

NORSOK STANDARD

PROCESS SYSTEMS

P-100
Rev. 1, August 1997

Please note that whilst every effort has been made to ensure the accuracy of the NORSOK standards neither OLF nor TBL or any of their members will assume liability for any use thereof.

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Note: The clause numbers in this standard deviates from normal practice in order to apply the system numbers recognized by the industry. Therefore some numbers are not used.

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Note: All system numbers according to the Norsok document Z-DP-002 Coding System, rev. 3, with the following exceptions: System number 16 and 26 is kept in this document, even though the numbers does not exist in Z-DP-002 Coding system standard

Annex A System Design Datasheets (informative)

FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and remove unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and are jointly issued by OLF (The Norwegian Oil Industry Association) and TBL (The Federation of Norwegian Engineering Industries). NORSOK standards are administered by NTS (Norwegian Technology Standards Institution).

The purpose of this industry standard is to replace the individual oil company specifications for use in existing and future petroleum industry developments, subject to the individual company's review and application.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of this standard will be used to provide input to the international standardization process. Subject to implementation into international standards, this NORSOK standard will be withdrawn.

Annex A is informative.

INTRODUCTION

This standard replaces all previous P-SR-001 to 019 NORSOK standards (19 off).

The development of this standard is primarily based on proven technology, but it does not preclude the use of new technology.

Users of this standard are encouraged to give comments in order to improve the standard based on experience.

1 SCOPE

This NORSOK standard defines the minimum functional requirements for process systems on an offshore installation.

2 NORMATIVE REFERENCES

The following standards include provisions which, through reference in this text, constitute provisions of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements of the standards referenced below.

API RP 520	Design and installation of pressure relieving systems in refineries.
API RP 521	Guide for pressure relieving and depressuring systems.
API 2000	Venting Atmospheric and Low-Pressure Storage Tanks
ISO 10418	Analysis, design, installation and testing of basic safety. Systems for offshore production platforms (mainly based on API RP 14C)
NAS 1638	Cleanliness requirements of parts used in hydraulic systems. National Aerospace Standard, 1964.
NORSOK O-CR-001	Life cycle cost for systems and equipment (O-001)
NORSOK P-001	Process design
NORSOK S-DP-001	Technical safety (S-001)
NORSOK S-DP-002	Working environment (S-002)
NORSOK S-DP-003	Environmental Care (S-003)
NORSOK Z-DP-002	Coding system (Z-002)

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

Normative references	Shall mean normative in the application of NORSOK standards.
Informative references	Shall mean informative in the application of NORSOK standards.
Shall	Shall is an absolute requirement which shall be followed strictly-in order to conform with the standard.
Should	Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable.
May	May-indicates a course of action that is permissible within the limits of the standard (a permission).
Can	Can-requirements are conditional and indicates a possibility open to the user of the standard.
Regularity:	A measure of a system's capability to meet the demand for deliveries. In this document, the requirements in terms of regularity are classified based on the consequence of an outfall of the system:

Class A System	Production shut-down, or reduced production for more than 2 hrs.
Class B System	Short production shut-down, or reduced production (less than 2 hrs).
Class C System	No effect on oil/gas production.

3.2 Abbreviations

BTX	Benzene Toluene Xylene
CCR	Central Control Room
DAS	Data Acquisition System
ESD	Emergency Shutdown
LAT	Lowest Astronomical Tide
LCC	Life Cycle Cost
NPSH	Net Positive Suction Head
OS	Operator Station
PSV	Pressure Safety Valve
SIFF	Statens Institutt For Folkehelse (The National Institute of Public Health)
SFT	Statens forurensingstilsyn (State Pollution Agency)
UPS	Uninterruptable Power Supply
UV	Ultra violet
VDU	Visual Display Unit

4 GENERAL REQUIREMENTS

4.1 General

The first clauses (1-4) covers requirements that applies for all systems. Process system design shall comply with the functional requirements in the following clauses and the design data stipulated for each system in separate data sheets.

General process design requirements are covered by Norsok standard P-001 Process design.

The supplier shall to the extent possible base delivery on standardised equipment/system packages within the constraints defined by the functional requirements in this document.

For each system, a design data sheet has been included in Annex A such that new projects can fill in data relevant to that particular project, thus making the design data sheet project specific. Note that part of the data can only be filled in after equipment design has been performed. Preliminary estimates can be given for some of these if it is considered necessary depending on the purchasing philosophy. Complete process data sheets (or other documents containing the same information) shall be prepared for final system selection.

4.2 General system design

4.2.1 LCC aspects of system design

Principles for LCC shall be included in design. Reference is made to Norsok standard O-CR-001 (O-001) Life cycle cost for systems and equipment.

4.2.2 Design for minimum impact of platform movement

In the case of installations with large movements, design criteria should be drawn up for movement and acceleration conditions under which the process facility is required to operate. Any limitations should be stipulated in the operations procedures.

4.2.3 Dynamic simulations

Dynamic simulation of pressure, temperature and flow-characteristics in process and auxiliary facilities may be used to achieve facilities with optimum efficiency and safety. Suitable simulation programmes may be valuable in order to identify transients imposing special requirements to facilities, control systems, procedures and operator intervention.

4.3 Commissioning and maintenance requirements

Commissioning / maintenance and operations personnel should participate in setting design targets and layout. This will minimise offshore hook up and commissioning, and simplify maintenance in the operational phase.

4.4 Safety requirements

4.4.1 “API RP 14C” analysis.

“API RP 14C” analysis per ISO 10418 shall be employed to ensure a systematic method of implementing principles for an operationable safe platform.

4.4.2 Hazard and operability (HAZOP)

The hazard and operational aspects should be assessed by means of a HAZOP study. The purpose of these analyses is to decide which facilities, parts of facilities and which components are the most critical, and to reduce the probability of an escalation of undesired events.

4.4.3 General safety

Reference is given to Norsok standard S-DP-001 (S-001) Technical safety.

4.4.4 Working environment

Reference is given to Norsok standard S-DP-002 (S-002) Working environment.

4.5 Environmental requirements

Reference is given to Norsok standard S-DP-003 (S-003) Environmental Care.

16 TOPSIDE FLOWLINES AND MANIFOLDS

16.1 Scope

This section defines the minimum functional requirements for the topside flowlines and manifolds system.

16.2 Functional requirements

16.2.1 General

The topside flowlines and manifolds system shall gather well stream from individual wells and transfer to downstream systems. The topside flowlines and manifolds system typically consists of a set of manifolds for gathering of production of crude oil or aquifer water from individual wells and routing of this production as appropriate.

Such manifolds may typically be:

- Production manifold(s) (High pressure (HP)/Low pressure (LP)).
- Test manifold.
- Blowdown/equalization manifold.
- Water source manifold

Further, the system includes a well service system providing access to individual wellbores for such operations as well clean-up and testing after completion and work-overs, kill operations, equalization, blowdown, backflow, stimulation, valve testing, annulus bleed, methanol and chemical injection/squeeze treatment.

The system will be used to transport the following fluids in connection with such operations:

- Natural gas.
- Crude oil.
- Produced water.
- Water based mud.
- Brine (completion fluid).
- Xylene.
- Diesel.
- Tracer chemicals.
- Methanol.
- Production chemicals.

16.2.2 Performance

In design and sizing of system operating cases over the life time of the field should be taken into account.

16.2.3 Regularity/sparing

System regularity Class A.

16.3 Operational requirements

16.3.1 Control and monitoring

All operations, control and monitoring may be done locally. No automatic functions are normally required. The pressure and temperature upstream/downstream of each choke in addition to the opening each choke should be monitored from the Central Control Room (CCR). The opening of each choke should be operated from the CCR with local manual override.

16.3.2 Safeguarding and shutdown

Safeguarding and shut-down of the system shall be in accordance with ISO 10418.

The piping in the production and test manifolds are normally rated to the maximum shut-in pressure to eliminate the need for overpressure protection.

16.3.2.1 System volume

Piping diameters shall be minimized in the well service piping and headers, because of frequent medium changeout.

16.3.2.2 Operational actions

Connection points for temporary hook-up of chokesan pipe, flexible hoses or instrument tubing shall be available where relevant.

16.3.2.3 Sand production / erosion

Heavy erosion from clean-up and backflow operations should be considered when determining wall thickness requirements particularly in bends. For the production and test manifolds "Target T" bends should be used.

16.4 Maintenance requirements

Only flanged valves shall be installed to facilitate frequent need for maintenance (due to erosion and high differential pressure).

There should be a possibility to remove one choke without having to dismantle other chokes on the same manifold.

Where heavy scale formation is expected, a provision for removal of scale should be installed.

16.5 Isolation and sectioning

Individual well flowlines shall be accessible for maintenance and hook-up without shut-down of manifolds.

16.6 Layout requirements

Drainage of piping and manifolds to the closed drain system should be ensured.

16.7 Interface requirements

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirements list for provision of such information.

16.8 Commissioning requirements

Piping shall be fitted with high point vents and low point drains.

16.9 Safety requirements

No specific requirements are identified.

16.10 Enviromental requirements

No specific requirements are identified.

20 SEPARATION AND STABILIZATION

20.1 Scope

This section defines the minimum functional requirements for the separation and stabilization system.

20.2 Functional requirements

20.2.1 General

The crude oil separation and stabilization system shall stabilize and dewater the crude oil to export specifications.

20.2.2 Performance

20.2.2.1 System capacity

In design and sizing of the system a complete set of data on the predicted variations in the inlet/wellstream quantities and characteristics should be considered. Simulation data should be available to cover all known operating cases over the lifetime of the field. From the simulation results, sizing cases should be tabulated for each equipment item

In selecting the sizing cases it is important to consider the:

- Maximum total liquids rate case.
- Maximum crude oil rate case.
- Maximum water rate case.
- Maximum gas rate case.

The crude oil export specifications are dictated by the downstream facilities and typically are :

Pipeline export	Pipeline specific
Shuttle tanker export	Oil Reid vapor pressure (RVP) of maximum - 0.79 barg (11 psig)

20.2.2.2 System configuration

The system configuration should be established based on optimization with respect to:

- Number of stages.
- Operating pressure at each separation stage.
- Heating and cooling requirements.
- Fluid properties (wax, foam, emulsions).
- Outlet specifications.
- Special design requirements (e.g. floating production facilities).

Normally a single train shall be employed. However, two trains should be used in cases where:

- Vessel sizes exceed normal fabrication and/or transportation constraints.
- Increased oil production regularity justifies multiple trains (e.g. where it is necessary to maintain high temperatures in the oil export line to avoid waxing or viscosity problems, two trains should be considered to ensure continued production when one train is out of service).
- There is a substantial quality/price difference in the crude oils to be processed thus providing an economical justification for separate processing and offloading.
- HP and LP separation trains are required to process feeds from wells operating at very different pressures (e.g. if two reservoirs are being processed simultaneously).

20.2.2.3 Heat exchangers

Seawater cooling shall not be used where the cold side skin temperature can not be kept below 55°C (seawater bulk temperatures of about 35°C) to avoid scaling.

20.2.2.4 Separator sizing

In the sizing of the separators, the equivalent residence time between normal operating and alarm level and between alarm level and trip level should not be less than 30 seconds or 80mm for both high and low ranges. Motion effect must be considered.

The potential for slug flow should be considered in the sizing of inlet separators.

Separator nozzles should be sized a minimum of one standard dimension larger than the requirement based on the design data provided. This applies only to the nozzles and not to the connecting pipework.

Liquid outlet nozzles shall be provided with vortex breakers.

Consideration should be given to provision of water outlet nozzles also on separators initially only intended for two phase (gas/oil) operation.

Typical sizing criteria for separators are;

Water in oil	Maximum 0.5 % by volume
Oil in water	Maximum 2% by volume
Liquid in gas	$1.32 \times 10^{-8} \text{ m}^3/\text{Sm}^3$ (liquid volume/standard gas volume)

20.2.2.5 Sand control / removal

When sand production is likely, separator(s) shall be equipped with sand pan or jet water facilities.

Jet water shall be supplied from one of the following sources, in the following priority:

1. Produced water (if available).
2. Fresh water (disinfected water).
3. Seawater (requires injection of antiscaling chemicals).

When sand production is expected, provision of dual level control valves should be considered, also the outlet to instrument bridles shall be protected against blockage.

20.2.2.6 Heat tracing

Bridles and field instrumentation shall be fitted with heat tracing and insulation, where malfunction can occur due to freezing or hydrate formation.

In case of heavy wax formation a heating coil may be required to prevent problems at restart.

20.2.2.7 Robustness

Pressure control (response times/control margins) shall be such as to avoid consequential shut-down of the oil separation train(s) as a result of unplanned gas compression shut-down.

20.2.3 Regularity/sparing

System regularity Class A.

Normally one train, no spare.

Test separator shall facilitate operation as first stage separator. May also be required to operate at lower pressure.

20.3 Operational requirements

20.3.1 Control and monitoring

Total control and monitoring from CCR

OS/VDU functions	P	T	L	F	Other	Remarks
Manifolds	M/A	M				
Test separator	C ¹ /A	M ¹	C/A	M ¹		¹) = To be recorded
1./2./3. separators	C/A		C/A			Auto to flare
1./2./3. separators water outlets				(M)		Requirement for water flow to be evaluated
Heater/cooler		C/A				
Coalescer			C/A			

Process variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions: A = Alarm, M = Monitoring, C = Control.

20.3.2 Safeguarding and shutdown

Safeguarding and shut-down of the crude oil separation and stabilization system shall be in accordance with ISO 10418/API RP 14C.

20.4 Maintenance requirements

Maintenance requirements shall be:

- Separator internals shall be fabricated such that they may be dismantled and taken out through the vessel manhole.
- The bottom of the separator should be possible to inspect without removing all internals.
- Full-flow bypass shall be installed across all Level Control Valves (LCV's).
- Bypass piping should be considered installed across heaters, coolers and coalescer.
- To allow for inspection and clean out of the vessels, steam out and utility connections should be provided as appropriate.

20.5 Isolation and sectioning

20.5.1 Test separator

Flow measuring devices that will require frequent maintenance shall be provided with isolation valves.

20.6 Layout requirements

The following lay-out considerations generally applies to the crude oil separation and stabilisation system:

- Separators should be grouped together to allow operators to move easily between vessels and to minimize piping run lengths.
- Level control valves should be located to avoid flashing upstream the valves, and to minimize slugging in the lines downstream such valves.
- Pressure control valves, gas blowdown valves, pressure relief valves and pressure instruments should be located such that easy operator access is ensured.
- The lay-out should allow for gravity draining of the separators (without pockets in the drain lines) to the closed drain system.
- An electrostatic coalescer if included in the separation train, must operate liquid full.
- Where a plate exchanger is used for oil cooling, the lay-out should be such as to ensure that flow through the unit is not flashing.

The final stage of separation should be elevated to ensure that net positive suction head (NPSH) requirements of downstream pumps are met.

20.7 Interface requirements

Specific interface requirements are to be provided by the supplier. Annex A contains datasheets with an Interface requirements list for provision of such information.

Individual injection points shall be installed on manifolds and upstream all separator inlets for antifoam chemicals. Injection points for emulsion breaker and other chemicals shall be provided for on the production manifolds. Consider injecting upstream choke for improved efficiency.

20.8 Commissioning requirements

Piping shall be fitted with high point vents and low points drains.

20.9 Safety requirements

In designing the separation and stabilisation system, the following safety aspects should be considered:

- The separators hold large quantities of hydrocarbons in liquid and gaseous phase. Fire protection insulation on the vessels in order to ensure their integrity in the event of a fire should be considered.
- Relief cases to be considered for sizing of relief valves should include blocked outlet, fire and gas blowby.
- During a process or emergency shutdown the system should be segmented by use of actuated isolation valves. It is normal practice to treat each separator as an individual section and isolation valves should be provided to automatically isolate each vessel in the event of an process or emergency shutdown.
- Each isolation section should be provided with a depressurisation line to allow for remote or automatic blowdown of the system in the event of an emergency.

20.10 Environmental requirements

No specific requirements are identified.

23 GAS RECOMPRESSION, COOLING AND SCRUBBING

23.1 Scope

This chapter covers the requirements for flash gas recompression system.

23.2 Functional requirements

23.2.1 General

The flash gas recompression system shall collect the gas from the different stages of separation, cool it, remove condensed liquids and compress the gas to a pressure suitable for further treatment.

23.2.2 Performance

23.2.2.1 Capacity

The system shall be capable of handling the variations in capacity and gas compositions resulting from operations over the life of the field at the required delivery pressure. Rewheeling of compressors may be required to achieve this, and shall be indicated. If installation of new equipment is required later in field life, tie-in points and space shall be provided, and utility and support system requirements shall be identified. The amount of flash gas from oil stabilization and the gas quality is uncertain, so an ample margin with respect to flow and molweight should be included.

23.2.2.2 Compressors

The compressor(s) should have variable speed drive(s).

To optimize compressor design to achieve the best overall efficiency, the intermediate operating pressures shall be based on vendor informations.

The discharge side volume of centrifugal compressors shall be minimized, ie. precooling is preferable to discharge cooling. The check valve should be located as close to the compressor as possible but downstream of the anti-surge recycle line and any discharge pressure safety valve (PSV).

Where a significant reduction in molecular weight can occur during start-up or recycling, a line to flare shall be provided to allow light gas to be discharged to enable the compressor to produce sufficient discharge pressure to establish forward flow.

When considering overpressure protection downstream the compressor, the effects of the following shall be taken into consideration:

- Maximum power available.
- Maximum speed.
- High suction pressure.
- Higher than normal molecular weight if applicable.
- Low suction temperature.

The compressor shall start with the discharge valve closed, and only open it when the pressure is equal on both sides of the valve. The valve shall close when the compressor is stopped.

If dry gas seals are used, the buffer gas should be dehydrated, dewpoint controlled or superheated to prevent condensation or hydrate formation.

23.2.2.3 Gas coolers

Seawater cooling shall not be used where the cold side skin temperature can not be kept below 55°C. The limit for the hot side skin temperature will depend on the properties of the gas. The important variable to take into account is hydrate formation temperature.

By utilizing cocurrent flow the risk of scale formation on the seawater side, or hydrate formation or wax deposits on the gas side, can be reduced.

Where compact heat exchangers are considered for gas cooling, special attention should be given to contaminants in the gas. These could be:

- Lube or seal oil from the compressors.
- Liquid carryover from separators containing;
 - Glycol
 - Asphaltenes
 - Methanol
 - (Wax)

All of the above mentioned contaminants can be removed by washing. Asphaltenes should be prevented from entering the compact cooler by filtration.

Contaminants in the cooling medium should also be considered

23.2.2.4 Scrubbers

The liquid removal efficiency of the scrubber shall match the requirements of the compressor to achieve the desired maintenance intervals.

The conditions downstream the liquid control valve shall be checked for hydrate formation, and suitable precautions taken, ie.;

- location of control valve close to downstream connection for possible heat transfer
- control valve type to reduce potential for internal freezing
- injection point for methanol

Overpressure protection of the scrubber shall take into account leakage from the compressor discharge side should the discharge valve fail to close on compressor shut down. If the discharge pressure exceeds hydrostatic test pressure of the scrubber, two check valves shall be installed in series. Check valves downstream compressors shall be of non-slam type.

