



Exploration & Production

GENERAL SPECIFICATION

SURVEYS

GS GEO 110

Requirements for Offshore Survey Vessels

00	10/04	First issue
Rev.	Date	Notes



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1. Scope

The present General Specification defines the basic requirements for vessels performing offshore survey works under direct Contract for the COMPANY, or under the responsibility of a SUB-CONTRACTOR working for the COMPANY, irrespective of flag or ownership. The objective is to reduce the hazards and risks which may affect survey vessels and their crew under normal operations.

The scope of the document covers both geophysical survey vessels and geotechnical drilling vessels, as well as both dedicated purposely built or permanently converted survey vessels and temporarily used vessels.

Other offshore service vessels, e.g. supply or support vessels, standby vessels, towing vessels, personnel transfer vessels, anchor handling vessels, construction crane vessels, diving support vessels, etc., are covered by other documents.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
ISO 9000	Quality Management and Quality Assurance Standards
ISO 10407	Petroleum and Natural Gas Industries - Drilling and Production Equipment - Drill Stem Design and Operating Limits
ISO 11961	Petroleum and Natural Gas Industries - Steel Pipes for Use as Drill Pipe - Specification
ISO 13500	Petroleum and Natural Gas Industries - Drilling Fluid Materials - Specifications and Tests
ISO 15546	Petroleum and Natural Gas Industries - Aluminium Alloy Drill Pipe
NORSOK J-003	Marine Operations
OGP and IAGC	All reference documents and safety manuals

Professional Documents

Reference	Title
API SPEC 4F	Specification for Drilling and Well Servicing Structures
API SPEC 5D	Specification for Drill Pipe
API SPEC 7	Specification for Rotary Drill Stem Elements
API RP 7G	Recommended Practice for Drill Stem Design and Operating Limits

Reference	Title
API SPEC 13A	Specification for Drilling-Fluid Materials
IMCA/UKOOA M149	Guidelines for the Safe Management and Operation of Offshore Support Vessels

Regulations

Reference	Title
IMO A.481 (XII)	Principles of Safe Manning
IMO A.538 (13)	Maritime Safety Training of Personnel on Mobile Offshore Units
IMO A.680 (17)	Guidelines on Management for the Safe Operation of Ships and for Pollution Prevention
IMO MSC Circ. 645	Guidelines for Vessels with Dynamic Positioning Systems
IMO - MARPOL	International Convention for the Prevention of Pollution from Ships
IMO - SOLAS	International Conventions for the Safety of Life at Sea
IMO - STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

Codes

Reference	Title
IMO - ISPS	International Ship and Port Facility Security Code
IMO - ISM	International Safety Management
IMO - MODU	Mobil Offshore Drilling Unit

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS GEO 101	Offshore Geotechnical Site Survey
GS GEO 201	Offshore Geophysical Site Survey
GS GEO 202	Geophysical Survey for Offshore Pipelines Installation

Reference	Title
GS GEO 301	Offshore Surface Positioning Works
GS GEO 302	Subsea Positioning Works
GS STR 402	Anchorage for Support Vessel on an Offshore Site

3. General requirements

3.1 Safety requirements

3.1.1 Safety and quality management

Prior to any offshore commencement of geophysical or geotechnical operation, a vessel acceptance audit shall be performed by COMPANY. The latest version of the **IMCA M149** (Marine Inspection Document) shall be used. An IMCA safety audit not older than one year shall be available on board.

A safety and quality management system in compliance with ISM is required and shall be maintained.

Risk analyses and job hazard assessments (RA/JHA) document covering all operations and activities on the survey vessel shall be established. Project specific risk analyses and hazard assessments may be required on certain projects, for example for a geotechnical survey vessel drilling in a suspected shallow gas area (see section 5.2).

Further, the vessel OWNER/Manager shall have established emergency response procedures (ERP) to ensure that any emergency can be handled safely, including any potential emergency situations that may arise in conjunction with survey operations on the vessel, which are likely to represent a danger to personnel, environment or equipment.

All accidents and incidents occurring on board a survey vessel under Contract shall be reported to the COMPANY as soon as reasonably practicable in addition to any CONTRACTOR, vessel OWNER/Manager, or flag state reporting requirements.

