubular): Tubing tail plug.
TTR: Through tubing retrievable.
TTRD: Through tubing rotary drilling.
TU: See Turbidity units.
Tubing: (1) The piping installed in wells for the production of oil and gas. (2) Small-diameter pipe that is installed in the casing. Oil is produced through tubing because it increases the viscosity of fluid and a well's flow capabilities. (3) Typically the smaller, inner string of pipe in a well that is primarily used for a fluid flow path.
Tubing Anchor: A packer-like device without seals that keeps the tubing from moving. Common in rod pumped wells.
Tubing Bonnet (Wellhead): The spool or hanger receiver in the wellhead, above which the master valve is the primary control.
Tubing Bowl: A section in a part of the wellhead that accommodates the tubing hanger.
Tubing Conveyed: Movement of any tool via the tubing string.
Tubing End Locator: A wire line device that indicates when the end of a tubing is reached.
Tubing Hanger: A slip set or donut that suspends and holds the top of the tubing in the wellhead.
Tubing Head: A flanged spool containing the tubing bowl where the tubing hanger will set and seal.
Tubingless Completion: A low-cost completion or multiple completion in which the tubing strings are cemented directly in the hole. There is no outer casing. Due to the small tubing diameters, the potential to repair or reenter the well for repairs is limited.
Tubing Performance Curve: A tubing specific relationship that is plotted with the IPR curve to select the tubing size for the well.
Tubing Pressure: The pressure on the tubing during either flow or shut-in.
Tubing Pump: A beam lift pump where the barrel of the pump is attached to the tubing.
Tubing Retrievable: Any equipment pulled with the tubing string.
Tubing Seal Bore Receptacle: A type of polished bore receptacle where the receptacle is on the tubing and the stinger is looking up.
Tubing Spider: The holder for the slips on a rig. Suspends the tubing during connection makeup.
Tubing Tail: End of tubing.
Tubing Valve: A gas lift valve controlled by pressure in the tubing.
Tugger: A winch line or other device that can pull equipment into place.
Tungsten Carbide: A hard, abrasion-resistant compound used in cutting tools such as mills and bits.

T

Tungstic: Tungstic acid comes in two forms—orthotungstic acid, which is H_2WO_4, and metatungstic acid, which is $H_2W_4O_{13} \cdot 9H_2O$. The tungstate anion is WO_4^{2-}.
Turbidity: The cloudy appearance of water caused by the presence of suspended and colloidal matter. In the waterworks field, a turbidity measurement is used to indicate the clarity of water. Technically, turbidity is an optical property of the water based on the amount of light reflected by suspended particles. Turbidity cannot be directly equated to suspended solids because white particles reflect more light than dark-colored particles and many small particles will reflect more light than an equivalent large particle.
Turbidity Meter: An instrument for measuring and comparing the turbidity of liquids by passing light through them and determining how much light is reflected by the particles in the liquid. The normal measuring range is 0–100 and is expressed as nephelometric turbidity units (NTUs).
Turbidity Units: Turbidity units are a measure of the cloudiness of water. If measured by a nephelometric (deflected light) instrumental procedure, turbidity units are expressed in NTUs or simply TU. Those turbidity units obtained by visual methods are expressed in Jackson turbidity unit (JTU), which is a measure of the cloudiness of water; they are used to indicate the clarity of water. There is no real connection between NTUs and JTUs. The Jackson turbidimeter is a visual method, and the nephelometer is an instrumental method based on deflected light.
Turbine: A piece of equipment in which a shaft is steadily rotated by the impact of a current of steam, air, water, or other fluids directed from jets or nozzles upon blades of a wheel.
Turbine Motor: A motor spun by injected fluid moving past vanes affixed to the rotor.
Turbo Drill: A turbine motor for drilling.
Turbulent Flow: Nonlaminar flow, usually above a Reynolds number (NRe) of about 3000. The Blasius equation estimates the friction factor for NRe values less than 100,000 as fB = 0.0791/NRe 0.25.
Turbulent Mixers: Devices that mix air bubbles and water and cause turbulence to dissolve oxygen in the water.
Turnaround: (1) A period of brisk activity at a plant or receiving terminal when processing units, or portions of them, are shut down either for scheduled maintenance or for the installation of new equipment and systems. (2) With a refinery unit, the procedure of shutting the unit down after a normal run, doing the necessary maintenance and repair work, and putting the unit back on stream.
Turn Back of Capacity: A situation that occurs when shipper contracts expire, without renewal or recontracting. Shippers "turn back" all or part of their firm contracted capacity to the pipeline company.
Turner Equation: An equation that predicts the minimum gas flow to lift liquids in wells above 1000 psi flowing pressure.
Turnkey Contract: A contract in which an operator or drilling contractor agrees to furnish all labor and materials necessary to drill a well to a certain depth or

stage of completion for a specified sum of money. The operator or contractor assumes all of the responsibility and risks involved in completing the operation.
Turnkey (Drilling): A type of a drilling contract. Once it meant the entire job, beginning to end, and often to ready-to-produce for a set price, however, the term has numerous meanings as defined by individual contracts.
Turnkey Supply: Delivery of an operational system.
Turret Mooring: The turret system is integrated into or attached to the hull of the tanker, in most cases near the bow, and allows the tanker to weathervane around it and thereby take up the line of least resistance to the combined forces of wind, waves, and current. A high-pressure oil and gas swivel stack is mounted onto the mooring system. This swivel stack is the connection between the risers from the subsea flow lines on the seabed to the piping onboard the vessel. For reasons of size and cost, the number of swivels is kept to an internal turret and external turret minimum, and therefore, the flow of oil and gas has to be manifolded in the turret area, particularly when the system produces a large number of wells. The turret mooring and high-pressure swivel stack are thus the essential components of an FPSO.
TVD: See *True vertical depth*.
TVDTR: True vertical depth from the rotary table.
TWC (Core): Thick-walled cylinder.
TWC (Flow Path): Two-way check.
TWC (Pipe): Thick-walled compression strength.
Twinning (Flow Lines): Adding an extra flow line with the same path to increase capacity.
Twinning (Wellbore): Using a single slot on a platform to house two wellbores, with independent controls, that are drilled to different parts of the reservoir.
Twisted Pair: A type of cable in which pairs of conductors are twisted together to produce certain electric properties.
Twist-Off: To separate the drill string during rotation, usually from excess torque.
Two Barrier: An operating philosophy and sometimes a requirement that calls for having two barriers to flow from a well. Most appropriate for active drilling, workover, or intervention. May not be appropriate for all production wells but is appropriate for wells with higher risk factors concerning safety or environmental.
Two-Stage Filters: Two filters are used. Effluent from the first filter goes to the second filter, either directly or with a clarifier between the two filters.
Type Curve: A method of analysis of well behavior by matching the problem curve to curves drawn from known conditions.