Where two compression trains are running in parallel, the transient conditions when one compressor trips, shall be considered. The coolers and scrubbers should be able to withstand the maximum flow that the associated compressor can handle at minimum discharge pressure without incurring mechanical damage.

23.2.3 Regularity

The system is vital for production:
System regularity: Class A.

23.3 Operational requirements

23.3.1 Control and monitoring

OS/VDU functions	P	T	L	F	Other	Remark
Compressor gas inlet				C		Input to antisurge
Compressor gas inlet	A,M	A,M				Input to antisurge, if required
Compressor gas outlet	A,M	A,M				Input to antisurge, if required
Scrubbers			C/A			
Coolers		C/A				

Process Variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process Functions: A = Alarm, M = Monitoring, C = Control.

Note: Compressor driver and corresponding utilities to be specified by vendor.

The following control requirements are valid for a minimum manning facility.

The control system shall allow all operations required to purge, pressurize, start, run and stop the compressor system to be carried out from the control room.

Auxilliary systems to the compressor and driver shall be monitored to the extent required for obtaining prealarms prior to shutdown actions. The number of shutdown actions should be limited, and the use of critical alarms should be considered instead.

23.3.2 Safeguarding and shutdown

Shutdown functions shall be provided according to ISO 10418. If the compressor operates with seal oil system, depressurisation due to seal oil failure shall be included.

23.4 Maintenance requirements

All major parts to be easily accessible and removable with a minimum disturbance to piping ie break-out spools shall be provided on the major piping where equipment may have to be removed.

23.5 Isolation and sectioning

Each compressor train shall be equipped with isolation valves and bleed for maintenance purposes.

23.6 Layout requirements

Layout requirements:

- Coolers and compressors should be elevated above scrubbers.
- Anti surge line should be sloped with valve at high point.

23.7 Interface requirements

The following utility and support systems may have to be provided to the compression system:

- Cooling medium or seawater for gas, lube and seal oil coolers.
- Nitrogen for isolation seal gas.
- Methanol if required. For hydrate prevention and removal. Injection points upstream each cooler with piping sloping towards cooler.
- Instrument air and hydraulic power
- Electric power and UPS, as required
- Service fresh water for turbine washing. Ion exchange filters to be part of the system
- Fuel gas
- Flare and drain

Specific Interface requirements shall be provided. Annex A contains datasheets with an interface requirements list for provision of such information.

23.8 Commissioning requirements

Commissioning requirements:

- Temporary strainers shall be installed upstream each compressor.
- If compact heat exchangers are used, temporary spools bypassing the exchangers shall be provided to allow full flow flushing of the cooling side piping. On all inlets filters of 300 micron must be installed immediately upstream the exchanger, even if the service is clean during normal operation
- If onshore commissioning is planned, type of fuel to the gas turbine should be considered.
- The gas coolers should be designed to allow for compressor testing with nitrogen or air, ie. increased water flow and larger vibrations without causing mechanical damage.

23.9 Safety requirements

Compressors should to the extent practical be located away from large hydrocarbon inventories such as production separators.

External temperature of gas turbine exhaust ducting shall be kept below ignition temperature of gas mixtures.

23.10 Environmental requirements

The power consumption of compression systems should be minimized by utilization of best available technology for antisurge-, and speed-control and load sharing where parallel units are operated.

When wet seals are used, and the pressures allow, the gas from the seal oil pots should be returned to the process. Gas from vacuum degassing units can normally not be recovered.

24 GAS TREATMENT

24.1 Scope

This chapter covers the requirements for systems for water dewpoint control. The main emphasis is on absorption systems since most offshore systems for water dewpoint control are absorption systems. Systems combining water dewpoint control and hydrocarbon dewpoint control are covered in system 25.

24.2 Functional requirements

24.2.1 General

The dehydration system shall remove water vapour from the gas to a level suitable for transport, injection or further processing, whichever is the more stringent.

24.2.2 Performance

24.2.2.1 Capacity

The system shall be capable of handling the gas design capacity of the processing facility. No special design margin should be included. The dehydration system should however not be the limiting unit determining the gas capacity. It would be prudent to design the system for the maximum capacity of compressors.

24.2.2.2 Glycol contactors

Structured packing is preferred to trays. Packing selection should emphasise capacity and low pressure drop in preference to high efficiency and low glycol circulation rate.

The liquid must be evenly distributed across the packing. The type of distributor selected is critical in achieving this. Also, plugging of the distributor may be a problem, as some types are susceptible to blocking from sludge, scale, or corrosion products accumulating in the glycol. To prevent this, a filter may be installed upstream.

The contactor internals shall be able to withstand the maximum gas velocity that may occur under any operating condition, including backflow, without sustaining mechanical damage.

To minimize glycol losses, a demisting device shall be located at the gas outlet of the vessel. Sufficient height should be allowed above the demistor to assure that gas coning will not occur.

Hydrocarbon condensate will interfere with the efficient operation of the glycol contactor. Thus an efficient scrubber should be provided upstream the contactor, either as a separate vessel, or integrated in the same vessel as the contacting section.

Continuous skimming of condensate from the glycol should always be provided. If the gas entering the glycol contactor has potential for retrograde condensation to occur, superheating of the gas should be considered, so that condensation in the glycol contactor is prevented. Alternatively, the amount of condensate should be calculated, and the skimming facilities designed to remove the

expected condensate. The glycol inlet temperature shall be maintained 5°C above the feed gas temperature to prevent condensation where the glycol enters the contactor.

Insulation and heat tracing on the level bridles on both scrubber and contactor shall be provided according to Norsok standard P-001.

24.2.2.3 Regeneration unit and storage

Atmospheric discharge of fuel gas stripping gas from glycol regeneration shall be minimized or preferably avoided.

Drainage of all equipment shall be collected in a glycol sump. The sump and storage tank shall be blanketed by an inert gas to prevent oxydation of the glycol, and also, to route potential hydrocarbons to a safe loaction. The inert gas must have an oxygen level sufficiently low to prevent oxidization at the relevant temperatures.

Provision shall be made to inject antifoam although this should only be used as a last resort as it can cause some fouling in the contactor tower. Corrosion inhibitor shall be injected to the system as needed.

From an environmental viewpoint electric heating in the reboiler is undesirable. Heating by wasteheat should therefore be evaluated. When electric heating elements are used for reboiling, it shall be possible to remove individual elements without draining the unit.

Glycol filters shall be provided to remove particulate degradation and corrosion products from the lean glycol.

Dissolved hydrocarbons, mainly aromatics, may be present in the feed to the glycol reboiler. These will be vaporized in the reboiler and may cause flooding in the still coloumn. This must be evaluated in the design of the still column, notably the increased vapour traffic and the extra duty in the reboiler.

A bypass line around the glycol contactor shall be provided to allow circulation and heating of the glycol in periods where the contactor is not operating. In this mode the glycol will not contain any gas, and fuel gas may be required to provide sufficient pressure in the regeneration system.

To minimize glycol losses while maintaining sufficient glycol purity, the temperature in the top of the still coloumn shall be controlled.

24.2.2.4 Wet gas inlet coolers

It is advantageous to cool the inlet gas to the dehydration unit as much as possible to limit the water load. Note that low skin temperatures in such coolers may cause hydrate formation.

24.2.3 Regularity

The system is vital for production:

System regularity: Class A.

24.3 Operational requirements

24.3.1 Control and monitoring

The dehydration unit shall be fully controlled from CCR. All operations required for starting and running the package as well as altering operating conditions shall be available from the operator station.

Required control and monitoring as a minimum

Component	P	T	L	F	Other	Remarks
Inlet cooler		C/A				
Scrubber			C/A			
Glycol contactor	M/A		C/A		M	Differential pressure water content produced gas
Reflux condenser		C/A				
Flash drum	C/A		C/A			
Reboiler		C/A				
Stripping column				M		Readout can be local only
Glycol cooler		C/A				
Glycol pumps	M			M	C/M/A	Start / stop / status
Glycol filters	M					Local readout of diff. P

Process Variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process Functions: A = Alarm, M = Monitoring, C = Control.

24.3.2 Safeguarding and shutdown

Shutdown functions shall be provided according to ISO 10418 where produced hydrocarbons are handled. This includes the gas coolers, scrubber, contactor, and flash drum, but not the rest.

24.4 Maintenance requirements

All major parts to be easily accessible and removable with a minimum disturbance to piping ie break-out spools shall be provided on the major piping where equipment may have to be removed.

Areas where frequent maintenance may be expected, like pumps and filters shall have easy access.

24.5 Isolation and sectioning

Where multiple units are used isolation shall be provided to allow work on one while the other is operating.

Isolation shall be provided to allow work on all parts of the regeneration system without having to depressurize the contactor column..

24.6 Layout requirements

The temperature transmitter controlling the glycol feed temperature to the contactor shall be located close to the contactor. This will ensure correct glycol temperature independent on ambient temperature and windchill.

Outlet piping from glycol reboiler should be designed to minimize backpressure on the reboiler.

24.7 Interface requirements

The following utility and support systems may have to be provided to the dehydration system:

- Cooling medium or seawater for gas and glycol coolers.
- Inert gas for blanketing storage and sump tanks.
- Methanol to injection points for hydrate prevention and removal where required.
- Instrument air.
- Electric power.
- UPS for instrumentation.
- Fuel gas for pressurizing when in bypass mode, possibly for stripping
- Flare
- Open and closed drain system
- Atmospheric vent
- Filling line from tote tanks storage

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirements list for provision of such information.

24.8 Commissioning requirements

The regeneration unit should be fully prepared for test running before leaving the shop.

24.9 Safety requirements

Direct fired reboiler shall only be considered after a rigorous evaluation of safety aspects.

24.10 Environmental requirements

The atmospheric discharge of stripping gas should be avoided. If discharged, consideration should be given to utilizing offgas from other equipment for this purpose. Also, if the feed gas is rich in aromatics, some form of BTX recovery should be considered to reduce the emissions.

Electric heating of glycol reboilers has a low thermal efficiency. It should therefore be evaluated to use heating medium, preferably from waste heat recovery for this purpose. This will reduce CO₂ emissions.

26 GAS REINJECTION TO RESERVOIR

26.1 Scope

This chapter defines the minimum functional requirements for the gas reinjection system.

26.2 Functional requirements

26.2.1 General

The gas reinjection compression system shall take the gas from the relevant source, cool it, remove condensed liquids and compress the gas to a pressure suitable for gas reinjection.

26.2.2 Performance

26.2.2.1 System capacity

The system shall be capable of handling variations in the required reservoir pressures and flows over the life of the field. Rewheeling of compressors may be required to achieve this, and shall then be indicated.

The reservoir pressure will normally decrease during the life of the field. The required pressure from the gas reinjection compressor therefore decreases and the capacity increases. To use the available gas reinjection compressor capacity, ample margin with respect to flow and molweight should be included in the design of the gas coolers and scrubber.

26.2.2.2 Compressors

The gas reinjection compressor(s) should have variable speed drive(s).

To optimize compressor design to achieve the best overall efficiency, the intermediate operating pressures shall be based on vendor informations.

The discharge side volume of centrifugal compressors shall be minimized, ie. precooling is preferable to discharge cooling. The check valve should be located as close to the compressor as possible but downstream of the anti-surge recycle line and any discharge pressure safety valve (PSV).

When considering overpressure protection downstream the compressor, the effects of the following shall be taken into consideration:

- Maximum power available
- Maximum speed
- High suction pressure
- Higher than normal molecular weight if applicable
- Low suction temperature

The compressor shall start with the suction valve open and the discharge valve closed, and only open the discharge valve when the pressure is equal on both sides of the valve. Both suction and discharge valves shall close when the compressor is stopped.

If dry gas seals are used, the buffer gas should be dehydrated, dewpoint controlled or superheated to prevent condensation or hydrate formation.

26.2.2.3 Gas coolers

Seawater cooling shall not be used where the cold side skin temperature can not be kept below 55°C (seawater bulk temperatures of about 35°C). The limit for the hot side skin temperature will depend on the properties of the gas. The important variable to take into account is hydrate formation temperature.

By utilizing cocurrent flow the risk of scale formation on the seawater side, or hydrate formation or wax deposits on the gas side, can be reduced.

Where compact heat exchangers are considered for gas cooling, special attention should be given to contaminants in the gas. These could be:

- Lube or seal oil from the compressors.
- Liquid carryover from separators containing; Glycol, Asphaltenes, Methanol, (Wax)

All of the above mentioned contaminants can be removed by washing. Asphaltenes should be prevented from entering the compact cooler by filtration.

Contaminants in the cooling medium should also be considered

26.2.2.4 Scrubbers

The liquid removal efficiency of the scrubber shall match the requirements of the compressor to achieve the desired maintenance intervals.

The conditions downstream the liquid control valve shall be checked for hydrate formation, and suitable precautions taken, ie.;

- location of control valve close to downstream connection for possible heat transfer
- control valve type to reduce potential for internal freezing
- injection point for methanol

Overpressure protection of the scrubber shall take into account leakage from the compressor discharge side should the discharge valve fail to close on compressor shut down. If the discharge pressure exceeds hydrostatic test pressure of the scrubber, two check valves shall be installed in series. Check valves downstream compressors shall be of non-slam type.

Where two compression trains are running in parallel, the transient conditions when one compressor trips, shall be considered. The coolers and scrubbers should be able to withstand the maximum flow that the associated compressor can handle at minimum discharge pressure without incurring mechanical damage.

26.2.2.5 Start-up

Special consideration should be given to restart after a complete depressurization to maintain the required discharge pressure.

If the compressor consists of several stages, one or more of the compressor stages will have start-up conditions far from normal operation. This operating case must be specified and taken into consideration in design.

26.2.2.6 Design pressure

Pressure safety valves should, if at all possible, be avoided at very high pressures. This can be achieved by having no equipment except piping downstream the last stage of compression and analyse the compressor curves and possibly allow some degree of overpressure of the piping for limited periods.

26.2.3 Regularity

System regularity: Class A.

26.3 Operational requirements

26.3.1 Control and monitoring

Minimum required control and monitoring functions for each separately driven stage of compression

OS/VDU functions	P	T	L	F	Other	Remark
Compressor gas inlet				C		Input to antisurge
Compressor gas inlet	A,M	A,M				Input to antisurge, if required
Compressor gas outlet	A,M	A,M				Input to antisurge, if required
Scrubbers			C/A			
Coolers		C/A				

Process Variables : P = Pressure, T = Temperature, L = Level, F = Flow.

Process Functions : A = Alarm, M = Monitoring, C = Control.

Note: Compressor driver and corresponding utilities to be specified by vendor.

The following control requirements should be included to achieve a minimum manning facility.

The control system shall allow all operations required to purge, pressurize, start, run and stop the compressor system to be carried out from the control room.

Variables required for condition monitoring and condition based maintenance planning shall be collected and stored automatically.

Auxiliary systems to the compressor and driver shall be monitored to the extent required for obtaining prealarms prior to shutdown actions. The number of shutdown actions should be limited, and the use of critical alarms should be considered instead.

All signals except valve status signals shall show the value of the variable ie come from transmitters.

26.3.2 Safeguarding and shutdown

Shutdown functions shall be provided according to ISO 10418. If the compressor operates with seal oil system, depressurisation due to seal oil failure shall be included.

26.4 Maintenance requirements

All major parts to be easily accessible and removable with a minimum disturbance to piping ie break-out spools shall be provided on the major piping where equipment may have to be removed.

Areas of the compressor and driver skid where frequent maintenance may be expected, shall be sheltered from the weather.

Water wash equipment to be provided for gas turbines.

Arrangement for direct filtering and filling of seal oil, plus drainage of seal and lube oil to closed drain, shall be installed.

26.5 Isolation and sectioning

Each compressor train shall be equipped with isolation valves and bleed for maintenance purposes.

The volume that has to be gas free in order to maintain the compressor shall be minimized.

26.6 Layout requirements

Layout requirements:

- Coolers and compressors should be elevated above scrubbers.
- Anti- surge line to be sloped with valve at high point.

26.7 Interface requirements

The following utility and support systems may have to be provided to the gas reinjection system:

- Fuel at sufficient pressure.
- Cooling medium or seawater for gas, lube and seal oil coolers.
- Nitrogen for dry gas seals.
- Methanol if required. For hydrate prevention and removal.
- Injection points upstream each cooler.
- Instrument air and hydraulic power.
- Electric power and UPS for instrumentation.
- Service fresh water for turbine washing.
- Ion exchange filters to be part of the system.
- Flare and drain.

26.8 Commissioning requirements

Commissioning requirements:

- Temporary strainers shall be installed upstream each compressor.
- If compact heat exchangers are used, temporary spools bypassing the exchangers shall be provided to allow full flow flushing of the cooling side piping. On all inlets filters of 300 micron must be installed immediately upstream the exchanger, even if the service is clean during normal operation
- If onshore commissioning is planned, type of fuel to the gas turbine should be considered.
- The gas coolers should be designed to allow for compressor testing with nitrogen or air, ie. increased water flow and larger vibrations without causing mechanical damage.

26.9 Safety requirements

Compressors should be located away from large hydrocarbon inventories such as production separators.

External temperature of gas turbine exhaust ducting shall be kept below ignition temperature of typical hydrocarbon gas mixtures.

26.10 Environmental requirements

The power consumption of compression systems should be minimized by utilization of best available technology for antisurge-, and speed-control and load sharing where parallel units are operated.

When wet seals are used, and the pressures allow, the gas from the seal oil pots should be returned to the process. Gas from vacuum degassing units can normally not be recovered.

Low NOx-nozzles should preferably be used on all gas turbines to reduce NOx to the atmosphere.

27 GAS EXPORT AND METERING

27.1 Scope

This chapter defines the minimum functional requirements for the gas export system.

27.2 Functional requirements

27.2.1 General

The gas export and metering system shall meter and compress the export gas to the required export pressure.

The gas export compression system normally takes the gas from downstream the gas treatment and hydrocarbon dewpoint control (if installed) sections, cool it if required, remove condensed liquids, compress and cool the gas to a pressure and temperature suitable for gas export.

The gas should be fiscally metered before export through a gas pipeline.

27.2.2 Performance

27.2.2.1 System capacity

The system shall be capable of handling variations in the gas export pipeline pressures and flowrates over the life of the field. Rewheeling or installation of extra compressor(s) may be required to achieve this, and shall then be indicated.

27.2.2.2 Compressors

The gas export compressor(s) should have variable speed drive(s).

To optimize compressor design to achieve the best overall efficiency, the intermediate operating pressures shall be based on vendor informations.

The discharge side volume of centrifugal compressors shall be minimized, i.e. precooling is preferable to discharge cooling. A discharge check valve should be located as close to the compressor as possible but downstream of the anti-surge recycle line and any discharge pressure safety valve (PSV).

When considering overpressure protection downstream the compressor, the effects of the following shall be taken into consideration:

- Maximum power available.
- Maximum speed.
- High suction pressure.
- Higher than normal molecular weight if applicable.
- Low suction temperature.

The compressor shall start with the suction valve open and the discharge valve closed, and only open the discharge valve when the pressure is equal on both sides of the valve. Both suction and discharge valves shall close when the compressor is stopped.

If dry gas seals are used, the buffer gas shall be dewpoint controlled or superheated to prevent condensation or hydrate formation.

27.2.2.3 Gas coolers

Seawater cooling shall not be used where the cold side skin temperature can not be kept below 55°C (seawater bulk temperatures of about 35°C). The values for the cold side skin temperature will depend on the properties of the gas.