All incidents with the potential to cause pollution, or which have already resulted in such, must be reported to the COMPANY and to the appropriate Regulatory Bodies.

Master of the vessel must ensure that all wastes are properly stowed, secured and segregated. All wastes shall be properly declared, packaged and marked in accordance with legislation prior to their transfer to a quayside facility.

Maintenance records shall be as per qualification requirements.

3.1.2 Safety zones and offshore responsibilities

Vessels are prohibited from entering inside the 500-metre safety zone around an offshore installation, or a temporary limited area corresponding to a safety zone, without formal approval issued by the COMPANY Representative.

Vessels operating inside the safety zone are under the responsibility of the COMPANY Offshore Installation Manager (OIM), acting as Responsible for Safety and Environment on Site (RSES). Masters should co-operate with OIM/RSES in carrying out their responsibilities, for example, OIM/RSES can modify or terminate any survey vessel activity which they regard as hazardous

with respect to other operations which may be in progress. In particular, any hot work permit approved by the Master shall also be approved and counter-signed by the OIM/RSES, and the Master shall ensure that the OIM/RSES is advised when the work/permit is complete.

Prior to entering the 500-metre safety zone surrounding a floating structure, and prior to manoeuvring close to the structure, the Master shall ascertain the following as part of the pre-approach checks:

- Vessel propulsion systems
- Motion characteristics of the floater
- Number and type of thrusters running on the floater (if any)
- Floater mooring system characteristics and position of the mooring lines (if applicable)
- Sea height and its effect on the vessel's position keeping capability
- Wind and current characteristics at the site
- Weather conditions and risk of weather deterioration.

Should equipment failure or a problem occur with the survey vessel's machinery/control systems, the Master must inform the OIM/RSES immediately and leave the 500-metre safety zone as soon as practicable. The vessel will not be allowed to re-enter until remedial action has been taken and that the Master and OIM/RSES are satisfied that the vessel is fully operational.

For a survey vessel operating in open seas outside safety zones, the COMPANY Representative on board the vessel acts as RSES, in particular for liaison between the Master and the COMPANY facilities offshore and/or onshore.

Fishing within the 500-metre safety zone is strictly prohibited.

3.1.3 Vessel classification

All survey vessels shall maintain valid class with a recognised Classification Society.

The classification should include all systems of importance to the safety of the operations, i.e. mooring systems, dynamic positioning (DP) systems, helicopter landing systems (if any), cargo handling systems, crane or lifting systems (e.g. A-frame, etc.), diving systems or sub-sea operations systems (e.g. ROV, if applicable), etc.

3.1.4 Communications and liaison between the Contracted vessel and the COMPANY

A direct line of communication shall be established between the Master of the survey vessel and the COMPANY facilities offshore and/or onshore, using VHF/UHF channel, satellite phone/fax, or mobile cell phone. Contacts from all parties shall be clearly identified for this purpose.

This direct communication line should not replace the first offshore communication between the Master of the survey vessel and the OIM/RSES but should complement it by ensuring that any on-going safety issues or other urgent concerns can be resolved efficiently.

Vessel shall maintain a continuous listening watch on the nominated working VHF/UHF channels. The survey vessel must also monitor the international marine emergency VHF channel at all times.

Effective communication shall be maintained between the bridge, engine room and deck crew at all times.

Weather forecast information for the intended survey work locations should be obtained on a daily basis as a minimum.

3.1.5 Personnel

All personnel participating in marine operations shall have valid safety training and medical fit certificates, including specialist survey personnel working temporarily on vessels. The vessel OWNER/Manager has the responsibility to ensure that the Master and crew are adequately trained, experienced, certificated and familiarised for the survey tasks they will undertake.

Vessel crews shall participate in regular safety drills, exercises and safety meetings, and shall have time allowed to carry out certain mandatory health and safety requirements.

All personnel shall be qualified for their assigned work. Qualifications requirements shall be specified for job categories of significance to safety and security.