U

UB: See *Underbalance.*
UBD: See *Underbalance drilling.*
UBI: Ultrasonic borehole imager.
UBO: Underbalance operations.
UCS: See *Unconfined compressive strength.*
UIC: Underground injection control.
ULCC: See *Ultralarge crude carrier.*
Ultimate Customer: Customer that purchases energy for consumption and not for resale. See *End user.*
Ultimate Potential: An estimate of recoverable reserves that will have been produced by the time all exploration and development activity is completed; includes production to date, remaining reserves, development of existing pools, and new discoveries.
Ultimate Strength: The maximum stress that a material can withstand.
Ultra-Deep Water: More than 1000 meters water depth.
Ultrafiltration: A membrane filters process used for the removal of some organic compounds in an aqueous (watery) solution.
Ultrahighpressure Water Jetting: Water jetting at pressures over 25,000 psi.
Ultralarge Crude Carrier: Oil transportation vessel from 320,000 to 600,000 dwt.
Ultrasonic: Very high-frequency sonic signals used in measuring distance, surface imperfections, or even metal thicknesses.
Ultraviolet Disinfection: A process using ultraviolet light to kill bacteria and viruses.
Umbilicals: (1) Flexible cables carrying electrical and instrument wiring, hydraulic tubing, and chemical tubing. (2) A control line attached to a remove piece of equipment, usually a subsea wellhead, to provide hydraulic or electrical control, or inject small amounts of chemicals.
UMV: Upper master valve.
Unaccounted for Crude Oil: Represents the arithmetic difference between the calculated supply and the calculated disposition of crude oil. The calculated supply is the sum of crude oil production plus imports minus changes in crude oil stocks. The calculated disposition of crude oil is the sum of crude oil input to refineries, crude oil exports, crude oil burned as fuel, and crude oil losses.
Unaccounted for Natural Gas: Represents the difference between the sum of the components of natural gas supply and the sum of components of natural gas disposition, as reported by survey respondents. These differences may

be due to quantities lost or to the effects of differences in company accounting systems in terms of scope and definition. A positive "unaccounted for" volume means that supply exceeds disposition by that amount. A negative "unaccounted for" volume means that supply is less than disposition.

Unassociated Gas: Natural gas found in reservoirs that do not contain crude oil.

Uncertainty Assessment (Risk): The process of combining uncertainties, as with a Monte Carlo Simulation, to generate output parameters that are represented by probability distributions. No involvement of risk is implied, for example, multiplying ranges of length and width to arrive at a range of resulting areas.

Uncertainty (Risk): A reflection of the measured or perceived possible range of outcomes associated with an event or process. Uncertainty can be expressed as deterministic quantitative value, a qualitative value, or a probability distribution that combines a range of quantitative coefficients with the likelihood that any value in the range will occur.

Unconfined Compressive Strength: A measure of the formation strength from compressive tests on core.

Unconformity: A geologic aged erosional removal from the top of a formation. Reservoir rocks below this surface may contain hydrocarbon deposits if the unconformity acts as a seal.

Unconsolidated Formation: Formations with insufficient cementing agents between the grains to stop movement of individual grains when fluid flows through the formation. Usually less than 2–10 psi compressive strength.

Unconventional Gas: Natural gas that cannot be produced using current technologies.

Unconventional Resources: Hydrocarbon from unconventional and more difficult to produce resources such as (hydrocarbon) shale gas, shale oil, heavy and viscous oil, hydrates, and tight gas.

Underbalance: When the pressure exerted by the column of fluid in the wellbore is less than the pore pressure in the formation.

Underbalanced Perforating: Perforating the well when the pressure in the wellbore is less than the pressure in the formation.

Underbalance Drilling: Drilling with a pressure in the wellbore that is lower than the pressure in the formation.

Underbalance Drilling Level 0: IADC-UBO term. Performance enhancement only; no zones containing hydrocarbons.

Underbalance Drilling Level 1: IADC-UBO term. Well incapable of flow to surface.

Underbalance Drilling Level 2: IADC-UBO term. Well capable of natural flow to surface, but conventional well kill methods are enabled, and limited consequences are possible in case of catastrophic equipment failure.

Underbalance Drilling Level 3: IADC-UBO term. Geothermal and nonhydrocarbon production. Maximum shut-in pressures are less than UBD

equipment's operating pressure rating. Catastrophic failure has immediate, serious consequences.

Underbalance Drilling Level 4: IADC-UBO term. Hydrocarbon production. Maximum shut-in pressures are less than UBD equipment's operating pressure rating. Catastrophic failure has immediate, serious consequences.

Underbalance Drilling Level 5: IADC-UBO term. Maximum projected surface pressures exceed UBO equipment's operating pressure rating, but are below BOP stack rating. Catastrophic failure has immediate, serious consequences.

Underdeposit Corrosion: A corrosion deposit occurring under a scale or bacterial deposition and thus not treatable by corrosion inhibitors that are not designed for the purpose.

Undergauge Hole: Any part of a wellbore drilled with a worn bit.

Underground Blowout: An uncontrolled and unintentional flow of fluids from one formation to another, generally when one or more well barriers have been breached.

Underground Gas Storage: The use of subsurface facilities for storing gas that has been transferred from its original location. The facilities are usually hollowed-out salt domes, natural geological reservoirs (depleted oil or gas fields), or water-bearing sands topped by an impermeable cap rock (aquifer).

Underground Storage Injections: Gas from extraneous sources put into underground storage reservoirs.

Underground Storage Withdrawals: Gas removed from underground storage reservoirs.

Underlift: Under production, short of the allotment or contract volume, that must be accounted for in a contract.

Underream: Enlarge an existing borehole by a special bit that opens to a diameter larger than running diameter by hydraulic or mechanical method or by use of a bi-center bit.

Underreamer: A tool with downhole deployable arms and cutters that allow a larger hole to be drilled below a smaller opening.

Undersaturated Oil: An oil with less gas than its solubility capacity.

Under Travel: When the travel of the rod string at the pump (bottom of the well) is less than the surface rod travel.

Undeveloped Acreage: (1) Leased acreage on which wells have not been drilled or completed to a point that would permit the production of commercial quantities of natural gas and oil, regardless of whether such acreage contains proved reserves. (2) Lease acreage on which wells have not been completed to a point of testing or allowing production.

Undeveloped Reserves: Undeveloped reserves are expected to be recovered: (1) from new wells on undrilled acreage, (2) from deepening existing wells to a different reservoir, or (3) where a relatively large expenditure is required to (a) recomplete an existing well or (b) install production or transportation facilities for primary or improved recovery projects (SPE).