By utilizing cocurrent flow the risk of scale formation on the seawater side can be reduced.

Where compact heat exchangers are considered for gas cooling, special attention should be given to contaminants in the gas. These could be:

- Lube or seal oil from the compressors.
- Liquid carryover from separators containing; Glycol, Asphaltenes, Methanol, (Wax)

All of the above mentioned contaminants can be removed by washing. Asphaltenes should be prevented from entering the compact cooler by filtration.

Contaminants in the cooling medium should also be considered

27.2.2.4 Scrubbers

The liquid removal efficiency of the scrubber shall match the requirements of the compressor to achieve the desired maintenance intervals.

Overpressure protection of the scrubber shall take into account leakage from the compressor discharge side should the discharge valve fail to close on compressor shut down. If the discharge pressure exceeds hydrostatic test pressure of the scrubber, two check valves shall be installed in series.

Where two compression trains are running in parallel, the transient conditions when one compressor trips, shall be considered. The coolers and scrubbers should be able to withstand the maximum flow that the associated compressor can handle at minimum discharge pressure without incurring mechanical damage.

Where the gas at suction of one export compressor stage have a normal operating temperature and pressure which is far away from the gas water or hydrocarbon dewpoint curve and all possible variations in operating conditions does not create any liquid, the compressor suction scrubber may be voided.

27.2.2.5 Export Pressure

The pipeline pressure may vary quite substantially. This should be taken into account when selecting design point of the compressor such that the compressor may be able to work against the pipeline pressure without a need for discharge throttling.

27.2.2.6 Capacity

If the product gas is to be split in for example part to export and part to injection, flow or pressure control may be required. The valves used in this service must be capable of handling a wide range of flow and pressure drops while maintaining stable control and acceptable noise levels.

27.2.2.7 Design pressure

Pressure safety valves should, if at all possible, be avoided at high pressures. This can be achieved by installing equipment and piping downstream the last stage of compression designed for the maximum possible pressure created by the compressor(s) stages plus a design margin, and analyse the compressor curves and possibly allow some degree of overpressure of the equipment (aftercooler) and piping for limited periods.

27.2.3 Regularity

System regularity : Class A.

27.3 Operational requirements

27.3.1 Control and monitoring

Minimum required control and monitoring functions for each separately driven stage of compression

OS/VDU functions	P	T	L	F	Other	Remark
Compressor gas inlet				C		Input to antisurge inlet & outlet seal oil
Compressor gas inlet	A,M	A,M				Input to antisurge, if required
Compressor gas outlet	A,M	A,M				Input to antisurge, if required
Scrubbers			C/A			
Coolers		C/A				

Process variables : P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions : A = Alarm, M = Monitoring, C = Control.

Note: Compressor driver and corresponding utilities to be specified by vendor.

The following control requirements should be included to achieve a minimum manning facility. The control system shall allow all operations required to purge, pressurize, start, run and stop the compressor system to be carried out from the control room.

Variables required for condition monitoring and condition based maintenance planning shall be collected and stored automatically.

Auxilliary systems to the compressor and driver shall be monitored to the extent required for obtaining prealarms prior to shutdown actions. The number of shutdown actions should be limited, and the use of critical alarms should be considered instead.

All signals except valve status signals shall show the value of the variable i.e. come from transmitters.

27.3.2 Safeguarding and shutdown

Shutdown functions shall be provided according to ISO 10418. If the compressor operates with seal oil system, depressurisation due to seal oil failure shall be included.

27.4 Maintenance requirements

All major parts to be easily accessible and removable with a minimum disturbance to piping i.e. break-out spools shall be provided on the major piping where equipment may have to be removed.

Areas of the compressor and driver skid where frequent maintenance may be expected, shall be sheltered from the weather.

Water wash equipment to be provided for gas turbines.

Arrangement for direct filtering and filling of seal oil, plus drainage of seal and lube oil to closed drain, shall be installed.

27.5 Isolation and sectioning

Each compressor train shall be equipped with isolation valves and bleed for maintenance purposes.

The volume that has to be gas free in order to maintain the compressor shall be minimized.

27.6 Layout requirements

Layout requirements:

- Coolers and compressors should be elevated above scrubbers.
- Anti- surge line shall be sloped with valve at high point.

27.7 Interface requirements

The following utility and support systems may have to be provided to the gas export system:

- Fuel at sufficient pressure
- Cooling medium or seawater for gas, lube and seal oil coolers
- Nitrogen for dry gas seals
- Methanol if required
- Instrument air and hydraulic power
- Electric power and UPS for instrumentation
- Service fresh water for turbine washing
- Ion exchange filters to be part of the system
- Flare and drain

27.8 Commissioning requirements

Commissioning requirements:

- Temporary strainers shall be installed upstream each compressor.
- If compact heat exchangers are used, temporary spools bypassing the exchangers shall be provided to allow full flow flushing of the cooling side piping. On all inlets filters of 300 micron must be installed immediately upstream the exchanger, even if the service is clean during normal operation
- If onshore commissioning is planned, type of fuel to the gas turbine should be considered.

- The gas coolers should be designed to allow for compressor testing with nitrogen or air, ie. increased water flow and larger vibrations without causing mechanical damage.

27.9 Safety requirements

Compressors should be located away from large hydrocarbon inventories such as production separators.

External temperature of gas turbine exhaust ducting shall be kept below ignition temperature of typical hydrocarbon gas mixtures.

27.10 Environmental requirements

The power consumption of compression systems should be minimized by utilization of best available technology for antisurge-, and speed-control and load sharing where parallel units are operated.

When seal oil is used, and the pressures allow, the gas from the seal oil pots should be returned to the process. Gas from vacuum degassing units can normally not be recovered.

Low NO_x-nozzles should preferably be used on all gas turbines to reduce NO_x to the atmosphere.

29 WATER INJECTION

29.1 Scope

This clause defines the minimum requirements for the seawater injection system.

29.2 Functional requirements

29.2.1 General

The water injection system shall deliver treated water at high pressure for injection to maintain reservoir pressure. For seawater injection systems treatment may include coarse filtration, fine filtration, disinfection, deoxygenation and chemical injection.

Note: Some of the requirements in this chapter may not be valid for a particular project due to reservoir conditions and/or material selection. Such requirements can be omitted. Typical examples are filtration, disinfection and deoxygenation.

29.2.2 Performance

29.2.2.1 Filtration

For permanent water injection systems self cleaning filters shall be used.

Coarse/fine filtration is optional.

29.2.2.2 Disinfection

Disinfection facility is optional based on injection water requirements.

Disinfection should be achieved with a minimum use of chemicals. Seawater supply shall be chlorinated. Continuous disinfection can be achieved by use of Ultra Violet (UV) sterilising units opposed to continuous injection of organic biocides.

Typical design dosage is 40 mWs/cm² (milli-Watt-second pr. square centimeter) with a transmissivity of 95% in 10 mm cell.

29.2.2.3 Deoxygenation

Optional based on reservoir requirements and material selection. If carbon steel piping and vessels are used, the water should be deoxygenated. If high alloy seawater resistant steel is used, deoxygenation for corrosion purposes can be avoided.

Deoxygenation shall preferably be achieved without the use of chemicals.

For vacuum deaeration tower(s) the following apply:

- Vacuum pumps to be oversized by 20% due to possible leakage in gaskets.
- Deoxygenated water should flow into a buffer tank (normally part of the deareator). Upstream the buffer tank there shall be provision for injecting chemicals for oxygen removal (oxygen scavenger) in case of operational problems with the deoxygenator unit. The buffer tank should be sized based on necessary time for chemical to react or to enable booster pump suction in case of fluctuations in seawater supply, whichever is largest.

Other processes for oxygen removal may also be used, such as stripping gas (f.ex. nitrogen).

29.2.2.4 Booster pumps

Pumps should be of fixed speed type. Start up dump line to be installed downstream the booster pump.

The booster pump may be integrated into the injection pump.

29.2.2.5 High pressure pumps

The high pressure pumps should be of variable speed type. Upstream the injection pump there must be adequate buffer volume to ensure sufficient water supply in case of booster pump trip to safely run down the injection pump.

29.2.2.6 Chemical injection

A chemical injection package shall be available for injection of the chemicals as required. The interaction of different chemicals, type of chemical and injection point shall be considered as many of the chemicals react with each other. A typical example is chlorine reaction with oxygen scavenger.

Disinfection:

Chlorine	Continuos injection in seawater supply to prevent marine growth, if not already present.
Organic biocides	Shock treatment at certain intervals for further reduction of living bacteria and control of biofilm build up.
UV sterilisation	Normally a more cost effective solution than continuos injection of large amounts of organic biocides.

Other chemicals:

Oxygen scavenger	Chemical removal of oxygen when the deoxygenator is out of service.
Antifoam	To prevent foaming in the deoxygenator.
Polyelectrolyte	Injected to enhance filtration efficiency in fine filters.
Scale inhibitor	May be required to prevent scaling in reservoir.

Note: The use of ferric chloride or equivalent coagulants to enhance filtration efficiency should be avoided due to experience with iron oxide precipitation in seawater injection systems.

29.2.3 Regularity/sparing

System regularity: Class B.

Sparing:

Filtration	2 x 100%
Deoxygenation	No sparing required
Disinfection	No sparing required
Booster pumps	No sparing required
Injection pumps	No sparing required
Chemical injection	No sparing required

29.3 Operational requirements

29.3.1 Control and monitoring

Control and monitoring from the CCR

OS/VDU Functions	P	T	L	F	Other	Remarks
Coarse filter	M/A					Alarm on high differential pressure
Fine filter	M/A					Alarm on high differential pressure
Disinfection						Common alarm
Deoxygenation/ buffer tank	M/A		C	C	Oxygen content	
Booster pumps	M				Running status	
Injection pumps	M/A			M		Alarm on high and low pressure

Process variables: P=Pressure, T=Temperature, L=Level, F=Flow.

Process functions: A=Alarm, M=Monitoring, C=Control.

29.3.2 Safeguarding and shutdown

Water hammer effects during start up and shutdown shall be considered during design.

29.3.3 Sampling

Sampling points shall be provided for routine monitoring of water quality and process performance.

29.4 Maintenance requirements

Space shall be provided close to filters and pumps for laydown of dismantled components during major overhaul and repair.

29.5 Isolation and sectioning

Individual equipment items in parallel duty shall be furnished with valves for individual isolation.

29.6 Layout requirements

Booster pumps to be located at the lowest elevation of the system to achieve the required NPSH.

29.7 Interface requirements

Seawater	Seawater supply from the seawater system.
Water	Formation water.
Chemical injection	As required.
Power supply	Drivers for pumps, vacuum compressors and UV sterilising.
Instrument air	As required.
Utility air	For (dual) media filter, if applicable.
Inert gas	On booster pump buffer tank, if this is required.
Drain system	As required.

Specific interface requirements are to be provided by the supplier. Annex A contains datasheets with an Interface requirements list for provision of such information.

29.8 Commissioning requirements

No requirements.

29.9 Safety

The handling and spill of chemicals shall be limited to the extent possible.

29.10 Environmental

The chemicals selected shall comply with the Parcom regulation and be approved by the State Pollution Agency (SFT).

Dumping of chemically treated water should be avoided during start up, shutdown and minimum flow.

Environmental friendly chemicals shall be preferred.

40 COOLING MEDIUM

40.1 Scope

This clause defines the minimum functional requirements for the cooling medium system.

40.2 Functional requirements

40.2.1 General

The cooling medium system shall remove heat in process and utility systems where direct seawater cooling is not applicable.

The cooling medium is normally a water/glycol (TEG) mixture.

40.2.2 Performance

40.2.2.1 System capacity

Pumps shall be sized as follows:

- Sum of all normal continuous operating loads.
- Intermittent loads handled by spare pump.

40.2.2.2 System operating pressures

Cooling medium system pressure should be maintained higher than the seawater system pressure to prevent seawater (chloride) migration into the cooling medium.

40.2.2.3 System return temperature

The cooling medium return temperature should be limited to assure that the seawater side skin temperature is kept below 55°C.

40.2.2.4 Expansion tank

Capacity to control volume expansion from temperature variation within the 25% and 75% liquid level range. Hydrocarbon monitoring shall be installed enabling detection of leakage with option to purge to flare.

40.2.3 Regularity/sparing

System regularity: Class A.

Continuous load shall be handled by the normally operating pump(s). Additional pump(s) shall be available for periods with intermittent high loads and as spare.

40.3 Operational requirements

40.3.1 Control and monitoring

Control and monitoring from CCR

OS/VDU functions	P	T	L	F	Other	Remarks
Cooling medium pumps	M/A	M		C	A	Pump running status
Cooling medium coolers		C/A				
Cooling medium Expansion tank			M/A		A	Hydro-carbon detection

Process variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions: A = Alarm, M = Monitoring, C = Control.

40.3.2 Safeguarding and shut-down

No specific requirements are identified

40.3.3 Fill-up/drainage

Fill-up line shall be permanently installed. System shall be gravity drained to tank or boat.

40.3.4 Mode of operation

Either pump may serve as standby pump. Automatic start of stand-by pump on trip of operating pump.

40.4 Maintenance requirements

Cooling medium coolers should be designed for maintenance to be done offshore. If onshore maintenance strategy is selected, then lifting devices shall be installed for dismantling and transportation.

40.5 Isolation and sectioning

Block valves and spool pieces as necessary shall be installed around pumps, coolers and cooler users for individual isolation to allow removal of units for maintenance. Drainage of small isolated volumes shall be installed to open drain system.

40.6 Layout requirements

System can be located in open air.

Layout requirements:

- Cooling medium coolers shall be located low.
- Expansion tank shall be located at the highest point in the circulation loop.

40.7 Interface requirements

Inert gas	Expansion tank shall be continuously blanketed.
Chemicals	Injection of corrosion inhibitor/PH stabiliser upstream of pumps shall be provided.
Power	Emergency or essential power shall be available for one pump. Pump selection may be done manually.
Seawater	As required for energy balance.
Instrument air	As required.
Vent/flare facility	If hydrocarbons are detected.

Specific interface requirements are to be provided by the supplier Annex A contains datasheets with an Interface requirements list for provision of such information.

40.8 Commissioning requirements

Critical equipment such as compact heat exchangers have special requirements for cleaning.

40.9 Safety requirements

No specific requirements are identified.

40.10 Environmental requirements

No specific requirements are identified.

41 HEATING MEDIUM

41.1 Scope

This chapter defines the minimum requirements for the heating medium system.

41.2 Functional requirements

41.2.1 General

The heating medium system shall provide required heat load to process and utility equipment. Heating energy is transferred by a heating medium circulating in a closed loop. The heat is usually supplied by means of waste heat recovery units from turbines.

Where heat is required before start up of turbines, a start up heater is required.

The heating medium is normally water/glycol (TEG) or hot-oil depending on temperatures required. The danger connected with use of flammable heat media should be considered.

The maximum operating pressure for the system shall cater for pressure surges and temperature variations in the system (startup/shutdown and normal operation).

41.2.2 Performance

41.2.2.1 System Capacity

System capacity is calculated as design load of continuous consumers plus peak load from intermittent consumers (if relevant).

41.2.2.2 Pumps

Pumps and motor to be sized for maximum viscosity of heating medium, i.e. cold state. To ensure NPSH it shall be assumed that waterbased heating medium is at boiling point in the expansion tank.

Drain from pump drip tray to normally be routed to non-hazardous open drain system.

41.2.2.3 Waste heat recovery units

It shall be possible to bypass the waste heat recovery tube bundle by bypassing the exhaust gas. This is important to avoid boiling or decomposition of heating medium within heating coil. The exhaust bypass can be used as heating medium temperature control.

Minimum operating temperature in the complete system should be above 120 °C, if units are exposed to saline atmosphere.

Minimum flow through heating coils in standby units should be included.

41.2.2.4 Filter

A filter shall be provided and sized to take a slip stream of the main circulation to clean the heating medium.

41.2.2.5 Stand by heater

Fired or electric heaters may be required as start up heater or for permanent heating where enough waste heat is not available.

41.2.2.6 Expansion tank

The heating medium expansion tank should be blanketed with inert gas with spill off to atmospheric vent. The tank shall as a minimum be sized to cater for the volumetric expansion of the heating medium within the 25% and 75% liquid range.

41.2.2.7 Insulation

The heating medium pipes and equipment shall be insulated for heat conservation.

Intermittent consumers and bypass lines shall be left uninsulated. In such case personnel protection shall be considered.

41.2.3 Regularity/sparing

System regularity: Class A.

Sparing:

Heating medium transfer pumps: 2 x 100% or 3 x 50%

Waste heat recovery units : 2 x 100% or 3 x 50%

Heating medium expansion tank: 1 x 100%

The requirement for a heating medium essential pump shall be considered.

41.3 Operational requirements

41.3.1 Control and monitoring

Control and monitoring from the CCR

OS/VDU functions	P	T	L	F	Other	Remarks
Pumps				C/A	Running status	Alarm on low flow
Waste heat rec. unit		C/A				Alarm on high temperature
Expansion tank	M/A		M/A			Alarm on high pressure and high and low level
Consumers				C		Heating medium flow control
Hydrocarbon detector					A	Alarm on hydrocarbon leakage in expansion tank

Process variables: P=Pressure, T=Temperature, L=Level, F=Flow.

Process functions: A=Alarm, M=Monitoring, C=Control.

41.3.2 Safeguarding and shutdown

The heating medium circulation pumps shall stop on low level in heating medium expansion tank, provided the exhaust has been bypassed around the waste heat recovery unit.

Waste heat recovery/standby heater units shall be protected against over pressure in case the units are blocked in. Tube rupture in waste heat exchanger piping , resulting in heating medium leaking into exhaust/burner stack, shall be considered and accounted for in design.

Tube rupture in consumer heat exchangers shall be considered during design.

The use of flanges and connections shall be limited, as the high temperature tend to create leaks due to expansion/contraction.

Avoid insulation of flanges in systems using hot oil as heating medium.

The selected heating meduim shall have a flame point above the highest operating temperature if parts of the system are located in non classified areas. Leakage combined with an ignition source can result in fire if the flame point of the heating medium is lower than the maximum operating temperature.

41.4 Maintenance requirements

Heating medium shall be drained to separate tanks for reuse after draining of equipment.
Filling and drain lines to be permanently installed.

41.5 Isolation and sectioning

It shall be possible to isolate major equipment of the system such as pumps, consumers and heat recovery/standby heater units.

Intermittent consumers of heating medium shall have block valves close to supply/return header.

41.6 Layout requirements

The heating medium expansion tank shall be located at the highest point in the heating medium system.

Heating medium pumps to be located below the expansion tank, and with sufficient height to ensure adequate net positive suction head.

41.7 Interface requirements

Turbine exhaust	Heat energy
Electric power	Circulation pumps
Heating medium	Fill lines
Instrument air	As required
Inert gas	Blanketing of expansion tank
Drain system	Drainage of system
Chemical	Corrosion inhibitor (depending heating meduim type)
Flare	Spill off from expansion tank

Specific interface requirements are to be provided by the supplier. Annex A contains datasheets with an Interface requirements list for provision of such information.

41.8 Commissioning requirements

The system shall be designed such that early commissioning of the turbines can be performed without damaging the waste heat recovery units or degrade the heating medium in the system. The normal solution is for the turbine exhaust to bypass the waste heat recovery unit.