The Master is responsible for ensuring that specialist survey personnel temporarily joining the vessel receives a safety induction briefing at time of joining the vessel or as soon as practicable thereafter. As a minimum, such briefing shall include but not be limited to the following:

- Emergency alarms and actions to be taken on hearing alarms
- Position of muster stations
- Position and use of life jackets and survival suits
- Vessel familiarisation tour
- Abandon ship routine
- Substance abuse policy
- Specific survey working practices (if applicable).

Appropriate personnel protective equipment shall be worn at all times by all crew and survey personnel outside accommodation.

In specific survey operations area (e.g. back deck of a geophysical survey vessel carrying streamers and seismic source winches, or drill deck of a geotechnical drilling vessel), personnel not involved directly with operations must keep clear of the work area at all times.

Survey equipment temporarily loaded on the vessel shall not obstruct escape ways which shall be clear of any objects at all times.

Any use of alcohol, drugs or narcotics is prohibited. Procedures shall be established for personnel who need medication for due medical reasons.

Key personnel participating in marine operations shall be able to speak in English correctly for ensuring good communication between the crew and the specialist survey personnel.

Unless otherwise indicated, the survey vessel shall be adequately manned to work on the basis of 24 hours per day. When determining the crew level and working practices, the specialised nature, hazards and risks associated with survey operations must be taken into account. If necessary, the Master and the OIM/RSES should discuss the intended operation so as to minimise, as far as possible, the problem of fatigue and to ensure the crew and survey personnel have adequate rest periods.

3.1.6 Personnel transfer offshore

Transfer of personnel offshore from the survey vessel to a fixed platform shall be made following COMPANY approved procedures and equipment (e.g. surfer/boat landing).

Personnel transfer by basket should be limited to emergency situations, or only used when other solutions are not possible or unsafe. Master shall be aware of CONTRACTOR's and COMPANY's instructions with regard to personnel basket transfer, but as a minimum:

- Master, OIM/RSES, crane driver and passengers shall be in agreement that it is safe to proceed with the transfer
- There must be a clear deck space available
- Standby boats (if any) shall be informed and shall be on close standby with fast rescue craft made ready
- All personnel involved are to be briefed on safety procedures and be supplied with appropriate safety equipment.

Transfer of personnel between two vessels offshore should be made by means of craft boat and pilot ladder with every person wearing an adequate life jacket and with both hands free.

In all cases, direct board to board transfer of personnel is forbidden.

3.1.7 Verification of compliance

Before a vessel enters into service for COMPANY under Contract, the CONTRACTOR shall confirm that the requirements outlined in this document are complied with. Any non-compliance with regard to these requirements shall be identified and reported. Necessary corrective actions must be proposed, and reasons shall be stated for those non-conformances which are proposed for acceptance.

To ensure the observance of good practice and compliance with relevant requirements, audits or inspections of vessels, equipment, safety and quality management systems and documents may at any time be performed by COMPANY. The IMCA (International Maritime CONTRACTORS Association) "Common Marine Inspection" document ([IMCA M149](#), issue 3) shall be the reference guideline document for performing such inspections or audits.

As a minimum, inspection and audits of survey vessels shall include but not be limited to:

- Vessel classification certificates
- Certification of safety equipment on board the vessel
- In some cases, the survey of vessel's structure, main and auxiliary engines
- Manning and certification of crews
- Last quarterly status report on board
- Arrangements on vessel for dealing with the prevention of pollution
- Crew accommodation and related matters (e.g. galley, mess room, recreation room, food stores, etc.)
- Operational arrangements for the survey work.

Any non-conformance revealed during such audits or inspections shall be promptly corrected and re-inspected for acceptance by COMPANY.

In addition, example check lists for inspection and acceptance of geotechnical survey vessels are given in Appendix of this document.

3.2 Position keeping requirements

3.2.1 Moorings and anchors

The mooring system and anchors shall be verified by a competent person or institution, with certified mooring wires. The mooring system should be verified to have the required capacity for the proposed location and survey work.

A survey vessel without dynamic positioning shall have at least four mooring points, and shall be able to lay anchors alone. The vessel specifications shall clearly state the water depth limitations for self-mooring capability and for mooring with assistance from an anchor handling ship.