U

Undiscovered Petroleum Initially in Place: That quantity of hydrocarbons estimated yet to be discovered.
Undiscovered Recoverable Resources: Those resources estimated to be recoverable from accumulations believed to exist based on geological and geophysical evidence but not yet verified by drilling, testing, or production.
Undisturbed Zone: Where the zone still has the natural connate fluids.
Undulating: A well path that rises and falls over its length.
Unfinished Oils: All oils requiring further processing, except those requiring only mechanical blending. Unfinished oils are produced by partial refining of crude oil and include naphthas and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum.
Unfractionated Streams: Mixtures of unsegregated natural gas liquid components excluding those in plant condensate. This product is extracted from natural gas.
Uninterrupted Power Supply: Designation of a power supply providing continuous uninterrupted service.
United States: The United States is defined as the 50 states and the District of Columbia.
United States Geological Survey: A US government agency.
Unit Heater: Heater consisting of a fan for circulating air over a heat exchange surface or coil, all enclosed in a common casing.
Unitization: When owners of oil and/or gas reserves pool their individual interests in return for an interest in the overall unit, which is then operated by a single company on behalf of the group, thus increasing efficiency and profitability.
Unitize: Form an operating unit with an operating company from a group of wells in the same field.
Unit Operator: The oil company identified as the operator in a unitized field.
Unit Process: A distinct and separate portion of the total wastewater treatment system.
Unit Value (Consumption): Total price per specified unit, including all taxes, at the point of consumption.
Unit Value (Wellhead): The wellhead sales price, including charges for natural gas plant liquids subsequently removed from the gas, gathering and compression charges, and state production, severance, and/or similar charges.
Unit Ventilator: Fan–coil unit package devised for applications in which the use of outdoor and return air mixing is intended to satisfy tempering requirements and ventilation needs.
Universal Transverse Mercator: An orienting/origin defining system used in surveys.
Unloading: Lightening of a fluid column, usually by adding gas, until the fluid flows out of the well.
Unloading Valve: Generally a downhole valve that, when opened, permits circulation.

Unproved Reserves: Unproved reserves are based on geologic and/or engineering data similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved. Unproved reserves may be further classified as probable reserves and possible reserves. Unproved reserves may be estimated assuming future economic conditions different from those prevailing at the time of the estimate. The effect of possible future improvements in economic conditions and technological developments can be expressed by allocating appropriate quantities of reserves to the probable and possible classifications (SPE).
Unsaturates: Hydrocarbon compounds of such molecular structure that they readily pick up additional hydrogen atoms. Olefins and diolefins, which occur in cracking, are of this type.
Unsteady State: Nonconstant, in fluid flow a condition marked by changing flow properties.
Unsulfonated Residue: That portion of an oil that is not acted upon when the oil is agitated with a definite amount of sulfuric acid under specified conditions.
Unweighted Fluid: The base fluid without added salts or solids.
UO: Oil viscosity.
Updip: In an upward direction in a tilting formation.
Updip Well: A well located higher in the structure.
Upgrade Projects: Various projects that are undertaken both onshore and offshore to upgrade or replace the existing facilities to ensure continued production over a long period of time.
Upgrading: The process of converting heavy oil or bitumen into synthetic crude oil.
Uplift: Vertical movement of a formation to a shallower depth than when it was deposited.
Upper Completion: The part of the completion above the packer.
Upper Crown Plug (Subsea): A plug that fits in the bore of a subsea tree to serve as the secondary barrier against reservoir pressure.
Upper Kelly Cock: A valve at the top of the kelly that can be closed in the event of an inside tubing kick or high pressures.
UPS: See *Uninterrupted power supply.*
Upset (Chemical): In a produced fluid stream, an upset is when chemical or physical reactions create precipitates or emulsions.
Upset Connection: A pipe connection with thicker wall area at the coupling. An external upset is thicker to the outside with a consistent ID with the pipe and is called an EU or EUE. A connection upset to the inside (smaller ID but consistent OD) is an IU.
Upset Digester: An upset digester does not decompose organic matter properly. An upset digester is characterized by low gas production, high volatile acid/alkalinity relationship, and poor liquids–solids separation.

A digester in an upset condition is sometimes called a "sour" or "stuck" digester.

Upset (Mechanical): An enlargement in the string, usually for cutting threads. May be internal or external upset.

Up Steam: In the fluid path before the point of interest.

Upstream: Oil and natural gas exploration and production activities, plus gas gathering, processing, and marketing operations.

UR: See *Underreamer*.

Uranium: U-238, one of the natural isotopes that as a trace element may incorporate into the matrix of naturally forming barium or strontium sulfate scale and make it a very low-level radioactive material (NORM scale).

USDW: Underground source of drinking water.

US EPA: United States Environmental Protection Agency.

USG: Tanker market term for US Gulf, more properly known as the Gulf of Mexico.

USGS: See *United States Geological Survey*.

USIT: A brand name for ultrasonic inspection tool, a corrosion damage monitoring device.

USITM: Ultrasonic imager.

Utilization Factor: A ratio of the maximum demand of a system or part of a system to its rated capacity.

UTM: See *Universal Transverse Mercator*.

UV: Ultraviolet.

V

Vacuum Breaker: A device that relieves the partial vacuum in pipelines to prevent back siphonage.
Vacuum Distillation: (1) Distillation under reduced pressure (less the atmospheric) that lowers the boiling temperature of the liquid being distilled. This technique with its relatively low temperatures prevents cracking or decomposition of the charge stock. (2) Distillation under reduced pressure, which reduces the boiling temperature of the material being distilled sufficiently to prevent decomposition or cracking. See *Distillation*.
Value-Added Industries: Digging stuff up and doing something to it so you can sell it for more than stuff you just dig up and sell. What we should be aiming to do more of for Australia's economy.
Valve: Any of several valves: plug, gate, butterfly, needle, etc., used in oil field operations.
Van der Waals Forces: (1) Attractive forces acting between uncharged molecules. There are three kinds: (a) dipole–dipole forces, (b) dipole-induced dipole forces, and (c) dispersion forces. Named after Johannes Diderik van der Waals (1837–1923). (2) Attraction created by the weak electrostatic forces of distributed charge in a polar molecule. Even though the water molecule as a whole is neutral, the polarity or the molecule leads to attraction between individual molecules from slight negative and positive centers. This enters into effects of viscosity and surface tension.
Vane Axial Fan: Disk-type wheel within a cylinder, a set of air guide vanes located either before or after the wheel, and including driving mechanism supports either for belt drive or for direct connection.
VAPEX: Vapor-assisted petroleum extraction.
Vapor Displacement: Release of vapors that had previously occupied space above liquid fuels stored in tanks. These releases occur when tanks are emptied and filled.
Vapor Lock: The displacement of liquid fuel in the feed line and the interruption of normal motor operation, caused by the vaporization of light ends in the gasoline. Vaporization occurs when the temperature at some point in the fuel system exceeds the boiling points of the volatile light ends.
Vapor Pressure: (1) The pressure exerted by the vapors released from an oil at a given temperature when enclosed in an airtight container. For motor gasoline, a criterion of vapor-lock tendencies; for light products, generally an index of storage and handling requirements. ASTM D323 is the standard method of measuring vapor pressure for volatile products except for

liquefied petroleum gases, where D 1267 is used. (2) The pressure exerted by a vapor that is in equilibrium with a liquid. (3) The lowest pressure at which a liquid contained in a closed vessel at a given temperature can remain in the liquid state without evaporation, that is, the pressure exerted when the substance is in equilibrium with its own vapor. Vapor pressure is a function of the substance and of temperature.

Vapor Recovery Unit: (1) A refinery unit to which gases and vaporized gasoline from various processing operations are charged to separate the mixed charged into desired intermediate qualities for further processing. (2) A device that removes mists and vapors from gas in a tank or enclosure.