41.9 Safety

Personnel should be protected against the hot surfaces.

41.10 Environmental

Degraded heating medium shall be disposed without impact on the environment.

43 FLARE

43.1 Scope

This chapter defines the minimum functional requirements for the flare system.

43.2 Functional requirements

43.2.1 General

The flare system shall provide safe discharge and disposal of gases and liquids resulting from:

- Relief of excess pressure caused by process upset conditions.
- System depressurisation either in response to an emergency, e.g. fire, or as part of a normal procedure, e.g. shutdown prior to maintenance.
- Process flaring of gas, primarily to allow oil production to continue when downstream gas treatment or compression facilities are unavailable or during start-up.
- Venting from equipment operating close to atmospheric pressure - vent gases may include blanket and purge gas along with various other minor discharges.

To accommodate releases to flare from systems operating at different pressures, practical and cost effective flare system design usually dictates a requirement for more than one collection and disposal system.

The three main categories are:

- The HP flare system - designed to operate at relatively high backpressure thereby minimizing piping and equipment size. Systems which discharge to the HP flare must operate at sufficiently high pressure, typically 10 barg or above. The HP flare tip is usually specified to operate at sonic velocity and significant pressure drop, and with good emissivity characteristics to minimise radiation intensity.
- The LP flare system - designed to receive discharges from equipment and piping operating at pressures which are too low to utilize the HP flare system. System backpressure is minimised by the selection of appropriate piping sizes and by the use of a sub-sonic open pipeflare which incurs minimal pressure drop.
- The vent system - designed to receive discharges from equipment unable to withstand backpressures in excess of 0.07 barg. Vent system gases are either combusted or “cold” vented to atmosphere, and in many cases a production facility will have both a combusted and un-ignited vent system.

Depending on the design requirements, further segregation of the flare system into sub-systems such as “liquid” and “low temperature” flare systems may be required.

To reduce releases of hydrocarbon gases and CO₂ to the atmosphere, some operators have installed systems for recovery of flare gas.

43.2.2 Performance

43.2.2.1 Design data

	HP	LP	Vent
Source discharge pressure (barg)	>10		<0.07
Knock-out drum pressure (barg)			ATM
Knock-out droplet size (micron)	<600 ¹⁾	<300	<300

Note 1: For subsonic flare, 300 micron shall be used.

43.2.2.2 System Design

Once the segregation of the flare system into sub-systems such as HP-, LP- and Vent-, etc. is determined, there are two fundamental elements in the design of each sub-system. These are:

- Establish rates and conditions for individual relief sources.
- Establish the overall platform flaring scenarios.

The first of the above elements is required to determine the design requirements for individual relief and blowdown lines and sub-headers, and to ensure correct specification of relief devices according to built-up backpressure limitations.

The overall platform flaring scenarios must be identified to determine the design requirements for the main system components, i.e.:

- Flare headers.
- Knock-out drums.
- Flare structure, stack and flare tips.

Flaring scenarios are normally classified as “continuous” or “intermittent” depending on the anticipated duration of the occurrence, and design criterias are different for the two types of scenarios.

Subsequent steps in flare system design are:

- Piping network calculations.
- Radiation calculation.
- Flare knock-out drum design.

These design activities are normally performed using commercially available software packages and computer models. Manual methods and common design criteria may be found in API RP 521.

43.2.2.3 Flare gas recovery systems

Flare gas recovery systems shall be designed such that the integrity of the flare system is not jeopardised. This may be accomplished by ensuring redundancy for key components in the system (e.g. installation of rupture discs in by-pass for control valves).

There are several variations of flare gas recovery systems, often in combination with cold (un-lit) flares. Such systems have not been considered in this document.

43.2.2.4 High integrity pressure protection systems (HIPPS)

HIPPS systems are normally employed to reduce instantaneous relief rates for overpressure protection, thus facilitating a reduction in the dimensioning design requirements for the flare systems.

A HIPPS systems shall be documented to maintain the same overall safety level as a conventional protection system designed in accordance with ISO 10418/API RP 14C.

43.2.3 Regularity/sparing

System regularity: Class A.

43.3 Operational requirements

43.3.1 Control and monitoring

Control and monitoring from CCR

OS/VDU functions	P	T	L	F	Other	Remarks
Knock-out vessel	M	M/A	C/M/A			Alarm on low temperature and liquid level
Flare				M		Input to DAS
Flare tip					A	Flare to be monitored by use of camera

Process variable: P = Pressure, T = Temperature, L = Level, F = Flow.

Process function: A = Alarm, M = Monitoring, C = Control.

If a heater is installed in the flare knock-out drum, a low level trip should ensure that the element is completely immersed during operation. The heater should be protected by a high temperature cut-out.

43.3.2 Safeguarding and shutdown

In the event that the liquid level in the flare knock-out drum rises to the high level, a controlled automatic production shutdown should be initiated.

43.3.3 Measurements

Systems shall be equipped with flow devices located downstream knock-out drums continuously measuring the rates of fluids being flared. The rates shall be available on OS/VDU picture and as input to Data Acquisition System (DAS).

43.3.4 Pilots/flare ignition

Functionality shall be proven under all operating conditions.

43.4 Maintenance requirements

43.4.1 Access

All instrumentation shall be located available for testing, repair and replacement without production shutdown, except instrumentation at flare tip. Ladders and platform for access to flare tips shall be provided.

Methods and temporary equipment for change out of flare tip shall be provided from the vendor.

43.4.2 Insulation

Insulation is normally not required on flare knock-out vessels.

Headers where no flow is expected during fire may require fire insulation

43.5 Isolation and sectioning

43.5.1 Valves

Leaks into flare systems shall be minimized by proper selection of valves (tight shut-off)

43.6 Layout requirements

The design of the flare and vent systems should take account of the following lay-out considerations:

- Flare and vent headers and relief valve tail pipes should be routed without pockets and sloped to allow free drainage to the respective knock-out drum or low point drain.
- Relief valves and other overpressure protection devices should be located at high points in the process systems to minimise liquid carry-over.
- The flare stack should be located at the hazardous end of the platform, as far as possible from living quarters and the helideck and with due regard to the location of a drilling derrick and platform cranes.
- Atmospheric cold vent discharges shall be located so as to minimise the risk and consequences of accidental ignition.

43.7 Interface requirements

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirements list for provision of such information.

43.7.1 Power

Vessels shall be fitted with heaters to prevent liquids from freezing due to low ambient temperature.

43.7.2 Purge gas

Each system shall be continuously purged with nitrogen or fuel gas supplied upstream in headers and sub-headers.

43.7.3 Pilots

Normally lit flare tips shall be equipped with pilot burners with alternative source provided as back-up.

43.7.4 Methanol

Methanol injection points (temporary) shall be considered at locations where conditions are such that hydrates may form and the duration of the pressure let-down operation is

such that these can cause blockages.

43.8 Commissioning requirements

Spectacle blinds shall be provided as required to perform leak testing of system, excluding flare stack piping from knock-out drum outlets.

43.9 Safety requirements

The design of the flare and vent system shall take account of the following safety considerations:

- The flare system should be designed to operate within all specified criteria for backpressure, velocity, noise and erosion.
- The specification, location and orientation of flare and vent tips shall ensure that all requirements with respect to radiation levels, gas dispersion and potential liquid spill-over are met.
- Satisfactory operation of the flare ignition system shall be ensured at all times.
- Flame impingement from flare tips on nearby structures shall be prevented.
- The formation of ice or hydrates causing potential blockages should be safeguarded against throughout the system. Preventive measures include:
 - The use of flare knock-out drum heaters.
 - Winterisation of liquid dead legs, e.g. knock-out drum outlet piping.
 - Insulation and heat tracing of dead legs upstream blow down valves and PSV's.
 - Provision of a separate low temperature flare header to avoid mixing of low temperature gas with hot, wet gas.
- Flare and vent headers should be continuously purged with nitrogen or fuel gas to prevent the ingress of air which may create an explosive mixture.

43.10 Environmental requirements

A flare gas recovery system shall be considered for all new installations. This evaluation is particularly relevant for the HP flare systems, and shall be based on LCC principles.

44 OILY WATER TREATMENT

44.1 Scope

This chapter defines the minimum functional requirements for the oily water treatment system.

44.2 Functional requirements

44.2.1 General

The system shall collect and treat produced water from the production separators, such that the water can be discharged to sea or reinjected into the reservoir, and the oil can be recovered and returned to the production system.

Hydrocyclones are normally used for separation of oil and water, but centrifuges may also be evaluated for low capacity systems.

Produced water should in general not be mixed with seawater before discharged to sea, as a mixture of seawater and produced water may cause scaling problems in piping and equipment, dependent on composition of the produced water.

When scaling problems are predicted, the following design precautions should be taken:

- define scale inhibitor points as required
- flanged pipe connections or rod out points should be provided for easy cleaning of pipe sections
- line sizes should reflect some scaling to allow reduced cleaning frequency

44.2.2 Performance

44.2.2.1 System capacity

The system capacity shall be based on the produced water profile through the production lifetime, and also take build-up of water in the production separators into account. Spare nozzles for future hydrocyclones, or spare space for future liners in the hydrocyclones should be considered when the maximum water rates are future.

44.2.2.2 Hydrocyclones

The hydrocyclone configuration shall be based on the feed stream characteristics, turndown requirement and separation requirement. The number of hydrocyclones, and number of liners in each hydrocyclone should be evaluated to give a flexible system with respect to separation efficiency, turndown requirements and maintenance requirements.

A mixing unit for flocculation chemicals upstream of the hydrocyclones should be considered.

44.2.2.3 Flash drum

The flash drum shall be designed with a sufficient retention time for degassing of the water. The retention time should as a minimum be 60 seconds.

Provisions should be made for regular skimming of the oil collected on top of the water surface.

The drum should be designed as a horizontal vessel.

The inlet lines to the vessel shall be arranged to optimize oil droplet separation in the vessel.

If produced water shall be used for injection, additional formation water produced from a separate water reservoir (Utsira reservoir for the North Sea) should be routed to the flash drum for degassing and mixing with the produced water. The formation water should be used as back-up for produced water.

The flash drum may be a pressure vessel normally operating at approximately the same pressure as the LP flare header.

The flash drum shall be designed with a jet water system for on-line jetting and disposal of solid particles.

44.2.2.4 Reclaimed oil sump

The volume of the sump should as a minimum be sufficient to collect the liquid inventory of any one of the production separators from low liquid level.

The sump shall be designed as an atmospheric tank with continuous inert gas purging.

Heating in the sump should be avoided unless strictly necessary for prevention of wax formation. Freeze protection can be performed with circulation back to the tank.

44.2.2.5 Reclaimed oil sump pump

A pump type creating low shear forces should be selected to prevent split up of the oil droplets. The capacity of the pump shall as a minimum equal the average incoming flowrate to the sump.

The system design should take the following into consideration:

- The system should allow a turn-down to avoid transient and unstable conditions in the downstream system at reclaimed oil sump pump start. This can be achieved either by using a centrifugal pump with downstream throttling valve, or a positive displacement pump with a return line back to the reclaimed oil sump. This must be evaluated against the possible negative effect on shearing.
- The handling of the reclaimed oil should aim to limit the degree of recirculation of the liquids back to the main separation train. If large water volumes are expected with the reject stream from the hydrocyclones, a secondary separation device should be evaluated.

44.2.2.6 Metering and sampling

Cleaned water from the flash drum shall be metered and sampled before discharged to sea. The samples shall be analyzed for oil in water concentration. Location of sample connections shall be according to the requirements given by the relevant authorities (Norway SFT State pollution agency). Provisions shall be made for future installation of an on-line oil-in-water analyzer.

44.2.3 Regularity/sparing

System regularity: Class A.

Hydrocyclones shall be provided in parallel for the different separator pressure levels.

Sparing of reclaimed oil sump pump should be considered.

Normally no other sparing is required.

44.3 Operational Requirements

44.3.1 Control and Monitoring

Control and monitoring from CCR

OS / VDU functions	P	T	L	F	Other	Remarks
Hydrocyclones	C/M					Diff. pressure control
Flash drum			C/M/A			High and low alarms
Water from flash drum				M	.	Flow indicator with totalizer
Reclaimed oil sump			C/M/A			
Reclaimed oil sump pump	A				Pump running status	High alarm. Start/stop of reclaimed oil sump pump by high/low level in the sump.

Process variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions: A = Alarm, M = Monitoring, C = Control.

44.3.2 Safeguarding and shutdown

No specific requirements identified.

44.4 Maintenance requirements

Provision shall be made for safe withdrawal of a pump from the reclaimed oil sump during operation of the system.

44.5 Isolation and sectioning

The inlet and outlet lines to the hydrocyclones and the flash drum, and the inlet lines to the reclaimed oil sump shall be provided with spectacle blinds or spade and spacer for positive isolation during inspection or maintenance work.

44.6 Layout requirements

All equipment shall be located in hazardous areas.

The reclaimed oil sump shall be located at lowest possible elevation to ensure gravity draining from the sources.

Jet water disposal lines should not be pocketed to avoid sand accumulation and blockage.

If produced water shall be used for injection, the flash drum shall be located at a sufficiently high level to provide the required NPSH for the water injection pump.

44.7 Interface requirements

Inert gas	Reclaimed oil sump shall be continuously purged to prevent ingress of oxygen in the tank. Flash drum may also need blanket gas.
Chemical injection	Biocide for batch dosing into the reclaimed oil sump. Emulsion breaker and flocculation chemicals may also be required.
Compressed air	As required.
Jet water	If required for the flash drum, produced water should be used.
Power	Reclaimed oil sump pump shall be powered from the main power distribution.

44.8 Commissioning requirements

No specific requirements are identified.

44.9 Safety requirements

No specific requirements are identified.

44.10 Environmental requirements

Water discharged to sea shall have an oil concentration of maximum 40 mg/l as a monthly average.

45 FUEL GAS

45.1 Scope

This chapter defines the minimum functional requirements for the Fuel gas system.

45.2 Functional requirements

45.2.1 General

The fuel gas system shall provide superheated fuel gas at suitable pressures to the platform consumers. The fuel gas system shall provide both high and low pressure fuel gas.

Typical high pressure fuel gas users:

- Main power generators
- Process gas compressors

Typical low pressure fuel gas users :

- Pilot ignition
- Back-up purge to HP/LP headers
- Blanket gas
- Stripping gas to glycol regeneration

Dry and dewpoint controlled hydrocarbon gas should be used, if available, to obtain high quality gas that will not form hydrates or condensate.

45.2.2 Performance

45.2.2.1 System capacity

The fuel gas shall meet the requirements from the different platform consumers.

The fuel gas scrubber should be sized to have sufficient hold-up of fuel gas (above a specified minimum pressure for 20 seconds) to enable a smooth changeover of the power generator turbines from fuel to diesel oil or a high pressure gas reservoir back-up.

45.2.2.2 Operating pressure

The fuel gas pressure is depending on the pressure required to the gas turbines.

The fuel gas pressure should be set such that it is possible to :

- Choose between several types of gas turbines.
- Use low NOx burner nozzles (require approx. 2.0 - 2.5 bar additional pressure).

45.2.2.3 Operating temperature

If waste heat is available on the platform, heating medium should be used to superheat the fuel gas, otherways electrical heating may be used.

For gas turbines and fired heaters the fuel gas temperature should be kept at :

- 20°C above its water dewpoint.
- 25°C above its hydrocarbon dewpoint.

For purge, flare pilot gas e.g 10°C above the water or hydrocarbon dewpoint is acceptable.

"Warm-up" lines routing the fuel gas at start-up to flare, should be provided upstream each of the gas turbines.

45.2.2.4 Fuel gas metering

The fuel gas shall be continuously metered as input to calculations for CO₂-taxes to the Norwegian Government. Allocation type meter with pressure and temperature corrections, should as a minimum be included.

45.2.2.5 Fuel gas filter

A dedicated filter separator is required on the fuel gas supply to each gas turbine at the turbine skid limit.

45.2.3 Regularity/sparing

System regularity: Class A.

When continuous heating is covered by a heating medium, a smaller electric heater may be installed in parallel for start-up purpose.

45.3 Operational requirements

45.3.1 Control and monitoring

Control and monitoring from the CCR

OS/VDU functions	P	T	L	F	Other	Remarks
Fuel gas scrubber			C/A			Alarm on high / low level
Distribution temp.		C/A				Alarm on low temp.
Distribution press.	C/A					Both H.P. and L.P. fuel gas. Alarm on high / low press.
Fuel gas flowrate				M		Include totaliser

Process variables : P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions : A = Alarm, M = Monitoring, C = Control.

45.3.2 Safeguarding and shutdown

Process shutdown valves should be included at the following locations:

- In main supply line to the fuel gas system.
- In each back-up fuel supply line to the system.
- In main gas distribution header (high pressure).
- In low pressure distribution header.
- In all fuel gas supply lines to gas turbines.

The following shutdown signals shall close all PSD valves to/from the system and automatically switch over to back-up fuel on the Main power generator turbines:

- High liquid level in the Fuel gas scrubber.
- High and low pressure in the main gas distribution header.

The following shutdown signals shall only close the PSD valves as specified:

- Low level in the fuel gas scrubber shall close PSD valve in liquid outlet line.
- High pressure in L.P. distribution header shall close PSD valve in header supply line.
- If electric heater is included, then high distribution temperature shall stop electric power.

Relief and blowdown of high pressure fuel gas system shall be to HP flare system and low pressure fuel gas to the LP or atmospheric vent system.

45.3.3 Sampling

A sampling point downstream the fuel gas heater should be provided.

45.3.4 Heat tracing

Heat tracing of supply lines to critical consumers (e.g. gas turbines) should be included.

45.4 Maintenance requirements

All major parts shall be easily accessible.

Fuel gas heater(s) should be designed for offshore maintenance.

45.5 Isolation and sectioning

Isolation valves shall be installed on main gas supply header, LP Fuel Gas header and on all fuel gas supply lines to consumers.

Block valves, spectacle blinds and spool pieces as required shall be installed around fuel gas scrubber, heater(s), metering unit and gas turbines filter/scrubbers for individual isolation to allow removal of equipment for maintenance. Heater to have block valves and bypass valve.

Drainage of liquid volumes shall be to closed drain system.

45.6 Layout requirements

The system can be located in open air.

- Fuel gas line between the scrubber and heater to slope back to scrubber unit.
- Fuel gas lines between the heater and the gas turbines filter/scrubbers to have no pockets.
- Space for replacement of filter elements to be included.

45.7 Interface requirements

Hydrocarbon feed	From process section with suitable pressure, preferably dry gas.
Liquid return	To oil/condensate stabilisation.
Heating medium/electrical power	Required to superheat the gas to specified value.
Methanol	Injection of methanol in fuel gas supply if wet gas is used at start-up.
Instrument air	As required.
HP flare system	For relief and blowdown.
Atm. vent system	For maintenance.
Closed drain system	For maintenance.

Specific interface requirements are to be provided by the supplier. Annex A contains datasheets with an Interface requirements list for provision of such information.

45.8 Commissioning requirements

Low point drains shall be installed.

45.9 Safety requirements

Fuel gas lines through non-hazardous area shall be all welded.

In order to be able to depressurise the fuel gas line to the turbine when the generator is not running, one block valve inside the turbine hood and one block valve upstream the filter/ scrubber should be provided.

45.10 Environmental requirements

Low NO_x-nozzles should preferably be used on all gas turbines to reduce NO_x to the atmosphere.

If diesel is used as back-up fuel for the Main power generators gas turbines, standard dual-fuel nozzles must at present be used. Provisions for future installation of dual-fuelled low NO_x-nozzles should be included.

46 METHANOL INJECTION

46.1 Scope

This chapter defines the minimum functional requirements for the methanol system.

46.2 Functional requirements

46.2.1 General

The methanol system shall receive, store and inject methanol. Injection shall prevent and dissolve hydrates in water containing hydrocarbon gas systems and may be to both topsides and subsea.

Methanol supply from injection pumps shall be adjustable either by means of variable speed/stroke and/or pressure control return to the storage tank. All injection points shall have a means of flow adjustment.

Subsea methanol injection systems should be designed to allow for multipurpose service such as depressurisation in connection with valve testing, hydrate plugs etc., in addition to methanol injection.

46.2.2 Performance

46.2.2.1 System capacity

The system capacity should be determined by methanol injection requirements for the hydrate prevention strategy of the production facility.

46.2.2.2 Operating pressure

The storage tank normally operate at atmospheric pressure.

The injection pumps shall deliver sufficient pressure to enable injection into the consumer systems.

46.2.2.3 Operating temperature

The system operate normally at ambient temperature.

For systems with recycle flow back to the storage tank the methanol temperature may increase. The system design shall ensure that the temperature rise does not lead to excessive vapour losses or pump suction problems.

46.2.2.4 Storage tank

The storage tank sizing basis is dependent on whether the system operate intermittently or continuously.

For intermittent systems, as a minimum requirement, the storage tank should be sized with sufficient capacity to permit the operation with the largest volumetric requirement plus one shutdown where applicable.

For continuously operated systems the storage tank shall be sized based on the maximum average daily demand and supply boat delivery frequency.

If the consumption is infrequent and in small volumes tote tanks may be used as storage tanks.

46.2.2.5 Injection pumps

Injection pumps shall be sized based on the peak injection demand.

46.2.2.6 Material selection

When designing methanol systems the following should be noted;

- methanol may contain some water which may require corrosion resistant material
- pumps, valves etc. should be thoroughly selected for methanol service

46.2.3 Regularity/sparing

System regularity: Class B.

Injection pumps should normally be spared to ensure start-up and safe shutdown.

46.3 Operational requirements

46.3.1 Control and monitoring

The injection pumps shall be controlled via a local panel with interface with the CCR restricted to shutdown input signals and supplier package common alarm output signals only.

Control and monitoring shall be in accordance with the table below

OS / VDU functions	P	T	L	F	Remarks
Storage tank			M,A		High and low level alarms.
Injection pumps	C,A				High alarm
Injection points				C,M	For critical consumers

Process variables: P=Pressure, T=Temperature, L=Level, F=Flow.

Process functions: A=Alarm, M=Monitoring, C=Control.

46.3.2 Safeguarding and shutdown

The following signals will initiate a system shutdown:

- High injection pump discharge pressure.
- Low storage tank level (if injection pump can be damaged by running dry).

Following a system shutdown the pumps shall stop and any actuated shutdown valve in an injection line shall close.

Emergency shutdown (ESD) valves should be included in the following locations:

- Injection lines to subsea locations.
- Injection lines to locations outside a riser isolation valve in continuous service.

46.4 Maintenance requirements

For continuously operating systems provision shall be made to enable isolation and maintenance of a standby pump. Spool pieces shall be provided on all pumps to facilitate removal.

It shall be possible to remove the pumps and clean the suction strainer without draining the storage tank.

46.5 Isolation and sectioning

It shall be possible to isolate all consumers individually.

46.6 Layout requirements

The system is classified as hazardous.

The piping for the supply of methanol to the storage tank shall be self draining and without pockets.

The injection pumps should be located adjacent to the storage tank such that adequate suction head is provided directly from the tank.

46.7 Interface requirements

Cooling medium / seawater	Cooling requirement for large capacity injection pumps.
Inert gas	Storage tank purging / blanketing.
Power	Essential power may also be required.
Flare	Subsea depressurisation. Drainage of injection manifolds.
Atmospheric vent	Storage tank vent discharge.
Closed drain	Drainage of injection manifolds.

46.8 Commissioning requirements

The storage tank, pumps and return lines should be located in the same module to minimise offshore commissioning.

46.9 Safety requirements

Methanol is a hazardous fluid with a flashpoint which lies within the ambient temperature range.

Use of flanges shall be minimised. Loading hoses from supply boats shall be equipped with unique couplings and be electrically earthed.

46.10 Environmental requirements

Methanol is a toxic chemical which poses a health risk. Facilities shall be provided to minimise handling requirements and exposure to personnel.

47 CHLORINATION

47.1 Scope

This chapter defines the minimum functional requirements for the chlorination system.

47.2 Functional requirements

47.2.1 General

The chlorination system shall generate or receive, store and inject hypochlorite into systems containing seawater. The concentrations specified below shall prevent macro and micro biofouling of equipment and piping:

- Design dosing concentration (equivalent free chlorine) 2.0 ppm (vol/vol).
- Residual concentration (equivalent free chlorine) 0.2 - 0.5 ppm (vol/vol).

Feed to the hypochlorite generator shall be from downstream of the seawater filters. The system shall operate continuously and produce hypochlorite at a stable rate at the required concentration.

47.2.2 Performance

47.2.2.1 System capacity

The system capacity should be determined by the continuous seawater consumption of the facility. Facilities shall be provided to adjust the flow of concentrated hypochlorite to each consumer.

47.2.2.2 Operating pressure

The electrolysis cells shall operate at a pressure set by the supplier which will lie between the seawater lift pump discharge pressure and atmospheric pressure.

47.2.2.3 Operating temperature

The system shall essentially operate at seawater supply temperature. Actual operating temperatures may be higher due to heat generated in the electrolysis cells.

47.2.2.4 Electrolysis cells

The cell capacity, seawater flowrate, generated hypochlorite concentration and filtration requirements should be based on a standard supplier cell design.

The seawater flowrate to the electrolysis cells shall be at a sufficient rate to remove the generated heat at an adequate rate. Operation of the cells shall be such that solids deposition on the electrodes does not occur.

The electrolysis cells transformer / rectifier shall have the facility to adjust the current in order to adjust the hypochlorite concentration.

47.2.2.5 Hypochlorite head tank/air blower (if applicable)

The head tank shall be sized for a residence time of 20 minutes at maximum volumetric hypochlorite production.

The hypochlorite head tank shall operate at near atmospheric pressure.

The air blower shall have a minimum capacity of 100 times the volumetric rate of hydrogen production.

47.2.2.6 Sampling

Provision for sampling from the electrolysis cell inlet and outlet lines shall be installed.

47.2.3 Regularity/sparing

System regularity: Class C.

System operation is not critical for production and a short outfall is acceptable.

No sparing is normally required except for the air blowers for hydrogen removal which shall be spared.

47.3 Operational requirements

47.3.1 Control and monitoring

The system shall be controlled via a local panel with interface with the CCR restricted to shutdown input signals and supplier package common alarm output signals only.

Control and monitoring shall be in accordance with the table below

OS / VDU functions	P	T	L	F	Remark
Electrolysis cells	C			M,A	Self-actuated pressure controller. Low flow alarm
Head tank			C,A		High and low alarms.
Injection points				M	Local flowmeter.

Process variables: P=Pressure, T=Temperature, L=Level, F=Flow.

Process functions: A=Alarm, M=Monitoring, C=Control.

47.3.2 Safeguarding and shutdown

The system shall be equipped with internal shutdown trips for safeguarding and equipment protection.

The operation of the blower shall be interlocked to the cells such that loss of the blower will shut down the power supply to the cells. Upon a shutdown the blower shall continue to operate for a period to ensure a hydrogen free system.

47.4 Maintenance requirements

Facilities shall be provided to enable maintenance of part or all of the system while the seawater system is in operation. Facilities to drain the electrolysis cells shall be provided.

47.5 Isolation and sectioning

Isolation facilities shall be installed around each electrolysis cell. It shall be possible to isolate all consumers individually.

Isolation spool pieces shall be provided to prevent galvanic corrosion around the electrolysis cells.

47.6 Layout requirements

The hypochlorite generator should be sited in a sheltered, unheated location which may be freely ventilated. The hypochlorite generator should be close to the seawater lift pumps.

The hypochlorite storage tank should be located at a higher elevation than sea level to enable gravity flow to the lift pump suction.

47.7 Interface requirements

Seawater	Hypochlorite generation medium
Compressed air	Valve actuation as required
Electrical power	Essential power may be required for operation of the air blower
Open drains / bilge	Drainage from hypochlorite generator drip tray

Specific interface requirements relating to supplier packages are to be provided by the supplier. Annex A contains datasheets with an Interface requirement list for provision of such information.

47.8 Commissioning requirements

No specific requirements are identified.

47.9 Safety requirements

The system generates hydrogen gas which represents an explosion hazard. The hydrogen evolved from the cells shall be diluted by means of the air blower to a maximum of 25% of the lower explosive limit in air (1% vol/vol). The diluted hydrogen stream shall be vented to a safe location.

In addition the hypochlorite head tank overflow shall contain a liquid seal to prevent hydrogen leakage.

47.10 Environmental requirements

The system should be operated in such a way as to minimise chlorine discharges to sea. The design injection concentration given in clause 47.2.1 should be reduced whenever possible, according to the breeding season of marine organisms, provided adequate equipment protection can still be achieved.

50 SEA WATER

50.1 Scope

This clause defines the minimum requirements for the seawater system.

50.2 Functional requirements

50.2.1 General

The system shall lift, disinfect and filter seawater for distribution to the various platform users.

50.2.2 Performance

50.2.2.1 System capacity

System capacity is calculated as design load of continuous consumers plus peak load from intermittent consumer (if relevant). Design seawater supply temperature to be evaluated against running spare pump(s) during summer periods.

50.2.2.2 Temperature

Seawater cooling shall not be used where the cold side skin temperature can not be kept below 55°C (seawater bulk temperatures of about 35°C).

50.2.2.3 Pumps

Pumps to be selected to keep discharge pipe design pressure low and minimize variations in system pressure.

Fixed speed pumps shall have minimum flow protection. The minimum flow should be controlled on flow not pressure.

The discharge pipe from the pump minimum flow valve should be a "goose neck" arrangement in order to create a small back pressure which will limit cavitational problems.

If the pump has a high non filled riser (at not running condition), the riser shall be equipped with vent valve to avoid vacuum when pump is stopped.

Pump suction elevation shall be evaluated in order to limit particles and marine growth in the seawater.

50.2.2.4 Filters

A coarse filter to be located downstream the pumps to avoid larger particles than 2 mm to enter the system. The filters should be equipped with an automatic backwash facility.

In the cases seawater is routed direct from sea chest to the pump, a strainer may be located upstream of the pump to prevent large particles to enter and damage the pumps.

50.2.2.5 Prevention of marine growth

There shall be injection points for chlorine to prevent marine growth in the pipe work. The chlorine injection shall be stopped when the pump is stopped. The maximum residual chlorine content is 0.5 ppm.

50.2.3 Regularity/sparing

System regularity: Class A.
Sparing: Seawater lift pumps minimum 2 x 100% or 3 x 50%.
Strainer on each pump suction
Filter 2 x 100% or online backwash

50.3 Operational requirements

50.3.1 Control and monitoring

The system shall have local control panel and field instrumentation.

Monitoring that shall be available on OS/VDU in CCR:

OS/VDU functions	P	T	L	F	Other	Remarks
Seawater lift pumps	A			C/A	Running status	Control on flow is preferred. Alarm on pressure on variable speed pumps.
Filter	A					Alarm on high diff. pressure

Process variables: P=Pressure, T=Temperature, L=Level, F=Flow.

Process functions: A=Alarm, M=Monitoring, C=Control.

Standby pump shall start automatically upon trip of duty pump.

50.3.2 Safeguarding and shutdown

Pump and piping shall be designed in order to limit water hammer effects during start up and shutdown. The system shall be designed to handle transient conditions and pressures shall be within the requirements of the piping specification and design code. This can typically be achieved by soft start of pumps, liquid filled pump riser or pulsation damper at pump discharge check valve.

If direct seawater cooling of hydrocarbon systems is provided, coolers shall be equipped with shutdown valves on the seawater side to enable isolation in case of tube rupture or hydrocarbon leakage into the system.

50.4 Maintenance requirements

All major parts shall be easily accessible for maintenance. Pumps to have sufficient room for pulling.

50.5 Isolation and sectioning

Pumps shall have block valves to ensure maintenance on one pump while the other is in service.

50.6 Layout requirements

Pump discharge to be on the lowest part of the platform to limit water hammer during start up/shutdown.

50.7 Interface requirements

Electric power supply	Seawater lift pumps.
Instrument air	As required.
Chlorine	Injection to prevent marine growth.

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirements list for provision of such information.

50.8 Commissioning requirements

System shall be designed for early commissioning.

50.9 Safety

If glassfiber reinforced pipe is being used in the seawater pipework special consideration shall be given to supporting and pipe routing due to the water hammer effects.

50.10 Environmental

Restrictions may apply to maximum seawater return temperature.

53 FRESH WATER

53.1 Scope

This chapter defines the minimum functional requirements for the Fresh water system.

53.2 Functional requirements

53.2.1 General

The system shall produce and/or receive, store and distribute fresh water to all users on the facility.

Potable water shall be provided by UV sterilisation of generated fresh water and by hypochlorite dosing and UV sterilisation of imported fresh water. Provision should also be made for hypochlorite dosing into generated fresh water upstream of the potable water tanks.

Separate storage tanks shall be provided for potable and service fresh water and each shall be equipped with dedicated pumps and a dedicated distribution system.

The system shall be designed to eliminate the risk of contamination. Facilities shall be provided at each user to prevent backflow to the distribution system.

53.2.2 Performance

53.2.2.1 System capacity

The fresh water maker and/or fresh water import rate shall be selected to meet the total average daily demand.

Pumps capacity shall be based on peak instantaneous demand.

53.2.2.2 Operating pressure

The storage tanks shall operate at atmospheric pressure.

The distribution pumps shall operate at a pressure according to distribution requirements.

53.2.2.3 Operating temperature

The system shall operate at ambient temperature conditions but shall not be allowed to fall to a level where freezing can occur.

Continuous circulation is preferable to heating and tracing to prevent freezing, except for small lines at the extremities of the distribution system.

53.2.2.4 Fresh water maker

The fresh water maker shall be sized to meet the total average daily fresh water demand.

53.2.2.5 Fresh water treatment

The hypochlorite dosing unit and palatability unit shall be sized for the maximum fresh water production rate.

The palatability unit shall be specified for six months continuous operation.

Potable water quality shall meet the authority requirements (SIFF in Norway) for offshore potable water.

Service fresh water shall be colourless and odourless and meet the following requirements :

- Electrical conductivity (max) 75 mS/m at 25°C
- PH 6.5 - 9.0

53.2.2.6 Fresh water storage

Fresh water storage capacity shall as a minimum be sufficient for four days total average daily demand.

53.2.3 Regularity/sparing

System regularity: Class C.

Sparing of potable water equipment shall be in accordance with authority requirements.

53.3 Operational requirements

53.3.1 Control and monitoring

The fresh water maker shall be controlled via a local panel with interface with the CCR restricted to supplier package common alarm signals only.

Control and monitoring of the system via the CCR

OS / VDU functions	P	T	L	F	Remark
Storage tanks			M,A		Low level alarms
Distribution system	M,A				Auto start of standby pumps according to low pressure.
Running status					Pumps and UV steriliser out of spec. alarm

Process variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions: A = Alarm, M = Monitoring, C = Control

53.3.2 Safeguarding and shutdown

The fresh water maker shall be equipped with all necessary internal trips for protection of personnel and equipment.

In addition the following trips shall be provided in the system :

- UV steriliser low radiation intensity.
- Storage tank low level.

The above trips shall trip the corresponding supply pumps.

53.4 Maintenance requirements

Adequate facilities shall be provided to carry out on line maintenance of spared equipment and equipment which can be by-passed. It shall be possible to carry out maintenance on fresh water production equipment without affecting storage and distribution.

Facilities shall be provided to enable all equipment and piping in the potable water system to be sterilised by flushing with hypochlorite solution.

53.5 Isolation and sectioning

For storage tanks which are spared adequate isolation shall be provided for maintenance of a tank while the other is on-line.

It shall be possible to isolate all consumers individually.

53.6 Layout requirements

The system is classified as non-hazardous.

All piping shall be designed such that there are no deadlegs or stagnant sections.

It shall be possible to completely drain all equipment and sections of piping.

Spool pieces shall be provided on all pumps to facilitate removal.

53.7 Interface requirements

Seawater	System water source
Heating medium	Fresh water maker
Power	Essential power required for potable water supply

53.8 Commissioning requirements

No specific requirements are identified.

53.9 Safety requirements

The system is essentially non-hazardous.

53.10 Environmental requirements

No specific requirements are identified.

56 OPEN DRAIN

56.1 Scope

This chapter defines the minimum functional requirements for the Open drain system.

56.2 Functional requirements

56.2.1 General

The open drain system shall collect rain water, fire water, wash down water and spillage of liquids from deck areas, equipment drip trays and bounded areas.

The system shall be designed such that it can handle the impurities entering with the seawater.

Hydrocarbon liquids from the spills shall be recovered, and the cleaned water shall be dumped to sea.

The hazardous and non-hazardous areas shall have dedicated collection systems kept apart from each other.

Drains from non-pollution areas should be routed directly to sea.

56.2.2 Performance

56.2.2.1 System capacity

For non-hazardous areas, the maximum wash down of one deck or peak rainfall on weather decks should be used as basis for the design flow.

For hazardous areas, the design flow to the collection should be based on the largest flow of peak rainfall or the maximum wash down of one deck.

The deluge water should be routed to sea either via overflow lines from the drain boxes or from fireseal overflow lines. The overflow lines shall be designed for the full deluge capacity for the actual area coverage. Provision shall be made to prevent flow of hydrocarbon liquid from one deluge area to another.

Open drain shall terminate at the open drain tank or caisson with a liquid seal.

The capacity of the collection tanks, pumps and treatment unit should be thoroughly evaluated. Standard size treatment units should be used, and the capacity of the pumps shall match the treatment unit capacity. The size of the collection tanks shall be evaluated based on maximum incoming flowrate and pump capacity. The tanks shall have a buffer capacity to avoid the liquid going in overflow for short duration washdowns.

The use of high pressure washers for wash down purposes may reduce the required capacity for the open drain system.

Vessels containing inflammable liquid shall have drip tray, bounded areas or similar arrangements installed to collect small and unpredictable leakage, typically broken sight glass or leaks from gaskets.

56.2.2.2 Operating pressure

The collection systems shall operate at atmospheric pressure.

Pumps are required for transport of drain water from the collection tanks to the treatment unit. The pump pressure shall balance the static head, friction losses and required supply pressure to the unit.

56.2.2.3 Operating temperature

The system receives liquid and operates at ambient temperature.

56.2.2.4 Special considerations

The design of the system shall consider all potential types of spillage, chemicals etc. that can have impact on selection of material and surface protection.