Variable Bore Rams: A ram element in a blowout preventer (BOP) that will fit more than one size of pipe. Commonly a ram element that can seal around the pipe body or the coupling.

Variable Costs (Wastewater): Costs that a utility must cover or pay that are associated with the actual collection, treatment, and disposal of wastewater. The costs vary or fluctuate.

Variable Price: A contracted price that can change by the hour, day, month, etc.

Variable Speed Drive: A mechanism that allows the motor speed and power to optimally match the requirements of a pump.

VASPS (Subsea): Vertical annular separation production system.

VAV: Variable air volume.

VAV Box: Variable air volume terminal device.

V-Door: See *Vee door.*

Vee Door: (1) An opening at flow level in the side of the rig to facilitate bringing in pipe. (2) The opening in the rig framework that allows pipe to be pulled upright from the catwalk.

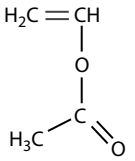
Velocity: The theoretical vertical height to which a liquid may be raised due to its kinetic energy. It is equal to the square of the velocity divided by twice the acceleration due to gravity ($V/2g$).

Velocity Gradient (Seismic): Usually the vertical velocity gradient, that is, the rate of change of velocity of sound traveling through rock with depth. Normally, it refers to seismic velocity at seismic frequencies, that is, smoothly varying (rather than rapidly varying, as with a sonic log). With respect to material being sheared, velocity gradient is the change (dv) in relative velocity (v) between parallel planes with respect to the change (dz) in perpendicular distance (z) throughout the depth of the material. Velocity gradient has the same dimensions as rate of shear, which is reciprocal seconds.

Velocity Pressure: In a moving fluid, the pressure due to the velocity and density of the fluid.

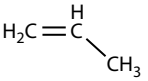
Velocity Safety Valve: A valve specially dressed for a particular well and kept current with maximum flow potential that can shut in the well if surface control is lost. Also called a storm choke—an early subsurface safety valve.

Velocity Stack: A long tube used in well fire fighting operations to move all the fluids and the fire up above the damaged wellhead. May also be used to put out the fire in some cases.
Velocity String: A small-diameter tubing string, often coiled tubing that is suspended inside the existing production tubing. By occupying part of the flow path space, the velocity of the produced fluid is increased, and the potential to lift water from the well is increased.
Vent: Release gas pressure.
Vented: Gas released into the air on the base site or at processing plants.
Ventilator: Device for replacing air inside a room by outside air.
Vent Screen: A length of tubing with a screen at each end, intended to be installed through tubing and half of the assembly covered with gravel. A common repair for a breached screen. Generally low rate.
Venturi: A shaped nozzle.
Verification: Tool surface operational check.
Vertical Depth: Vertical extent of a depth measurement.
Vertical Seismic Profile: Run in a single wellbore. Helps correlate logs with seismic data.
Vertical Tree (Subsea): A subsea tree with the master valve above the tubing hanger.
Very Large Crude Carrier: Oil transportation vessel from 200,000 to 320,000 dwt. Also see *Large range (LR) and very large crude carriers*.
V-G Meter: Fann viscosimeter.
VI: See *Viscosity index*.
Vibroseis: (1) The process of producing seismic shock waves with "thumpers" or vibrator vehicles. (2) A seismic survey where the energy is generated by vibrators attached to large truck-mounted plates at the surface.
Vinyl Acetate: (1) Vinyl acetate is a colorless, clear liquid with a sweet fruity smell; it does not occur naturally in the environment. Vinyl acetate readily evaporates into air and dissolves easily in water; it is flammable and may be ignited by heat, sparks, or flames. It is primarily used in the production of polyvinyl acetate and polyvinyl alcohol, which are widely used in adhesives for packaging and construction and in water-based paints. (2) A common monomer used to make chain-growth polymers.



Vinyl Chloride: (1) Vinyl chloride is a colorless, flammable gas (CH_2=CHCl) with a faintly sweet odor. It liquefies in a freezing mixture and polymerizes in light, air, or heat unless stabilized by inhibitors such as phenol. It is industrially important because of the inherent flame-retardant properties of its

polymer. It is a monomer for polyvinyl chloride (PVC), a plastic resin used in innumerable consumer and industrial products. (2) One of the most common monomers used to make chain-growth polymers. Here is a picture:



One of the few legitimate arguments against PVC in a country like Australia is that making it involves shipping this potent carcinogen from place to place in trucks.

Virgin Stock: Oil processed from crude oil that contains no cracked material. Also called straight-run stock.

Visbreaking: (1) A thermal cracking process in which heavy atmospheric or vacuum-still bottoms are cracked at moderate temperatures to increase the production of distillate products and reduce viscosity of the distillation residues. (2) Viscosity breaking is a low-temperature cracking process used to reduce the viscosity or pour point of straight-run residuum.

Viscosifiers: Any material that increases the viscosity of a fluid.

Viscosity: A measure of the resistance that a fluid makes to motion or flow; it usually decreases as the temperature increases.

Viscosity Index: An arbitrary number, usually between 0 and 200, which is a measure of the temperature dependence of an oil's viscosity.

Viscosity Index Improver: A lubricant additive, usually a high molecular mass polymer, that reduces the tendency of an oil's viscosity to change with temperature.

VIS or VISC: See *Viscosity*.

VIT: Vacuum insulated tubing.

Vitrinite Reflectance: A measure of shale maturity based on whether it has generated hydrocarbons. The value is in units of reflectance, in% Ro with values of 0 to >3.

VIV (Riser): Velocity-induced vibration.

VLCC: See *Very large crude carrier*.

VME: Von Mises equivalent.

VOCs: See *Volatile organic compounds*.

Voids: Holes, blank spots, or empty areas.

Volatile: A volatile substance is one that is capable of being evaporated or changed to a vapor at relatively low temperatures. Volatile substances also can be partially removed by air stripping. In terms of solid analysis, volatile refers to materials lost (including most organic matter) upon ignition in a muffle furnace for 60 min at 550°C. Natural volatile materials are chemical substances usually of animals or plant origin. Manufactured or synthetic volatile materials such as ether, acetone, and carbon tetrachloride are highly volatile and not of plant or animal origin.