56.2.3 Regularity / sparing

System regularity: Class C.

Normally no requirement for sparing.

56.3 Operational requirements

56.3.1 Control and monitoring

Control and monitoring from CCR

OS / VDU Functions	P	T	L	F	Other	Remarks
Haz. and non-hazardous open drain tanks			C /M			High level alarms
Drain water treatment pack. (Centrifuges). Running status						
Effluent water to sea				M		
Drain pump(s)					Pump running status	Auto start/stop of pump by high/low liquid in the drum.

Process variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions: A = Alarm, M = Monitoring, C = Control.

Sample connections shall be provided on the effluent line to sea. Provisions shall be made for future installation of an on-line oil-in-water analyser.

56.3.2 Safeguarding and shutdown

No specific requirements are identified.

56.4 Maintenance requirements

The fire seal pots should be available for maintenance without scaffolding.

Preferred location for pumps are outside the tanks. Where the location of the tanks makes this impractical, provision shall be made for safe withdrawal of a pump from the hazardous open drain tank during operation of the collection system.

The hazardous and non-hazardous open drain tanks shall be designed for easy disposal of solid particles. Corrosion resistant strainers should be considered upstream of the pumps to prevent excessive pump wear.

The drain headers shall be provided with rod out points.

The collection tanks should have sloped tank bottom to ease the tank cleaning. Strategy for cleaning of the tanks shall be implemented during design.

56.5 Isolation and sectioning

The inlet drain lines to the collection tanks shall be provided with spectacle blinds or spade and spacer for positive isolation during inspection or maintenance of the tanks.

Pumps, filters and treatment unit shall be provided with block valves for isolation of equipment to allow removal for maintenance.

Drain from drilling area shall not be mixed with drains from other areas unless mud and particles are removed in advance.

56.6 Layout requirements

The hazardous open drain tank and pump, and the treatment unit shall be located in hazardous areas.

The non-hazardous open drain tank may be located either in non-hazardous or hazardous areas.

The collection tanks shall be located such that gravity draining is possible from all sources, except for bilge water.

Piping system shall be designed for solid particles. Adequate sloping (minimum 1:100) and rodout/flushing facilities shall be implemented. Minimum header size shall be 3".

Drain points shall be designed to represent low points in decks.

Drain headers shall be located above high levels in collection tanks.

Tundishes and gullies shall be designed for easy plugging to prevent HC gas migration during hot-work.

56.7 Interface requirements

Inert gas	Hazardous open drain tank shall be continuously purged to prevent ingress of oxygen in the tank.
Fresh water	Service water for the centrifuges.
Seawater	For cooling of the centrifuges and as back-up water to the centrifuges.
Power	Pumps and centrifuges shall be powered from the main power distribution.
Flare and vent	Vent of hazardous open drain tank.
Oily water treatment	Discharge of oil from treatment unit to reclaimed oil sump.
Biocide	Batch dosing when required.
Glycol	Freeze protection as required

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirements list for provision of such information.

56.8 Commissioning requirements

No special requirements are identified.

56.9 Safety requirements

The non-hazardous and hazardous collection systems shall be completely segregated to prevent back flow of hydrocarbons from a hazardous to a non-hazardous area. The inlet lines to the collection tanks shall terminate below liquid low level in the tanks to prevent back flow of hydrocarbon gas from the treatment system.

Drains from hazardous areas shall be provided with a seal pot for every fire area. The seal pot shall prevent gas entrainment from one fire area to another.

56.10 Environmental requirements

The oil concentration of the drain water discharged to sea shall not exceed 40 mg/l as a monthly average.

57 CLOSED DRAIN

57.1 Scope

This chapter defines the minimum functional requirements for the closed drain system.

57.2 Functional Requirements

57.2.1 General

The closed drain system shall collect hydrocarbon liquid drains from platform equipment and piping, and safely dispose the liquid and degas products.

All drainage to the closed drain flash drum should be by gravity flow.

Liquid transfer from the drum to the reclaimed oil sump should be by gravity flow if possible. Pumps may be required for this service.

There shall be no hard piping connections between the open and closed drain system, except at the inlet of the reclaimed oil sump or similar.

57.2.2 Performance

57.2.2.1 System capacity

The design flow to the closed drain flash drum shall be based on credible coincident supplies to the flash drum. Both continuous and intermittent flows shall be evaluated.

The maximum flowrate from manual draining of vessels should cater for drainage of 50% of the largest vessel inventory in 1 hour.

57.2.2.2 Operating pressure

57.2.2.3 The system shall operate at the same pressure as the flare header connected to the closed drain flash drum. The pressure in the drum shall float on the flare system pressure.

57.2.2.4 Operating temperature

The system shall be able to receive liquid from all sources at their operating temperatures.

Due to depressurisation of the sources before draining temperatures below minimum ambient can be expected for the system. However, the need for draining under such circumstances shall be evaluated.

57.2.2.5 Closed drain flash drum

The closed drain flash drum shall be designed for a liquid retention time of minimum 1 minute to achieve proper degassing.

The LP flare K.O. drum may substitute the closed drain flash drum, or collect some of the closed drain streams for degassing. The reclaimed oil sump may also be used for drainage of small oil volumes at levels below closed drain flash drum inlet level.

57.2.3 Regularity / sparing

System regularity: Class B.

Normally there is no requirement for sparing of any equipment in the system.

57.3 Operational requirements

57.3.1 Control and monitoring

Control and monitoring from CCR

OS / VDU Functions	P	T	L	F	Other	Remarks
Closed drain flash drum			C,M,A			High / low alarms
Drain pump(s) (when applicable)					Pump running status.	Auto start/stop of pump by high/low liquid in the drum

Process variable: P = Pressure, T = Temperature, L = Level, F = Flow.

Process function A = Alarm, M = Monitoring, C = Control.

57.3.2 Safeguarding and shutdown

The automatic shutdown actions for the system should be according to ISO 10418.

57.4 Maintenance requirements

If drain pump(s) are provided, spool piece(s) at pump flanges shall be provided for easy removal of pump(s). Lifting arrangement shall also be provided for this purpose.

57.5 Isolation and sectioning

No specific requirements are identified.

57.6 Layout requirements

The equipment shall be located in hazardous area.

The closed drain flash drum should be located such that gravity draining is possible from all main sources, and it should be located above the reclaimed oil sump (exception to this is given earlier in this system).

57.7 Interface requirements

Power	Normally not required, only applicable if pump is required for discharge of liquid from the closed drain flash drum.
Flare and vent	Discharge of degas products from the closed drain flash drum.
Oily water treatment	Routing of oil to reclaimed oil sump

57.8 Commissioning requirements

No specific requirements are identified.

57.9 Safety requirements

Before manual draining of equipment or piping inventory to the closed drain system, the actual sources shall be depressurised.

57.10 Environmental requirements

Hydrocarbon gas from the system shall be routed to the flare system for burning or recovery. The liquid drain shall be routed back to the production train for recovery of hydrocarbons.

62 DIESEL OIL

62.1 Scope

This clause defines the minimum requirements for the diesel oil system.

62.2 Functional requirements

62.2.1 General

The diesel system shall provide storage and treatment of raw diesel supplied by boat and supply treated and untreated diesel to users.

62.2.2 Performance

62.2.2.1 Pumps

Sentrifugal pumps shall have minimum flow protection. Raw diesel pumps may be of low shear type.

62.2.2.2 Storage tanks

Total storage should normally be for minimum 4 days normal consumption.
Storage tank shall include a low point for gathering and drainage of water.
To prevent vacuum for pumpout and drainage reference is made to API 2000.

62.2.2.3 Hose loading stations

Shall be provided on two sides of platform. Sampling points shall be installed. Hook-up points for biocide treatment shall be installed.

Hose loading station shall as a minimum have a check and a block valve. A coarse strainer should be considered on the loading lines to the raw diesel tanks.

Hoses to be of anti-static type.

62.2.2.4 Day tanks

Automatic refilling shall be used on large consumers. Overflow from day tanks shall be routed to raw diesel storage.

62.2.2.5 Filtration and water removal

Facilities to remove particles and water in treated diesel to be based on consumer requirements (diesel engines, turbines etc.).

62.2.3 Regularity/sparing

System regularity: Class B.

Sparing:

Diesel transfer pumps to be 2 x 100% .

Hose loading stations, 2 off, one on each platform side.

Raw diesel tanks, 2 x 50% or 3 x 33%.

Treated diesel tanks, 1 x 100%.

62.3 Operational requirements

62.3.1 Control and monitoring

The system shall have local control panel and field instrumentation.

Monitoring that shall be available on OS/VDU in CCR

OS/VDU functions	P	T	L	F	Other	Remarks
Diesel filter/treatment					DeltaP/A	Alarm on high deltaP
Raw diesel storage			M/A			Alarm on low level
Treated diesel storage			M/A			Alarm on low level
Distribution system	A					Alarm if low pressure

Process variable: P=Pressure, T=Temperature, L=Level, F=Flow.

Process function: A=Alarm, M=Monitoring, C=Control.

Start up and shutdown of the diesel system should be local.

62.3.2 Safeguarding and shutdown

No specific requirements are identified.

62.4 Maintenance requirements

All major parts shall be easily accessible for maintenance. Drip trays shall be installed under equipment where leaks may occur during maintenance.

If the system is required to operate during a maintenance shutdown of the facility, it shall be possible to maintain all sections of the system during normal operation. Adequate provision of equipment bypass shall be made to enable such activities.

Storage tanks shall have low spots with drain for easy cleaning and removal of dirt.

62.5 Isolation and sectioning

Isolation valves shall be installed in branches from main distribution header.

Pumps shall have block valves to ensure maintenance on one pump while the other is in service.

62.6 Layout requirements

Raw diesel can be stored in the platform deck structure.

Gravity feed piping to be sized to ensure positive pressure upstream consumers at maximum flow, ie. standby unit in simultaneous operation.

Treated diesel can be stored in crane pedestals. For fixed installations treated diesel should be located at the highest elevation of the system, and consumers to be supplied by gravity feed.

62.7 Interface requirements

Electric power supply	Treated diesel pumps shall be on emergency power.
Instrument air	As required.
Drain system	For draining of smaller volumes of diesel.
Atmospheric vent	As required.
Chemical Injection	Biocide as required
Fresh water	Centrifuge

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirements list for provision of such information.

62.8 Commissioning requirements

A combination of day tank storage capacity and availability of the treatment system shall enable early commissioning and start up of system.

The system shall be operable before the main power is available.

62.9 Safety

No specific requirements are identified.

62.10 Environmental

Overflow lines to sea are not acceptable.

63 COMPRESSED AIR

63.1 Scope

This section defines the minimum functional requirements for the compressed air system

63.2 Functional requirements

63.2.1 General

The compressed air system shall provide compressed air at a defined quality and pressure to instrument air consumers and to plant air consumers.

A compressed air system may include facilities to provide:

- Instrument air.
- Plant air.
- Topping air.
- Black start air.

Instrument air is the motive force for all pneumatic controllers and valve actuators and is used for purging of electrical motors and panels.

Plant air is used for air hoists/winches, air motors, sand blasting, spray painting, air tools and motor purging.

Blackstart air compressor and topping air compressor may be supplied to charge the diesel engine start air bottles for the emergency generators and fire water pumps.

63.2.2 Performance

63.2.2.1 Dehydration

The air to be cooled as much as possible before water knock out to minimize requirement for dehydration

Air should at least be treated to a dewpoint corresponding to -25°C at max operating pressure.

63.2.2.2 Filtration

Filters should be considered installed between dryer and receiver dependant on requirements from end users

63.2.2.3 Air receiver

Air receivers must be sufficiently sized to provide instrument air at specified pressure for five minutes after compressor shutdown.

Topping air / blackstart air compressors

If topping air / blackstart air compressors are considered required, following design criteria should be followed:

- The Topping air compressor should be sized to charge the air start bottles for the emergency generator and the fire water pumps to a pressure of 35 barg in reasonable time.
- The Blackstart air compressor should be sized to charge the air start bottles for the emergency generator and the fire water pumps to a pressure of 35 barg in reasonable time.

63.2.2.4 Operating pressure

Typical range of instrument setpoints

Normal operating pressure	8.8 barg
Stand-by compressor start	8.6 barg
Plant air totally restricted	7.7 barg
Plant air to inert gas isolated	7.4 barg
Alarm is activated	7.1 barg
Minimum pressure for instr. air	4.5-5.5 barg

Note: The max allowable operating pressure for instrument air shall be maximised to 10 barg.

63.2.2.5 Oil content

If oil lubricated compressors are used, facilities to remove oil impurities should be installed upstream dryers.

63.2.3 Regularity / sparing

System regularity: Class A.

A shut down valve shall be installed to close the feed to all the plant air consumers if the air pressure falls below required pressure.

Two compressors are sufficient on the condition that one compressor covers the total instrument air capacity requirement and both covers the total air requirement.

The instrument air shall be supplied with 100% sparing with regard to air drying. For plant air 1 x 100% shall be installed as a minimum.

Bleed air from gas turbines should be considered as additional supply source if needed.

63.3 Operational requirements

63.3.1 Control and monitoring

Monitoring that shall be available in CCR as a minimum

OS/VDU functions	P	T	F	Other	Remarks
Compressor package	M			A	Run status
Cooler					
Receiver	M				
Dryer				A	Humidity high

Process variables: P=Pressure, T= Temperature, F= Flow.

Process functions: A= Alarm, C= Control, M= Monitoring.

63.3.2 Safeguarding and shutdown

Low priority users (e.g. plant air) shall, in case of low system pressure, automatically be shut off favouring high priority users (e.g. instrument air, inert gas feed).

Gas detection shall be provided on air intake unless air is supplied from an area that already has gas detection.

63.4 Maintenance requirements

During maintenance of the air receiver, a by-pass line must be installed to route the instrument and plant air directly to the instrument ring main and the plant air main header.

Spectacle blinds are required for positive isolation of the air receiver during maintenance.

Space shall be provided for maintenance of all equipment on the unit.

Compressor/drivers shall be possible to remove/replace.

63.5 Isolation and sectioning

Valves shall be located to enable maintenance on system main units, and on distribution system to enable modifications/extensions to the system during operation.

63.6 Layout requirements

The discharge line from compressor control valve should be routed away from areas where personnel will require frequent access

Low point drains should be provided to remove any moisture accumulating in the distribution headers

Inlet air should be taken from safe location.

All units grouped together.

Connection for temporary connection for extra plant air shall be supplied.

63.7 Interface requirements

Inlet flow	Atmospheric air.
Open drain	For maintenance.
Seawater cooling medium	For cooling.
Electric power	As a minimum one compressor shall be able to run on emergency power.

Specific interface requirements shall be provided. Annex A contains datasheets with an Interface requirement list for provision of such information.

63.8 Commissioning requirements

Connections and isolation facilities on ring main should be provided to supply instrument air to all users during commissioning.

63.9 Safety requirements

No specific requirements are identified.

63.10 Environmental requirements

No specific requirements are identified.

64 INERT GAS

64.1 Scope

This clause defines the minimum functional requirements for the inert gas system

64.2 Functional requirements

64.2.1 General

The inert gas generator shall deliver inflammable, filtered inert gas mixture with low oxygen content at a specified pressure and temperature.

Inert gas is used for blanketing and purging of tanks, and for purging of equipment and systems before maintenance.

The inert gas system may be divided into three sub-systems:

- Nitrogen generator/source.
- Storage system.
- Distribution system.

There are several different processes available for nitrogen generation. The most commonly used techniques for extraction of nitrogen from air is membrane separation

64.2.2 Performance

64.2.2.1 System capacity

Typical inert gas users

Consumer description	Remarks
Compressor gas seals	Per compression stage. Actual rate pending gas seal design /type
Produced water flash drum	Back-up gas for pressure maintenance
Produced water disposal caisson	Purge gas
Heating medium expansion vessel	Back-up gas for pressure maintenance
Methanol storage tank	Purge gas. The flow rate should equal pumping capacity
High pressure flare header	Continuous purging of flare stack/tips to avoid ingress of air
Low pressure flare header	Continuous purging of flare stack/tips to avoid ingress of air
Atmospheric vent header	No direct purging. Purged through vents from disposal caisson, tanks and sumps
Hazardous area open drain sump	Purge gas. The flow rate should equal pumping capacity
Closed drain flash drum	Back-up gas for pressure maintenance
Reclaimed oil sump	Purge gas. The flow rate should equal pumping capacity
Utility stations	Used during initial start-up and maintenance

Peak loads during maintenance periods may be supplied by liquid nitrogen. The distribution system must allow connection from vapourizer package..

64.2.2.2 Operating/design conditions

Typical supply pressure is 6-9 barg when using plant air feed.

Typical design and operating criteria for the main equipment

Feed air pressure	8-10 bara
Feed air temperature	30-50 °C
Feed air particle size	3 µm
Feed air dew point (at 10 bar)	-25 °C
Oilfree feed air	yes
Design pressure	13 barg
Design temperature, min/max	-10/60 °C
Product pressure, min/norm	6.0/8.0 barg

Design and operating conditions for the Inert gas generator

Product quality	Inert content: 97% vol at normal operation and 95 % at peak load
	Water dewpoint: Min -20°C

64.2.2.3 Inlet temperature

Requirement for feed air heater is pending feed air temperature and is a balance between cost for heater and cost for additional membrane modules to meet purity and productivity requirements

64.2.3 Regularity / sparing

System regularity: Class C.

No sparing. Critical consumers eg. compressor gas seals to have separate back up.

A nitrogen receiver vessel may be installed downstream the nitrogen generator as a buffer in order to dampen nitrogen pressure and purity variations. A receiver vessel may also be used as a storage device in case of limited supply of nitrogen after generator shut-down.

64.3 Operational requirements

64.3.1 Control and monitoring

Monitoring that shall be available in CCR as a minimum

OS/VDU functions	P	T	F	Other	Remarks
Feed air		C			If heater is installed
Nitrogen distribution	M			M	Alarm on high oxygen content
Membrane back pressure	C				

Process variables: P = Pressure, T = Temperature, L = Level, F = Flow.

Process functions: A = Alarm, M = Monitoring, C = Control.

64.3.2 Safeguarding and shutdown

Low priority users shall, in case of low system pressure, automatically be shut off favouring high priority users.

Oxygen monitor shall initiate opening of a product dump valve at high level.

64.4 Maintenance requirements

64.4.1 Generator

The regular maintenance work on the generator package must be facilitated by maximum access for:

- Calibration of oxygen analyser.
- Replacement of feed air filter element.

64.4.2 Oxygen analyser

The oxygen analyser would need frequent calibration. During this work, the signals from the analyser should be overridden in order to avoid unintended product dumping.

64.4.3 Feed air filter

The feed air filter elements are replaced upon high DP. provided installation of 2 x 100% filters, the replacement work should not disturb operation of the plant.

64.4.4 Feed air heater

A by-pass line around the feed air heater should be installed to allow maintenance without plant shut down.

64.5 Isolation and sectioning

Valves shall be located to enable maintenance on system main units, and on distribution system to enable modifications/extensions to the system during operation.

64.6 Layout requirements

Nitrogen storage/back-up shall be in the utility area. Major users, like flare system purge, shall have dedicated line, while smaller users can be served by branch lines from ring distribution.

64.7 Interface requirements

The Inert gas system has interface against Compressed air system for feed air supply.

Normal recipients for purge gas is listed in clause 64.2.2.1.

64.8 Commissioning requirements

No specific requirements are identified.

64.9 Safety requirements

The inert gas plant should, because of the risk of a non-breathable atmosphere, be located in a naturally ventilated area.

Oxygen rich gas shall be ventilated to safe area.

64.10 Environmental requirements

No specific requirements are identified.

65 HYDRAULIC POWER

65.1 Scope

This clause defines the minimum requirements for the topsides hydraulic power system.

65.2 Functional requirements

65.2.1 General

The hydraulic power package shall provide the hydraulic-operated topside valves with hydraulic power, and also supply hydraulic power to all other topside users at specified pressures and cleanliness levels.

It may be necessary with several hydraulic power packages to supply all users.

65.2.2 Performance

65.2.2.1 System capacity

The system shall have a back up facility in case the main power source fails.

65.2.2.2 Reservoir

Sized such that when all actuators are driven the tank shall be 25% full and when total actuator capacity is returned the level shall not be greater than 75%.

The system shall be designed to avoid the accumulation of water/solids and shall be provided with adequate means for their removal.

- A filter on the fill line should be installed unless the new oil is as clean as the system it enters into.
- If the system is static (ie. no valve movements during normal operation) it will influence on cleanliness level. This should be compensated for (circulation of oil in the reservoir through a filter is one possible method).
- Return from "dirty service" shall be returned to closed drain or to a separat drain pot with vent to safe area. Drain pot to be manually drained to open drain system. Typical dirty service is the down hole safety valve.

Means of circulating oil from accumulators/actuator should be included.

The hydraulic oil shall have a cleanliness level according to the hydraulic components requirements.

The hydraulic reservoir shall be equipped with an atmospheric vent nozzle with a breath filter. The reservoir shall be designed for easy draining of particles collecting at tank bottom.

65.2.2.3 Pumps

Sized, allowing for simultaneous use of standby pumps, to have sufficient capacity to move all valves and equipment away form their shutdown positions within a 10 minute period with all accumulators empty.

65.2.2.4 Filters

Particles larger than typically 5 microns should be removed by filters in the pump discharge line.

65.2.3 Regularity/sparing

System regularity: Class A.

Sparing: Pumps to be 2 x 100%.
Filters to be 2 x 100%.

65.3 Operational requirements

65.3.1 Control and monitoring

Required control and monitoring from the CCR

OS/VDU functions	P	L	F	Other	Remarks
Pump	C/A				Alarm for high and low pressure
Filter	A				Alarm on high differential pressure
Hydraulic reservoir		M/A			Alarm on low level
Heater in reservoir				A	Alarm on heater off

Process variables: P=Pressure, T=Temperature, L=Level, F=Flow.

Process functions: A=Alarm, M=Monitoring, C=Control.

65.3.2 Safeguarding and shutdown

Start up and shutdown of the hydraulic power package shall be local. For normal operation, the pumps shall have an auto start and stop function initiated by the system header pressure transmitters and should include a routine operation of standby pumps to meet periods of high demand. In addition it shall be possible to override the pressure transmitter to enable manual operation for maintenance or emergency situations.

The hydraulic system shall be equipped with central accumulator capacity to activate all connected valves twice without use of any hydraulic source.

Downstream of the various valves the hydraulic oil shall be collected in a common return header and sent to the hydraulic reservoir. The return header shall not impose any restriction on safety related valves and equipment returning to their fail positions within their specified minimum stroke times.

65.4 Maintenance requirements

Preventive maintenance shall be based on inspection and monitoring of performance. Services and repairs shall be carried out as required by technical condition and performance of components.

Oil sample points shall be included for on the reservoir, supply and return lines.

Maintenance of any part of the system, with the exception of the reservoir, shall be possible during operation.

The consequences of isolation and maintenance of a standby pumps shall be evaluated since full capacity would not be available during high demand.

The hydraulic unit shall have drip tray for collection of hydraulic oil spills during maintenance.

65.5 Isolation and sectioning

During normal operation of the platform, it shall be possible to do maintenance work on the Hydraulic power system without affecting the processing of hydrocarbons.

Where parallel units are installed it shall be possible to work on one unit with the other in operation. In such cases the high pressure side shall be isolated by double block valves.

65.6 Layout requirements

The system should be located in a sheltered area. The system should be located in the area with most consumers, and hook up between modules/areas should be minimized to reduce offshore commissioning.

Layout of skid to allow for easy maintenance (filter change etc.).

65.7 Interface requirements

Electric power supply	Essential power may be required.
Instrument air	As required.
Drain system	Drain from hydraulic reservoir and drip tray.
Atmospheric vent stack	For hydraulic reservoir.
Inert gas	Reservoir blanketing.
Nitrogen	Accumulator operation.

Specific interface requirements shall be provided. Annex A contains an Interface requirements list for provision of such information.

65.8 Commissioning requirements

System installation shall be planned such that early commissioning, hook up and operation of the system can take place.

65.9 Safety

The system is classified as non hazardous, however, if there is a possibility of hydrocarbons being returned to the reservoir with the hydraulic fluid, the system shall be classified as hazardous.

The vent from the reservoir shall be routed to a safe location.

65.10 Environmental

The hydraulic oil shall be of bio-degradable type.

Used hydraulic oil shall be safely disposed into oily drain systems or transportation pod.

ANNEX A SYSTEM DESIGN DATA SHEETS (INFORMATIVE)

PDS-016	Well related production topside	Rev. 1, August 1997
PDS-020	Separation and stabilisation	Rev. 1, August 1997
PDS-021	Crude handling and metering	Rev. 1, August 1997
PDS-023	Gas recompression, cooling and scrubbing	Rev. 1, August 1997
PDS-024	Gas treatment (drying)	Rev. 1, August 1997
PDS-026	Gas injection to reservoir	Rev. 1, August 1997
PDS-027	Gas export and metering	Rev. 1, August 1997
PDS-029	Water injection	Rev. 1, August 1997
PDS-040	Cooling medium	Rev. 1, August 1997
PDS-041	Heating medium	Rev. 1, August 1997
PDS-043	Flare	Rev. 1, August 1997
PDS-044	Oily water	Rev. 1, August 1997
PDS-045	Fuel gas	Rev. 1, August 1997
PDS-046	Methanol injection	Rev. 1, August 1997
PDS-047	Chlorination	Rev. 1, August 1997
PDS-050	Sea water (low to medium pressure)	Rev. 1, August 1997
PDS-053	Fresh water	Rev. 1, August 1997
PDS-056	Open drain	Rev. 1, August 1997
PDS-057	Closed drain	Rev. 1, August 1997
PDS-062	Diesel oil	Rev. 1, August 1997
PDS-063	Compressed air	Rev. 1, August 1997
PDS-064	Inert gas	Rev. 1, August 1997
PDS-065	Hydraulic power	Rev. 1, August 1997

NORSOK P-100	SYSTEM DESIGN DATA SHEET WELL RELATED PRODUCTION TOPSIDE	PDS-016 Rev. 1, August 1997 Page 1 of 2
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Design data

	Unit	
Required regularity	%	
Design operating life	years	

Design data for the production and test manifold

Condition	Unit		
Number of production wells			
Production rate per well gas/liquid :	Sm ³ /d	Max. gas case	Max. liquid case
Wellhead shut-in pressure	bara	* max. * min.	
Flowing wellhead pressure	bara	* max. * min.	
Flowing wellhead temperature	°C	* max. * min.	
Sand production	g/hr		

Specified conditions for transport of the following fluids at the well service manifold(s)

Fluid	Unit	Quantity	Condition
Well production (backflow from wells)	Sm ³ /d		
Water-based mud	m ³ /d		
Brine	m ³ /d		
Diesel	m ³ /d		
Methanol	m ³ /d		
Chemicals	m ³ /d		
Other	m ³ /d		

NORSOK P-100	SYSTEM DESIGN DATA SHEET WELL RELATED PRODUCTION TOPSIDE	PDS-016 Rev. 1, August 1997 Page 2 of 2
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Interface requirements list

Utility	Unit	Quantity	Condition
Instrument air	Sm ³ /hr		
Electric power	kW		
Brine	m ³ /hr		
Diesel	m ³ /hr		
Methanol	m ³ /hr		
Hydraulic power	kW		
Mud	m ³ /hr		

NORSOK P-100	SYSTEM DESIGN DATA SHEET SEPARATION AND STABILISATION	PDS-020 Rev. 1, August 1997 Page 1 of 2
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Design data

Process variable	Unit	Value
Required regularity	%	
Design operating life	years	

Inlet/wellstream conditions

Condition	Unit		
Wellhead/inlet pressure	bara	* max. * min.	
Wellhead/inlet temperature	°C	* max. * min.	
Sand production	g/hr		

Separators and coaleshers

Process variable	Unit	Value
Design pressure/temperature	max. / min. barg / °C	
Operating pressure/temperature	barg / °C	
Inlet conditions:		
Design flowrate	kg/h	
Composition		
Density	kg/m ³	
Dynamic viscosity	Ns/m ²	
Vapour outlet conditions:		
Design flowrate	kg/h	
Composition		
Density	kg/m ³	
Dynamic viscosity	Ns/m ²	
Molweight	MW	
Compressibility		
Liquid outlet conditions:		
Design flowrate	kg/h	
Composition		
Density	kg/m ³	
Dynamic viscosity	Ns/m ²	
Water outlet conditions:		
Design flowrate	kg/h	
Composition		
Density	kg/m ³	
Dynamic viscosity	Ns/m ²	

NORSOK P-100	SYSTEM DESIGN DATA SHEET SEPARATION AND STABILISATION	PDS-020 Rev. 1, August 1997 Page 2 of 2
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Heat Exchangers

Process variable	Unit	Value
Hot side:		
Fluid description		
Temperature inlet/outlet	°C	
Flow	kg/h	As for separator inlet
Minimum skin temperature	°C	
Pressure drop	mbar	
Fouling resistance		
Cold side:		
Fluid description		
Temperature inlet/outlet	°C	
Flow	kg/h	
Maximum skin temperature	°C	
Pressure drop	mbar	
Fouling resistance		

Interface requirement list

Utility	Unit	Quantity	Condition
Instrument air			
Hydraulic power			
Chemicals			
Electric power			
Heating medium	kW		
Cooling medium	kW		
Jet water			
Open drain			
Closed drain			
Flare			
Vent			

NORSOK P-100	SYSTEM DESIGN DATA SHEET CRUDE HANDLING AND METERING	PDS-021 Rev. 1, August 1997 Page 1 of 1
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Design data

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
Flow rate	kg/h	
Density	kg/m ³	
Viscosity	Ns/m ²	
Operating pressure/temperature	barg / °C	
Design pressure/temperature	barg / °C	
Pumps:		
Differential pressure required	bar	
NPSH available	m	
Driver	kW	
Heat exchanger:		
Hot side temperature inlet/outlet	°C	
Minimum skin temperature	°C	
Pressure drop	mbar	
Fouling resistance		
Cold side temperature inlet/outlet	°C	
Flow	kg/h	
Maximum skin temperature	°C	
Fluid description		
Pressure drop	mbar	
Fouling resistance		
Metering package:		
Operating pressure	barg	
Operating temperature	°C	
Allowable pressure drop	mbar	
Turn down ratio		

Interface requirement list

Utility	Unit	Quantity	Condition
Power	kW		
Cooling	m3/h		
Instrument air			
Hydraulic power			
Chemical injection			

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS RECOMPRESSION, COOLING AND SCRUBBING	PDS-023 Rev. 1, August 1997 Page 1 of 2
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Design Data	Unit	Case no	Case no	Case no
Regularity	%			
Design Operational Life	Years			
Feed flowrate	kg/hr			
Pressure	bar a			
Temperature	°C			
Composition				
Contaminants				
Cooler				
Hot side temperatures inlet/outlet	°C			
Hydrate formation temperature	°C			
Minimum skin temperature at turndown	°C			
Pressure drop	mbar			
Cooling fluid				
Cold side temperatures inlet/outlet	°C			
Maximum skin temperature at turndown	°C			
Pressure drop	mbar			
Scrubber				
Vapour flowrate	kg/hr			
Pressure	bar a			
Temperature	°C			
Demistor pressure drop	mbar			
Composition				
Droplet cut-off size	μ			
Liquid content in vapour	mg/m ³			
Liquid flowrate	kg/hr			
Composition condition				
Pressure downstream Level Valve (LV)	bar a			
Temperature downstream LV	°C			
Hydrate formation temperature ds. LV	°C			
Compressor				
Flowrate	kg/hr			
Temperature inlet/outlet	°C			
Pressure inlet/outlet	bar a			
Molweight	MW			
Seal / lube oil in gas	mg/m ³			
Allowed head rise to surge	%			
Power consumption	kW			
Installed driver power	kW			

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS RECOMPRESSION, COOLING AND SCRUBBING	PDS-023 Rev. 1, August 1997 Page 2 of 2
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Interface requirements list

Utility	Unit	Consumption	Condition
Cooling medium	m ³ /hr		
Seawater	m ³ /hr		
Inert gas N ₂	Sm ³ /hr		
Methanol	m ³ /hr		
Instrument air	Sm ³ /hr		
Hydraulic power	m ³ /hr		
Electric power	kW		
UPS for instrumentation	kW		
Fresh water	m ³ /hr		
Fuel	Sm ³ /hr		
HP flare system	Sm ³ /hr		
LP flare system	Sm ³ /hr		
Atmospheric vent	Sm ³ /hr		
Closed drain system	m ³ /hr		
Open drain	m ³ /hr		

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS TREATMENT (DRYING)	PDS-024 Rev. 1, August 1997 Page 1 of 2
Project:	Doc. No:	Rev.

Design Data

Required data for absorber and regeneration system

Design Data	Unit	Case no	Case no	Case no
Required regularity	%			
Design Operational life	Year			
Absorber section				
Flowrate gas	kg/hr			
Composition				
Contaminants				
Aromatics content	mol %			
Water content inlet / outlet	ppm V			
Temperature inlet/outlet	°C			
Pressure inlet/outlet	bar a			
Pressure drop in inlet and packing/trays	mbar			
Amount of condensate formed in packing	m ³ /hr			
Glycol circulation rate	m ³ /hr			
Glycol water content inlet/outlet	wt %			
Glycol temperature inlet/outlet	°C			
Condensate entrained with glycol	wt %			
Flash drum				
Pressure	bar a			
Temperature	°C			
Gas flow	kg/hr			
Glycol residence time	s			
Reboiler and still				
Pressure top/bottom	bar a			
Temperature top/bottom	°C			
Vapour flow to still (included HC)	m ³ /hr			
Reboiler duty	kW			

NB: Data for coolers and scrubbers must also be given.

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS TREATMENT (DRYING)	PDS-024 Rev. 1, August 1997 Page 2 of 2
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Interface requirements list

Utility	Unit	Consumption	Condition
Cooling medium	m ³ /hr		
Seawater	m ³ /hr		
Inert gas	Sm ³ /hr		
Methanol	m ³ /hr		
Instrument air	Sm ³ /hr		
Hydraulic power	m ³ /hr		
Electric power	kW		
UPS for instrumentation	kW		
Fuel gas	Sm ³ /hr		
HP flare	Sm ³ /hr		
LP flare	Sm ³ /hr		
Atmospheric vent	Sm ³ /hr		
Closed drain system	m ³ /hr		
Open drain	m ³ /hr		
Filling of glycol (transport tanks, supply boats, other)	m ³ /hr		

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS INJECTION TO RESERVOIR	PDS-026 Rev. 1, August 1997 Page 1 of 2
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Design Data	Unit	Case no	Case no	Case no
Regularity	%			
Design Operational Life	Years			
Feed flowrate	kg/hr			
Pressure	bar a			
Temperature	°C			
Composition				
Contaminants				
Cooler				
Hot side temperatures inlet/outlet	°C			
Hydrate formation temperature	°C			
Minimum skin temperature at turndown	°C			
Pressure drop	mbar			
Cooling fluid				
Cold side temperatures inlet/outlet	°C			
Maximum skin temperature at turndown	°C			
Pressure drop	mbar			
Scrubber				
Vapour flowrate	kg/hr			
Pressure	bar a			
Temperature	°C			
Demistor pressure drop	mbar			
Composition				
Droplet cut-off size	μ			
Liquid content in vapour	mg/m ³			
Liquid flowrate	kg/hr			
Composition condition				
Pressure downstream Level Valve (LV)	bar a			
Temperature downstream LV	°C			
Hydrate formation temperature ds. LV	°C			
Compressor				
Flowrate	kg/hr			
Temperature inlet/outlet	°C			
Pressure inlet/outlet	bar a			
Molweight	MW			
Seal / lube oil in gas	mg/m ³			
Allowed head rise to surge	%			
Power consumption	kW			
Installed driver power	kW			

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS INJECTION TO RESERVOIR	PDS-026 Rev. 1, August 1997 Page 2 of 2
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Interface requirements list

Utility	Unit	Consumption	Condition
Cooling medium	m ³ /hr		
Seawater	m ³ /hr		
Inert gas N ₂	Sm ³ /hr		
Methanol	m ³ /hr		
Instrument air	Sm ³ /hr		
Hydraulic power	m ³ /hr		
Electric power	kW		
UPS for instrumentation	kW		
Fresh water	m ³ /hr		
Fuel	Sm ³ /hr		
HP flare system	Sm ³ /hr		
LP flare system	Sm ³ /hr		
Atmospheric vent	Sm ³ /hr		
Closed drain system	m ³ /hr		
Open drain	m ³ /hr		

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS EXPORT AND METERING	PDS-027 Rev. 1, August 1997 Page 1 of 2
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Design Data

Design Data	Unit	Case no	Case no	Case no
Regularity	%			
Design Operational Life	Years			
Feed flowrate	kg/hr			
Pressure	bar a			
Temperature	°C			
Composition				
Contaminants				
Cooler				
Hot side temperatures inlet/outlet	°C			
Hydrate formation temperature	°C			
Minimum skin temperature at turndown	°C			
Pressure drop	mbar			
Cooling fluid				
Cold side temperatures inlet/outlet	°C			
Maximum skin temperature at turndown	°C			
Pressure drop	mbar			
Scrubber				
Vapour flowrate	kg/hr			
Pressure	bar a			
Temperature	°C			
Demistor pressure drop	mbar			
Composition				
Droplet cut-off size	μ			
Liquid content in vapour	mg/m ³			
Liquid flowrate	kg/hr			
Composition condition				
Pressure downstream Level Valve (LV)	bar a			
Temperature downstream LV	°C			
Hydrate formation temperature ds. LV	°C			
Compressor				
Flowrate	kg/hr			
Temperature inlet/outlet	°C			
Pressure inlet/outlet	bar a			
Molweight	MW			
Seal / lube oil in gas	mg/m ³			
Allowed head rise to surge	%			
Power consumption	kW			
Installed driver power	kW			

NORSOK P-100	SYSTEM DESIGN DATA SHEET GAS EXPORT AND METERING	PDS-027 Rev. 1, August 1997 Page 2 of 2
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Interface requirements list