Volatile Acids: Fatty acids produced during digestion that are soluble in water and that can be steam-distilled at atmospheric pressure. Also called "organic acids." Volatile acids are commonly reported as equivalent to acetic acid.
Volatile Oil: Easily evaporated oil, usually above a gravity of 40° API.
Volatile Organic Compounds: Gases and vapors, such as benzene, released by petroleum refineries, petrochemical plants, plastic manufacturing, and the distribution and use of gasoline; volatile organic compounds include carcinogens and chemicals that react with sunlight and nitrogen oxides to form ground-level ozone, a component of smog.
Volatile Solids: Those solids in water, wastewater, or other liquids that are lost on ignition of the dry solids at 550°C for 60 min.
Voltage Drop: Voltage reduction due to wire resistance.
Volume Control Damper: Device mounted in a duct or opening used to vary the volume of air flowing through.
Volumetric: Measurement by volume; as opposed to gravimetric, which is measurement by weight.
Volumetric Drive: A reservoir drive mechanism provided by the expansion of solution gas in the oil.
Volute: A spiral-shaped casing, surrounding the impeller of a centrifugal pump, which collects the liquid discharged by the impeller.
Vortex Shedding (Marine): A form of hydrodynamic loading of deep water structures that may lock into a structure's natural vibration frequency. May include loop currents.
Vreeland Effect: A dynamic force. Most common is suddenly stopping a traveling casing string. May cause a pipe joint to separate.
VRU: See *Vapor recovery unit*.
VSD: See *Variable speed drive*.
VSP: See *Vertical seismic profile*.
V-Stack: A seal stack of chevron-type seals.
Vug: A large open pore feature. May be associated with chemical dissolution of part of the matrix over geologic time.
Vulnerability Assessment (Water): An evaluation of drinking water source quality and its vulnerability to contamination by pathogens and toxic chemicals.
VXT (Subsea): See *Vertical tree (subsea)*.

W

WAG: See *Water-alternating gas*.
Wait and Weigh Method: A method of controlling kicks in which the weight of the kill weight mud is calculated by the difference between the difference of casing and tubing pressure and the volume of fluid increase; followed by injection of the kill weight mud to displace the lighter weight mud and the kick in a single circulation.
Waiting on Cement: The time spent waiting on cement to reach sufficient strength to proceed with operations.
Walking Beam (Beam Lift): The main moving beam in a beam lift pump.
Walking Squeeze: A cement squeeze under the fracture pressure, trying to build pressure slowly. Typical in fracture sealing.
Walking Wash: Placement of a fluid in the wellbore with coiled tubing where the fluid is spotted at the bottom of the zone and the CT is withdrawn at the same rate the hole is filled.
Wall Cake: Filter cake.
Wall Hook: A device at the bottom of an overshot for centering the upward looking end of pipe that may be laying against the casing. The hook may resemble a finger or strip of metal pointing clockwise and used with pipe rotation to surround and center the pipe.
Wall Stuck: Usually differential sticking (by overbalance) but may also include effect of friction and mud cake adhesion to the tubing or drill string.
WARI: Walk around rig inspection.
WAS: See *Waste activated sludge*.
Wash: In petroleum refining, to cleanse or purify oils by agitation with water or chemicals.
Washing: Forced circulation of fluid through the perforated interval with the intent of generating communication between perforations or intervals.
Washout (Drilling): Flow cutting of equipment downhole.
Washout (Formation): An enlarged area of the wellbore caused by the removal of formation grains during drilling or circulation.
Wash Over: A recovery process in which a larger pipe is used with circulation to surround and capture a pipe stuck in sand or cuttings. Circulation is critical to washing the sand from around the fish. Can be used with normal or reverse circulation.
Wash Over Operation: Using an overshot tool and circulation to remove debris above and from around a fish and grip the fish with the overshot.
Wash Over Pipe: A recovery tool that fits over the OD of the lost pipe.

W

Wash Pipe: A nonupset pipe with an outer diameter (OD) close enough to the inner diameter (ID) of an inner pipe to cause hydraulic diversion. Used inside a screen during gravel packing to direct flow and gravel to the bottom of the screen and effect a tighter pack. Developing hydraulic diversion benefits with a wash pipe usually requires that the wash pipe OD be at least 80% or the outer pipe or screen's ID.

Waste Activated Sludge (mg/L): The excess growth of microorganisms that must be removed from the process to keep the biological system in balance.

Wastewater: (1) Water with any home or industrial waste. (2) A community's used water and water-carried solids (including used water from industrial processes) that flow to a treatment plant. Storm water, surface water, and groundwater infiltration also may be included in the wastewater that enters a wastewater treatment plant. The term "sewage" usually refers to household wastes, but this word is being replaced by the term "wastewater."

Wastewater Collection System: The pipe system for collecting and carrying water and water-carried wastes from domestic and industrial sources to a wastewater treatment plant.

Wastewater Facilities: The pipes, conduits, structures, equipment, and processes required to collect, convey, and treat domestic and industrial wastes and dispose of the effluent and sludge.

Wastewater Ordinance: The basic document granting authority to administer a pretreatment inspection program. This ordinance must contain certain basic elements to provide a legal framework for effective enforcement.

Wastewater Treatment Plant: An arrangement of pipes, equipment, devices, tanks, and structures for treating wastewater and industrial wastes. A water pollution control plant.

Wasting Assets: Assets that will lose or are losing their value.

Water-Alternating Gas: A tertiary drive mechanism using alternating injections of water and gas.

Water-Based Emulsion or Mud: Mud with water as the external phase. May contain clays, polymers, or even an internal oil phase.

Water Block: A relative permeability problem usually occurring in a gas zone. The highest potential formations for water blocks are low-pressure gas sands (<0.25 psi/ft pore pressure), with small pore throats (<10 μm), lower permeability (<100 mD), and when using water that has a surface tension about 50 dyne/cm.

Water Conning: The encroachment of water in a wellbore in a water-drive reservoir owing to an excessive rate of production. The water below the oil moves upward to the wellbore through channels, fissures, and permeable streaks, leaving the oil sidetracked and bypassed.

Water Cushion: A level of water in a string to be used for flow back to generate an initial damping back pressure.

Water Cut: The amount of water in percent in a produced fluid stream.

Water Cycle: The process of evaporation of water into the air and its return to Earth by precipitation (rain or snow). This process also includes transpiration from plants, groundwater movement, and runoff into rivers, streams, and the ocean. Also called the "hydrologic cycle."
Water Disposal Well: A well where produced water is injected back into a deep, usually depleted zone but one that is not connected to the producing pay zones.
Water Drive: A reservoir drive mechanism where an aquifer provides pressure support and pushes toward the low-pressure area around the well, driving the oil ahead of it.
Water Flooding: (1) A secondary recovery method for the production of oil from a formation. Oil will float on water. When water is injected into some formations, the oil will float or be washed to the surface, thereby increasing the amount of production from a well or field. Some formations will not react to this type of stimulation. (2) One method of secondary recovery in which water is injected into an oil reservoir to force additional oil out of the reservoir rock and into the wellbore of producing wells.
Water Frac: A fracturing treatment using ungelled water.
Water Hammer: A sharp, sometimes very high force and pressure load that is created when a valve is closed too rapidly in a flowing stream. The major force occurs behind the valve. Most common in a production well when sudden closure (slam closure) of a subsurface safety valve can create a load of over 50,000 lb force in the tubing tensile/compressive loading. In an injector, the water hammer effects of a rapid shut-in are lower, but some effects may be seen on the formation.
Water Heater: Closed vessel in which water is heated by the combustion of fuels, electricity, or any other source and is withdrawn for use external to the system at pressures not exceeding 160 psig, including the apparatus by which heat is generated, and all controls and devices necessary to prevent water temperatures from exceeding 210°F.
Water Injection: Method of enhanced recovery in which water is injected into an oil reservoir to increase pressure and maintain or improve oil production.
Water Injector Well: A well used to inject water into a reservoir to maintain pressure or to drive hydrocarbons toward producing wells.
Water-in-Oil Emulsion: Water droplets suspended in a continuous oil phase.
Water Mellon Mill: A string mill, designed to enlarge the hole.
Water of Condensation: The water initially in vapor phase within a gas that condenses out when gas cools. Usually 1 to 2 bbls per million scf.
Water Pack: A gravel packing treatment using ungelled water as the carrier fluid.
Watershed: (1) The region or land area that contributes to the drainage or catchment area above a specific point on a stream or river. (2) All lands that drain runoff water into a specific area.

W

Water Table (Drilling): The top of the drilling mast where the crown or stationary block rests.
Water Table (Water Supply): The upper level of groundwater.
Water Treatment: Process that alters supply water so that it can be used for process or HVAC purposes without deleterious effect.
Water Wet: A surface condition in which the coating chemicals show an attraction preference for water.
Watt: The unit of measurement of electric power or rate of work. One amp represents the amount of current at a pressure of one volt.
Waveform: Characteristic shape of an electric current or signal. The ace output from an inverter.
Wavelength: The distance between the same two points on adjacent waves; the time required for a wave to complete a single cycle.
Wave Train: Response of an elastic formation to an acoustic energy impulse.
Wax: (1) Paraffin, C18+ alkane fraction. (2) Any fatty substance that is relatively hard, brittle, and nongreasy at room temperature. Most waxes, whether derived from mineral, vegetable, or animal sources, are a mixture of relatively high molecular weight (more than 30 carbons) hydrocarbons, esters, alcohols, and carboxylic acids.
Wax Beads: A diverting agent.
WBM: See *Water-based emulsion or mud*.
WBS (Rock Strength): Wellbore stability.
WBS (Seismic): Wellbore seismic.
WC: See *Water cut*.
WCL (SSSV): Well to control line communication.
Weak Link (Coiled Tubing): A weak point at the top of the BHA, designed to separate before the tubing fails if the BHA becomes stuck.
Weak Point (Wire Line or CT): A designed weak point, usually right about the fishing neck on the tool that is designed to separate when excess tension or axial loads are applied.
Wear Bushing: A part surrounding the drill string designed to wear instead of more expensive components of the rotary train.
Weathered Crude: Crude petroleum that, owing to evaporation and other natural causes during storage and handling, has lost an appreciable quantity of its more volatile components.
Weathered Mineral: A chemically altered mineral that has lost some definition of the lattice or crystal shape. May be more unstable or more reactive.
Weather Window: Period of time during which weather conditions favorable for operations will or may exist.
Weave Screens (Sand Control): Screens where the filtration layer is largely layers of woven screen wire.
Weevil: An inexperienced worker.
WEG: See *Wire line entry guide*.
Weight Bar: Same as a weight stem, a bar used mainly to add weight in a wire line BHA.

Weight Indicator: A string weight measurement device that can report the weight on the string at any time.
Weight Stem: A weight bar in a wire line tool BHA.
Weighting Materials: Solids added to increase density in a fluid.
Weight (Tubing): The weight of a particular tubing size, grade, and weight on a weight per pound basis. Includes the weight of the coupling.
Weight Up: Increase fluid density.
Weir: A wall or plate placed in an open channel and used to measure the flow of water. The depth of the flow over the weir can be used to calculate the flow rate, or a chart or conversion table may be used to convert depth to flow.
Weir Diameter: Circular clarifiers have a circular weir within the outside edge of the clarifier, and all of the water leaving the clarifier flows over this weir. This diameter is the length of a line from one edge of a weir to the opposite edge and passing through the center of the circle formed by the weir.
Weir (Proportional): A specially shaped weir in which the flow through the weir is directly proportional to the head.
Well: A hole bored or drilled into the earth for the purpose of obtaining water, oil, gas, or other natural resources.
Wellbore: (1) The hole in the rock made by the drill bit. (2) A hole drilled or bored into the earth, usually cased with metal pipe, for the production of gas or oil.
Wellbore Cleanout: A treatment designed to remove damage or debris from the wellbore and the perforations.
Wellbore Diagram: The drawing of the well and its equipment showing depths, sizes, grades, and specific equipment.
Wellbore Screen-Out: An early time frac failure when the frac width is too small and the fracture proppant bridges off on the fracture.
Wellbore Storage Effect: The after flow, created by wellbore volume, into a wellbore after the surface valve has been closed.
Wellbore Wash (Chemical Treating): A solvent or acid wash of the wellbore with minimum leak off into the matrix.
Well Cleanup: Removal of solids, completion fluids, and workover fluids by production.
Well Completion: (1) The techniques of preparing a newly drilled well for production. (2) The work of preparing a newly drilled well for production. This is a costly procedure and includes setting and cementing the casing, perforating the casing, running production tubing, hanging the control valves (nippling up the production tree, i.e., Christmas tree), connecting the flow lines, and erecting the flow tanks or lease tanks. (3) The processes involved, after drilling, are properly isolate pressures and fluids and then stimulate or restrain the formations so that hydrocarbons can be produced with minimum amounts of extraneous fluids.
Well Construction: The drilling and completion steps prior to production.
Well Control: Using barriers to prevent unwanted flow of hydrocarbons to surface.

W

Wellhead: (1) The control equipment fitted to the top of a well casing, incorporating outlets, valves, blowout preventers, etc. (2) The equipment installed at the surface of the wellbore. A wellhead includes such equipment as the casing head, tubing hanger, and various valves to control flow from the well.
Wellhead Flange: The flange on the first cemented string of casing to which the BOP is bolted during drilling and on which the wellhead is built after drilling.
Wellhead Price: The value at the mouth of the well. In general, the wellhead price is considered to be the sales price obtainable from a third party in an arm's length transaction. Posted prices, requested prices, or prices as defined by lease agreements, contracts, or tax regulations should be used where applicable.
Well Interference: The change in pressure or flow rate in one well caused by production in another.
Well Jacket: A protective structure built around an offshore well to keep boats or floating debris from damaging the wellhead.
Well Logging: Gathering and recording information about the surface formation, the nature, and the extent of the various downhole rock layers. Also included are records kept by the driller, the record of cuttings, the core analysis drill-stem tests, and the electric, acoustic, and radioactivity logs. Any pertinent information about a well, written and saved, is a log—from sailing ship days.
Well Operation: The act of producing the well with all the efforts involved in bringing the well online, keeping it flowing and shutting it in.
Well Pulling Hoist: A unit used for the retrieval of completion strings and accessories.
Wellsite Information Transfer Standard Markup Language: A standard for transmitting technical data between organizations in the petroleum industry.
Well Sorted: A measurement of the comparison of large to fine grains. A well-sorted formation has a between the smallest and the largest particles.
West Texas Intermediate: A type of crude oil commonly used as a price benchmark.
Wet: Water bearing with little hydrocarbon.
Wet-Bulb Temperature: Temperature indicated by a psychrometer when the bulb of one thermometer is covered with a water-saturated wick over which air is caused to flow.
Wet Combustion: Injecting air and water into a reservoir during a fireflood.
Wet Gas: (1) A hydrocarbon gas with heavier ends (C2+). (2) A gas containing condensable hydrocarbons or other liquids. The term is subject to varying legal definitions as specified by applicable statutes. Natural gasoline, butane, pentane, and other light hydrocarbons can be removed by chilling and pressure or extraction. Usually maximum allowable is 7 lb/mmcf for water content and 0.02 gal/mmcf for natural gasoline.