Utility	Unit	Consumption	Condition
Cooling medium	m ³ /hr		
Seawater	m ³ /hr		
Inert gas N ₂	Sm ³ /hr		
Methanol	m ³ /hr		
Instrument air	Sm ³ /hr		
Hydraulic power	m ³ /hr		
Electric power	kW		
UPS for instrumentation	kW		
Fresh water	m ³ /hr		
Fuel	Sm ³ /hr		
HP flare system	Sm ³ /hr		
LP flare system	Sm ³ /hr		
Atmospheric vent	Sm ³ /hr		
Closed drain system	m ³ /hr		
Open drain	m ³ /hr		

NORSOK P-100	SYSTEM DESIGN DATA SHEET WATER INJECTION	PDS-029 Rev. 1, August 1997 Page 1 of 2
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Design Data	Unit	Value
Required Regularity	%	
Design Operational Life	Years	
System Location (haz./non-haz.)		
Injection water requirements:		
System Design Flowrate	m ³ /hr	
System Normal Flowrate	m ³ /hr	
System injection pressure - normal / max	Barg	
Oxygen Content	ppb	(20-80) ²⁾
Free chlorine (on wellhead)	ppm vol	(0.5) ²⁾
Coarse filtration	micron	
Fine filtration	micron	
Water supply:		
Standard Density	kg/Sm ³	
Dynamic Viscosity	Ns/m ^{2 1)}	
Water supply pressure	Barg	
Water supply temperature	°C	
Oxygen content of seawater supply	ppm	8 ppm
Free chlorine	ppm vol	(0.5) ²⁾
Chemical requirements:		
Organic Biocide (shock treatment)	ppm	(1000) ²⁾
Organic Biocide (continuous injection)	ppm	(200) ²⁾
Oxygen scavenger continuous/intermittant	ppm	
Polyelectrolyte	ppm	
Scale inhibitor	ppm	

1) 1 Ns/m² = 1000 centipoise

2) Values in brackets () are typical values

ppm = parts per million

ppb = parts per billion

NORSOK P-100	SYSTEM DESIGN DATA SHEET WATER INJECTION	PDS-029 Rev. 1, August 1997 Page 2 of 2
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Interface requirements list

Utility	Unit	Quantity	Condition
Power	kW		
Instrument air	m ³ /h		
Electric Power	kW		
Inert gas	m ³ /h		
Drain system	m ³ /h		
Organic Biocide (shock treatment)	m ³ /h		
Organic Biocide (continuous injection)	m ³ /h		
Oxygen scavenger continuous/intermittant	m ³ /h		
Polyelectrolyte	m ³ /h		
Scale inhibitor	m ³ /h		

NORSOK P-100	SYSTEM DESIGN DATA SHEET COOLING MEDIUM	PDS-040 Rev. 1, August 1997 Page 1 of 2
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Design data

	Unit	
Required regularity	%	
Design operating life	years	
System location (haz./non-haz.)		
Cooling medium (C.M.)		35 wt.% TEG in water (typical)
Total system duty	kW	
Total C.M. flowrate	m ³ /h	
Total seawater demand	m ³ /h	
C.M. supply temperature	°C	
C.M. return temperature (average)	°C	
Seawater inlet temperature	°C	
Seawater outlet temperature	°C	
C.M. supply pressure	barg	
Seawater inlet pressure	barg	

NORSOK P-100	SYSTEM DESIGN DATA SHEET HEATING MEDIUM	PDS-041 Rev. 1, August 1997 Page 1 of 2
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Design data

Design Data	Unit	Value
Required Regularity	%	
Design Operational Life	Years	
System Location (haz./non-haz.)		Hazardous
System capacity:		
System Heat duty	kW	
System Design Flowrate	kg/h	
System Normal Flowrate	kg/h	
System operating pressure in expansion tank	Barg	
System operating pressure at pump discharge	Barg	
System design pressure	Barg	
System Operating/Design Temperature	°C	
Heating Medium:		
Density at operating temp.	kg/m ³	
Density at Standard condition	kg/m ³	
Dynamic Viscosity - Operating temperature	Ns/m ^{2 1)}	
Dynamic Viscosity - Standard condition	Ns/m ^{2 1)}	
Specific heat - Operating temperature	J/kg K	
Specific heat - Standard condition	J/kg K	

1) 1 Ns/m² = 1000 centipoise

NORSOK P-100	SYSTEM DESIGN DATA SHEET HEATING MEDIUM	PDS-041 Rev. 1, August 1997 Page 2 of 2
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User list

Continuous users

User	System design flowrate kg/h	Unit design flowrate kg/h	Unit duty kW	Return temperature °C
TOTAL				

Intermittent users

User	System design flowrate kg/h	Unit design flowrate kg/h	Unit duty kW	Return temperature °C
TOTAL				

Interface requirements list

Utility	Unit	Quantity	Condition
Turbine exhaust			
Electric power			
Heating medium			
Instrument air			
Inert gas tank			
Drain system			
Chemical			
Flare			

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Design data list

	Unit	
Required regularity	%	
Design operating life	years	
System design temperature	°C	
System design pressure	barg	
Flare Knock-Out Drum		
Vessel volume	m ³	
Operating temperature	°C	
Operating pressure	bara	
Vapour mass flowrate	kg/h	
Vapour density	kg/m ³	
Vapour viscosity	cp	
Vapour molweight	kg/kgmol	
Liquid mass flowrate	kg/h	
Liquid density	kg/m ³	
Liquid viscosity	cp	
Liquid specific heat - Note 1	KJ/Kg°C	
Liquid conductivity - Note 1	W/M°C	
Design droplet size	µm	
Flare K.O. Drum Pumps		
Number of units		
Design capacity	m ³ /h	
Liquid density at oper.T&P	kg/m ³	
Liquid viscosity at oper. T&P	cp	
Suction temperature	°C	
Suction pressure	bara	
Discharge pressure	bara	
Pump head	m	
NPSH available - Note 2	m	
Automatic start required	Yes/No	
Start with closed disch. valve	Yes/No	

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	Unit	
Flare Tip Package		
Design case		Blocked outlet of 1st Stage Separator- Note 3
Design vapour mass flowrate	kg/h	
Vapour density	kg/m ³	
Vapour viscosity	cp	
Vapour molweight	kg/kgmol	
Vapour k-value (Cp/Cv)		
Vapour net heating value	KJ/Sm ³	
Entrained liquid droplet size	µm	
Vapour composition	Mol %	Note 4
Tip allowable pressure drop	bar	
Tip max./min. design temp.	°C	
Tip orientation	45 or 90°	
Design wind speed at tip	m/s	
Wind direction		
Purge gas type		
Required purge gas flowrate	Sm ³ /h	
Flare Ignition Package		
Type of ignition		
Dimensions LxWxH	mm	

Notes : 1. If heater is included within the Flare Knock-Out Drum
2. NPSH = Net Positive Suction Head
3. Only given as an example
4. Composition to be defined on separate sheet.

Scale drawings showing the plan view and side elevation (with respect to the flare structure) should be attached to the data sheet.

The following information should be requested from the vendor:

- Radiation isopleths for the specified design cases.
- Flare tip turndown capabilities.
- Noise emission levels and indication of any expected acoustic vibration.
- Smoke production levels.
- Flare tip life.
- Curve giving flare tip pressure drop as a function of flowrate

NORSOK P-100	SYSTEM DESIGN DATA SHEET FLARE, VENT AND BLOWDOWN	PDS-043 Rev. 1, August 1997 Page 3 of 3
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Interface requirements list

Utility	Unit	Quantity	Condition
Instrument air			
Electric power			
Nitrogen			
Fuel gas			
Propane/LPG (bottles)			
Methanol			

NORSOK P-100	SYSTEM DESIGN DATA SHEET OILY WATER TREATMENT	PDS-044 Rev. 1, August 1997 Page 1 of 2
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Design Data

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
System location (haz./non-haz.)		Hazardous
Design pressure HP hydrocyclone	barg	
Design temperature HP hydrocyclone	°C	
Design flowrate HP hydrocyclones	m ³ /h	
Oil content in feed	ppm	
Design pressure LP hydrocyclone	barg	
Design temperature LP hydrocyclone	°C	
Design flowrate LP hydrocyclones	m ³ /h	
Oil content in feed	ppm	
Design pressure flash drum	barg	
Design temperature flash drum	°C	
Design flowrate flash drum	m ³ /h	
Design pressure reclaimed oil sump	barg	
Design temperature reclaimed oil sump	°C	
Design flowrate reclaimed oil sump	m ³ /h	
Design pressure reclaimed oil sump pump	barg	
Design flowrate reclaimed oil sump pump	m ³ /h	
Design duty reclaimed oil sump pump	kW	

NORSOK P-100	SYSTEM DESIGN DATA SHEET OILY WATER TREATMENT	PDS-044 Rev. 1, August 1997 Page 2 of 2
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User list

User	Flowrate m ³ /h Continuous	Flowrate m ³ /h Intermittent	Flowrate m ³ /h Design
TOTAL			

Interface requirements list

Utility	Unit	Quantity	Condition
Inert gas			
Chemical injection			
Compressed air			
Jet water			
Power			
Flare and vent system			
Oil separation			
Water injection (optional)			

NORSOK P-100	SYSTEM DESIGN DATA SHEET FUEL GAS	PDS-045 Rev. 1, August 1997 Page 1 of 2
Project:	Doc. No:	Rev.

Design data

Design data	Unit	Value
Required regularity	%	
Design operational life	Years	
System location (haz./non-haz.)		Hazardous area
Fuel gas (F.G.)		Hydrocarbons, preferably dry
Net heating value	MJ/Sm ³	
Standard density	kg / Sm ³	
System design duty	kW	
System design flowrate	Sm ³ /h	
System normal flowrate	Sm ³ /h	
High press. F.G.distribution pressure	barg	
Low press. F.G. distribution pressure	barg	
F.G. distribution temperature	°C	
High press. F.G. design press./temp.	barg /°C	
Low press. F.G. design press./temp.	barg /°C	
Filtration requirement	micron	Note 1

1) For gas turbines, fuel gas according to manufacturers specifications

NORSOK P-100	SYSTEM DESIGN DATA SHEET FUEL GAS	PDS-045 Rev. 1, August 1997 Page 2 of 2
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User list

Continuous users

User	System design flowrate kg/h	Unit design flowrate kg/h	Unit duty kW
TOTAL			

Intermittent users

User	System design flowrate kg/h	Unit design flowrate kg/h	Unit duty kW
TOTAL			

Note: The design flowrate should include start-up of the stand-by main generator with gas turbine driver at idle speed (equal 40% of ISO-rating)

Interface requirements list

Utility	Unit	Quantity	Conditions
Heating medium			
Electric power			
Methanol / glycol			
Instrument air			
HP flare			
LP flare			
Closed drain			

NORSOK P-100	SYSTEM DESIGN DATA SHEET METHANOL INJECTION	PDS-046 Rev. 1, August 1997 Page 1 of 1
Project:	Doc. No:	Rev.

Design data

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
Design pressure HP	barg	
Design pressure LP	barg	
Design temperature	°C	
Storage volume	m ³	

User list

User	Flowrate m ³ /h Continuous	Flowrate m ³ /h Intermittent	Flowrate m ³ /h Design
TOTAL			

Interface requirements list

Utility	Unit	Quantity	Condition
Cooling medium / seawater			
Inert gas			
Electrical power			
Flare			
Atmospheric vent			
Open drains			
Closed drains			
Compressed air			

NORSOK P-100	SYSTEM DESIGN DATA SHEET CHLORINATION	PDS-047 Rev. 1, August 1997 Page 1 of 1
Project:	Doc. No:	Rev.

Design Data

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
Design pressure	barg	
Design temperature	°C	

User list

User	Flowrate m ³ /h Continuous	Flowrate m ³ /h Intermittent	Flowrate m ³ /h Design
TOTAL			

Interface requirements list

Utility	Unit	Quantity	Condition
Seawater			
Compressed air			
Electrical power			
Open drains			

NORSOK P-100	SYSTEM DESIGN DATA SHEET SEA WATER	PDS-050 Rev. 1, August 1997 Page 1 of 2
Project:	Doc. No:	Rev.

Design data

Design data	Unit	Value
Required Regularity	%	
Design Operational Life	Years	
System Location (haz./non-haz.)		
Seawater:		
Design Flow	kg/hr	
Normal Flow	kg/hr	
Discharge pressure max / normal /min	barg	
Seawater supply temperature max / normal / min	°C	
Design pressure	barg	
Design temperature	°C	
Discharge elevation (reletive LAT)	m	
Suction elevation (relative LAT)	m	
Seawater filtration	micron	2000 (2 mm)
Free Chlorine, residual	ppm vol	0.3 - 0.5
Standard Density	kg/m ³	
Dynamic Viscosity	Ns/m ² 1)	

1) 1 Ns/m² = 1000 centipoise

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Project:	Doc. No:	Rev.

User list

Continuous seawater users:

User	System design flowrate kg/h	Unit design flowrate kg/h	Unit duty kW	Return temperature °C
TOTAL				

Intermittant seawater users:

User	System design flowrate kg/h	Unit design flowrate kg/h	Unit duty kW	Return temperature °C
TOTAL				

Interface requirements list

Utility	Unit	Quantity	Condition
Electric Power			
Instrument air			
Clorine			

NORSOK P-100	SYSTEM DESIGN DATA SHEET FRESH WATER	PDS-053 Rev. 1, August 1997 Page 1 of 1
Project:	Doc. No:	Rev.

Design data

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
Design pressure	barg	
Design temperature	°C	
Supply boat frequency	days	
Generation capacity	m ³ /h	
Storage tanks (number of/volume)	m ³	
Number of persons on facility		Note 1

Notes:

1. Typical potable water consumption value is 200 liter/person pr. day

User list

User	Flowrate m ³ /h Continuous	Flowrate m ³ /h Intermittent	Flowrate m ³ /h Design
TOTAL			

Interface requirements list

Utility	Unit	Quantity	Condition
Seawater			
Heating medium			
Electrical power			
Open drains			
Compressed air			

NORSOK P-100	SYSTEM DESIGN DATA SHEET OPEN DRAIN	PDS-056 Rev. 1, August 1997 Page 1 of 1
Project:	Doc. No:	Rev.

Design data

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
System location (haz./non-haz.)		
Tank design pressure	barg	0.07 + liquid head
Tank design temperature	°C	
Tank volume	m ³	
Treatment capacity	m ³ /h	

Source list

Sources	Flowrate m ³ /h Continuous	Flowrate m ³ /h Intermittent	Flowrate m ³ /h Design
TOTAL			

Interface requirements list

Utility	Unit	Quantity	Condition
Inert gasNitrogen			
Fresh water			
Seawater			
Power			
LP flare			
Vent			
Oily water tratment (reclaimed oil)			
Biocide			
Glycol			

NORSOK P-100	SYSTEM DESIGN DATA SHEET CLOSED DRAIN	PDS-057 Rev. 1, August 1997 Page 1 of 1
Project:	Doc. No:	Rev.

Design data

Process parameter	Unit	Value
Required regularity	%	
Design operating Life	years	
Tank design pressure	barg	
Tank design temperature	°C	
Tank volume	m ³	
Pump capacity	m ³ /h	

Source list

Sources	Flowrate m ³ /h Continuous	Flowrate m ³ /h Intermittent	Flowrate m ³ /h Design
TOTAL			

Interface requirements list

Utility	Unit	Quantity	Condition
Power			
HP flare			
Vent			
Oily water treatment			

NORSOK P-100	SYSTEM DESIGN DATA SHEET DIESEL OIL	PDS-062 Rev. 1, August 1997 Page 1 of 2
Project:	Doc. No:	Rev.

Design data

Design data	Unit	Value
Required Regularity	%	
Design Operational Life	Years	
System Location (haz./non-haz.)		
Diesel:		
Standard Density	kg/m ³	850
Dynamic Viscosity	Ns/m ² ¹⁾	
Raw diesel:		
Raw diesel storage	m ³	
Raw diesel consumption	m ³ /h	
Diesel transfer pressure (nozzle of pumps)	Barg	9
Treated diesel:		
Treated diesel storage	m ³	
Trated diesel consumption	m ³ /h	
Filtration requirement	micron	Note 1
Free water	ppm by vol.	< 100 ²⁾

1) 1 Ns/m² = 1000 centipoise

2) For gas turbines, treated diesel according to manufacturers specifications.

NORSOK P-100	SYSTEM DESIGN DATA SHEET COMPRESSED AIR	PDS-063 Rev. 1, August 1997 Page 1 of 2
Project:	Doc. No:	Rev.

Design data

Instrument and plant air

Process parameter	Unit	Value
Required regularity	%	
Design operating life	years	
Design pressure	barg	
Design temperature	°C /	
Dew point air	°C at 10 barg	
Particle size	Max. micrometer	Typical 2-3 µm

Topping (start) air

Process parameter	Unit	Value
Inlet pressure	barg	
Design pressure	barg	
Design temperature	°C /	
Dew point air	°C at 10 barg	
Charging time	1)	

Blackstart air

Process parameter	Unit	Value
Inlet pressure	barg	
Outlet pressure	barg	
Design pressure	barg	
Design temperature	°C	
Diesel daytank storage	m ³	
Charging time	1)	

Note 1: Charging time to be evaluated based on reasonable time for repressurization of start air bottles.

NORSOK P-100	SYSTEM DESIGN DATA SHEET COMPRESSED AIR	PDS-063 Rev. 1, August 1997 Page 2 of 2
Project:	Doc. No:	Rev.

User list

Sources	Flowrate Continuous Sm³/h	Flowrate Intermittent Sm³/h	Flowrate Design Sm³/h
Instrument air Total instr.air required			
Plant air Total plant air required			
Total compressed air requirement			
Topping air			
Black start air			

Interface requirement list

Utility	Unit	Quantity	Condition
Atmospheric air			
Open drain			
Seawater			
Power			

NORSOK P-100	SYSTEM DESIGN DATA SHEET INERT GAS	PDS-064 Rev. 1, August 1997 Page 1 of 1
Project:	Doc. No:	Rev.

Design data

Process parameter	Unit	Value
Required regularity	%	
Design operating life/ performance	% drop per years	
Inlet pressure		
Design pressure	barg	
Design temperature	°C	

User list

Sources	Flowrate Continuous Sm ³ /h	Flowrate Intermittent Sm ³ /h	Flowrate Design Sm ³ /h
TOTAL			

Interface requirement list

Utility	Unit	Quantity	Condition
Compressed air			
Heating			

NORSOK P-100	SYSTEM DESIGN DATA SHEET HYDRAULIC POWER	PDS-065 Rev. 1, August 1997 Page 1 of 3
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Design data

Process variable	Unit	Value
Required Regularity	%	
Design Operational Life	Years	
System Location (haz./non-haz.)		
Hydraulic Oil		Bio Degradable
Standard Density	kg/m ³	
Dynamic Viscosity	Ns/m ² 1)	
Bulk Modulus of Elasticity	N/m ²	
System Design Flowrate	m ³ /h	
System Normal Flowrate	m ³ /h	
Cleanliness level	NAS 1638	Class 6 (typical)
Discharge pressure	Barg	
Supply filter	micron	5
Return filter	micron	25
Circulation filter (if added)	micron	5
1) 1 Ns/m ² = 1000 centipoise		

NORSOK P-100	SYSTEM DESIGN DATA SHEET HYDRAULIC POWER	PDS-065 Rev. 1, August 1997 Page 3 of 3
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Interface requirements list

Utility	Unit	Quantity	Condition
Electric Power			
Instrument air			
Drain			
Vent			
Inert gas			
Nitrogen			