Wet Gloss Heating Value (Reactions): The total energy transferred as heat in an ideal combustion reaction of a water-saturated gas at a standard temperature and pressure in which all water formed appears as a liquid.
Wet Natural Gas: The natural gas from the wellhead. The gas may have undergone some conditioning and treating to remove water, solids, and carbon dioxide, but it still contains heavier hydrocarbons (ethane and heavier).
Wet Oil: Oil with a water content above specification.
WETS™: Wellwork evaluation tracking system.
Wet Shoe: A casing shoe with poor cement support.
Wettability: The measurement of the wetting phase currently on a formation. Wetting is driven by the fluid or the surfactants in the fluid in contact with the surface.
Wetted Surface: Any surface in contact with the flowing fluids in a well.
Wetting Fluid: The fluid that coats a mineral surface; usually either oil wet or water wet.
Wet Well: A tank or chamber in which the flow of liquid is contained and to which the suction of a pump is connected.
WF: Water flood.
WF: *Wellhead flange*.
WFRV: Water flood regulation valve.
WFT: Wire line formation tester or wire line formation testing. See *Wire line formation tester*.
WG: Wire grab.
WHE (Wells): Wellhead equipment.
WHFP: Wellhead flowing pressure.
Whipstock: A tool used at the bottom of the borehole to change the direction of the drilling bit. The whipstock is, essentially, a wedge that crowds the bit to the side of the hole, causing it to drill at an angle to the vertical.
Whirl (Drilling): A detrimental condition where a bit bites into a part of the hole off center and forms a pivot point that creates impact of the bit and some of the string with the borehole wall.
White Oils: (1) Oils produced by more drastic refining to remove nitrogen and sulfur, unsaturated compounds, and aromatic material. (2) A colloquial term for condensate, gas condensate, and casinghead gasoline; liquid hydrocarbons produced with natural gas.
White Spirits: The functions intermediate between gasoline and kerosene with a boiling range of approximately 150°C–200°C. Mainly used in paints and dry cleaning.
Whole Core: A core as drilled from the reservoir and not separated into smaller cores.
WHP: Wellhead pressure.
WHT: Wellhead temperature.
Wildcat: (1) An exploration well drilled in "unproven territory," without direct evidence of the contents of the underlying rock structure. (2) A well that is drained one or more miles from a proven well.

W

Wildcat Appraisal Well: An appraisal well drilled with minimum preliminary information about the underlying structure and conditions; it usually follows a wildcat well that reported shows of oil or gas.
Window (Casing): An exit point of a lateral from a mother bore, generally a hole cut in the side of the casing to allow sidetracking the well. Can also be where the entire section of the casing is removed.
Window (Hydraulic): The allowable effective fluid density difference between the fracturing pressure and the pressures exerted by a fluid that are needed to control formation flow and the wellbore.
Wing Valve: A valve located at the tree, above the master valve, and on the flow line.
WIO: Working interest owners.
WIOP: Well integrity operations procedure.
Wiper Plug: A pumpable plug with flexible cuplike extensions that seal and isolate the fluid behind the plug from the fluid in front.
Wire Line: The term wire line usually refers to a cabling technology used by operators of oil and gas wells to lower equipment or measurement devices into the well for the purposes of well intervention and reservoir evaluation.
Wire Line Entry Guide: A small fitting on the end of a tubing string that is shaped to allow easier entry of logging tools when pulled back into the tubing from the wellbore below.
Wire Line Feeler: A fishing tool used to find and catch wire line in preparation for fishing the line.
Wire Line Formation Tester: A formation fluid sampling device.
Wire Line Logs: Use a wire and conductor line to lower a logging tool into the completed well.
Wire Line Preventer: A BOP for wire line operations.
Wire Line Retrievable: Tools or equipment retrievable with a wire line trip.
Wire Line Tools: Tools specifically designed to operate on wire line conveyance. May be either for slickline (nonelectric signal conducting) or for electric line.
Wire-Wrapped Screen: A sand control screen with a shaped wire wound to achieve a set opening size (within tolerance) around a perforated base pipe.
WITSML: See *Wellsite information transfer standard markup language*.
WOB: Weight on bit.
Wobbe Index: It is defined as the ratio between the higher heating value (HHV) of a gaseous fuel and the square root of its specific density relative to air. It is an index that characterizes the heat produced in a burner.
Wobble Ring (Gas Lift): Lock ring that anchors the gas lift valve in the side pocket mandrel.
WOC: See *Waiting on cement*.
Work Basket: The basket on a snubbing unit where the operator stands.
Worked Penetration: The penetration of a sample of lubricating grease immediately after it has been brought to 25°C and "worked" 60 strokes in the ASTM grease worker.

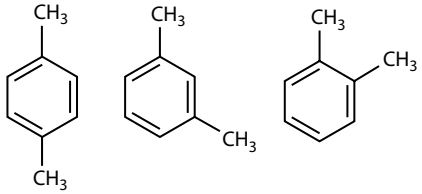
Work Hardening: A metal deterioration in which the metal becomes progressively harder and more brittle with repeated application of load.
Working Gas: Volume of natural gas expected to be cycled from a natural gas storage facility.
Working Interest: (1) The operating interest in an oil and gas lease. (2) A working interest in an oil or gas property is one that is burdened with the cost of development and operation of the property, such as the responsibility to share expenses of drilling completing or operating an oil and gas property, according to working or operating mineral interest in any tract or parcel of land. Rights to overriding royalties, production payments, and the like do not constitute working interests because they are not burdened with the responsibility to share expenses of drilling, completing, or operating oil and gas property. Likewise, contract rights to extract or share in oil and gas, or in the profits from extraction, without liability to share in the costs of production do not constitute working interests. (3) An interest in an oil and natural gas lease that gives the owner of the interest the right to drill for and produce oil and natural gas on the leased acreage and requires the owner to pay a share of the costs of drilling and production operations.
Working Interest (Full Term): A working interest that lasts as long as the well or the lease is productive; as long as oil and gas are produced in quantities that make the well economic to operate.
Working Pressure: The pressure rating that continuous operations may take place at the set conditions and fluids. Examples include WP set at 80% of rated burst for new pipe, 70% for used pipe, and 50% for welded or damaged pipe.
Working Storage Capacity: The difference in volume between the maximum safe fill capacity and the quantity below which pump suction is ineffective (bottoms).
Working Window: A section, usually pressurized and capable of being opened, below a coiled tubing injector where larger tool can be added or removed to the CT BHA.
Workover: (1) The process whereby a completed production well is subsequently reentered and any necessary cleaning, repair and maintenance work done. (2) Operations on a producing well to restore or increase production. Tubing is pulled and the casing at the bottom of the well is pumped or washed free of sand that may have accumulated. (3) Repairing a well. Usually implies opening the well and running in with a tubing string. May or may not involve killing the well and may or may not involve a conventional rig.
Workover Rig: A servicing rig designed to run and pull tubing. It usually has some capacity to mill or drill.
Work String: A special, often large string of tubulars that are used during the completion of the well. Usually higher pressure capacity or allow higher weights than the production tubing.

W

World-Scale Project: LNG plant capable of producing at least 7 million tons per annum (Mtpa) of liquefied natural gas.
World-Scale Rates: A schedule of nominal freight rates against which tanker rates for all voyages, at all market levels, can be compared and readily judged.
Worm: An inexperienced worker.
Wormhole: A channel created by acid reacting along a high-permeability streak.
WOS: West of Shetlands.
WPC: World Petroleum Council (formerly World Petroleum Congress).
Write-Offs: That portion of an oil investment that is deductible for tax purposes. All intangibles are deductible.
Wrought: Metal that is formed into a desired shape by rolling, extruding, forging, etc.
Wrought Iron: Forged iron.
WTI: See *West Texas intermediate*.
WTS: West Texas sour crude oil.
WWS: See *Wire-wrapped screen*.

X

Xanthan™: A biopolymer.
Xanvis™: A modified Xanthan polymer.
XCD™: The brand name of a biopolymer.
xHPHT: Ultrahigh-pressure high temperature.
X-Link: Cross-linked gel.
Xmas Trees: See *Subsea (Xmas) trees*.
XN Profile: X profile with a no-go or no-go ledge for selling a no-go sleeve.
XO: Crossover.
XOM: Exxon Mobil.
X Profile: A standard profile. Can accept a plug or other tools.
XRD: X-ray diffraction analysis.
XT: Christmas tree.
Xylene: (1) An aromatic hydrocarbon that is the basis for many petrochemicals; along with toluene, a key ingredient in unleaded gasoline. (2) Colorless liquid of the aromatic group of hydrocarbons made the catalytic reforming of certain naphthenic petroleum fractions. Used as high-octane motor and aviation gasoline blending agents, solvents, and chemical intermediates. Isomers are metaxylene, orthoxylene, and paraxylene. (3) Xylene is a flammable, toxic aromatic hydrocarbon liquid. Xylene is related to benzene and can be distilled or synthesized. (4) The nonsystematic name for dimethylbenzene, as shown in the following figure:



Y

Yeast: Any of a number of species of single-celled fungus. Most important are the *Saccharomyces* spp., which are used in bread making and beer brewing.
Y (Growth Rate): See *Growth rate.*
Yield: The quantity of petroleum product derived from a process, based on the specific weights of raw materials.
Yield (Drilling Fluid): A measurement applied to clay dealing with the number of barrels of a set viscosity fluid that can be made from a given quantity of clay.
Yield Point: The point at which a fluid shears.
Yield Point (Drilling Point): The resistance to initial flow of a fluid or stress required to start fluid moving.
Yield Point (Metal): The stress on a material at which the first significant permanent or plastic deformation occurs without an increase in stress (NACE).
Yield Strength (Metal): The stress at which a material exhibits a specified deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain by either the offset method (usually at a strain of 0.2%) or the total-extension-underload method (usually at a strain of 0.5%).
Yield Value (Fluids): The critical shear stress that must be exceeded before flow can be initiated.
Young's Modulus (*E*): Stress over strain. A measure of stiffness or modulus of elasticity. Rocks are ½ to 12×10^6 psi and mild steel is 30×10^6 psi.
YP: See *Yield point*.

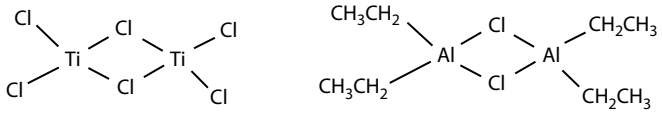
Z

Zeolite: A class of minerals that are "hydrated aluminosilicates." An aluminosilicate is where some of the Si atoms in silica (which has the perfectly reasonable chemical formula SiO_4) are replaced with aluminum, giving an excess negative charge. "Hydrated" means that water is strongly associated with these materials by hydrogen bonding. Lastly, a positively charged "counterion" is needed to balance the negative charge on the zeolite. Zeolites are extremely porous materials, with a regular internal structure of cavities of defined size and shape.

Zeta Hammer™: A brand name of a tool used to deliver rapid impact stokes to a small BHA downhole. Operated by fluid flow. Usually run on CT.

Z-Factor: The compressibility correction index used in the ideal gas law. $Z = V_{actual}/V_{ideal}$.

Ziegler–Natta Catalyst: A compound containing a metal–carbon bond that can be used to make highly ordered, high-density polymers by a chain-growth mechanism. A typical Ziegler–Natta catalyst is the compound formed in situ between titanium trichloride and diethylaluminum chloride; see the following figure:



These catalysts are named after two famous polymer chemists named, strangely enough, Ziegler and Natta. You can find out much more than you ever wanted to know about them at the Macrogalleria.

Zinc Brine: A brine made of salts of zinc, usually very dense.

Zinc Sulfide/Sulfate: Scales that may occur after use of zinc brines where sulfate water is found.

$ZnCl_2$: Zinc chloride.

Zone: (1) An interval of a geologic formation that contains one or more oil or gas reservoirs; a portion of a geologic formation that has the porosity and permeability to form petroleum traps for oil and natural gas. (2) Space or group of spaces within a building with heating or cooling requirements sufficiently similar that comfort conditions can be maintained by a single controlling device.

Zone of Cooperation: An area of the Timor Sea jointly administered by Australia and East Timor.

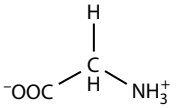
Z

Zoogleal Film: A complex population of organisms that form a "slime growth" on trickling filter media and break down the organic matter in wastewater. These slimes consist of living organisms feeding on organic matter in wastewater, dead organisms, silt, and other debris. "Slime growth" is a more common term.

Zoogleal Mass: Jellylike masses of bacteria found in both the trickling filter and activated sludge processes. These masses may be formed for or function as protection against predators and for storage of food supplies.

Z (Production Logging): Acoustic impedance.

Zwitterion: "Zwitter" is German for "hybrid," and zwitterions are chemical species that manage to be both cations and anions at the same time. How can this come about? Consider ammonium acetate (NH_4CH_3COO). It is a perfectly ordinary salt and, when dissolved in water, splits into its two constituent ions, NH_4^+ and CH_3COO^-. These ions will be able to approach quite close to each other in solution, but there will be no transfer of charge from one to another because of the "shell" of water around each one. In fact, there is no reason we cannot have a molecule where there is a physical bridge joining these two ions—for example, a CH_2 group. The resulting species is a zwitterion, the ionized form of the amino acid glycine, and it is in this form that glycine exists when dissolved in water at a neutral pH.



Zwitterionics: A class of surfactant with both positive and negative charges.

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مجری : هم اندیشان انرژی کیمیا

محل برگزاری: تهران، مرکز همایشهای صداوسیما

برخی از محورهای همایش

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