When assistance is required from anchor handling ships, the Master of the survey vessel has the responsibility for ensuring that anchor handling ships, together with their equipment, are fit for purpose and adequately manned by competent personnel with the relevant experience. If possible, Masters and key personnel in charge of anchor handling should be briefed prior to leaving port or, failing that, on location prior to anchoring operations. Full procedures for anchors installation and/or retrieval should be agreed by Masters and key personnel involved. In addition, each Master should hold a pre-job meeting with his own crew to ensure that his anchor handling procedures are fully understood and in agreement with his own safety procedures. There should be agreement on to the responsibility for providing additional mooring equipment (e.g. piggy-back anchors, buoys, pennant wires, etc.) and agreement as to the amount and specification of such equipment.

If required, a mooring analysis shall be performed by qualified personnel using a recognised computer programme, to verify compliance with minimum safety factors under the applicable weather conditions.

3.2.2 Dynamic positioning

DP vessels shall be designed, equipped and operated in accordance with [IMO MSC Circ. 645](#).

Means for voice communication shall be available to enable necessary information between DP operators and all other parties directly involved in or responsible for survey operations. All essential communication systems should be provided with 100% redundancy.

Audio-visual alarms shall be connected to the DP system to draw the attention of personnel responsible for survey operations whose safety is dependent upon the vessel's position keeping to an indication of degraded status.

For DP vessels using a sub-sea positioning system in the 500-metre safety zone or in the area surrounding ongoing sub-sea construction works, it shall be checked that the vessel's positioning system does not interfere with acoustic frequencies utilised for other sub-sea works which may be in progress (refer to the General Specification [GS GEO 302](#)).

Use of manual positioning for certain types operations is not excluded, provided that CONTRACTOR can demonstrate that the required survey work can be performed safely and in compliance with the COMPANY requirements.

3.2.3 Pipelines and sub-sea obstructions/structures

All relevant parties involved must have full details regarding the location of pipelines and sub-sea obstructions/structures relating to the whole survey work.

The vessel and its mooring lines and anchors shall be located at a safe distance from any sub-sea or sea surface obstructions/structures, including pipelines, cables, wellheads, risers, fixed or floating platforms, mooring buoys, navigation marks, etc. Safe distance shall be defined prior to starting offshore survey operations, paying due consideration to site and work conditions, and be included in the project operations procedure. In all cases, it shall never be less than 200m or 400m when an anchor line crosses a pipeline (refer to the General Specification [GS STR 402](#)).

When it is known that anchor handling operations will be conducted near to pipelines or sub-sea obstructions/structures, then full written procedures should be agreed by all parties and shall not proceed before formal approval has been given by the COMPANY Representative.

Prior to anchoring or performing survey work near any pipelines or sub-sea obstructions/structures, detailed check of the positioning equipment of the vessel shall be performed and agreed by all parties (refer to the General Specification [GS GEO 301](#)). If necessary, equipment to verify the exact location of the obstructions/structures on the seabed (e.g. side scan sonar, ROV, etc.) should be available.

3.2.4 Weather conditions

The Master has responsibility for the safety of the vessel and crew. If requested to work on deteriorating weather conditions, the Master should assess all potential risks on the basis of his knowledge of the vessel's behaviour. Such a risk assessment should include but not be limited to:

- Experience of Master
- Sea height and its effect on the vessel's position keeping
- Prevailing wind speed and direction
- Forecast weather
- Vessel's power management configuration and confidence in the reliability of power generation equipment and propulsion units.

Based on the Master's experience, vessel environmental limitations for safe marine operations shall be established, including, but not limited to, maximum wave height, current and wind speed.

When deteriorating weather conditions may affect the results of the survey work, specific limitations for safe offshore survey operations shall be established in co-operation with the COMPANY Representative.

In the event of any conflict of requirements between the Master of the survey vessel and the COMPANY Representative, the final decision rests with the Master.

4. Technical requirements for geophysical survey vessels

4.1 General

Every work shall start with a safety start up audit of the geophysical equipment.

Plant, tools and equipment shall be maintained in an operable condition. An impression of the general state of these items will be formed during the start up audit. Periodic formal inspections of workshop and related equipment (with associated documentation) shall be routinely done by CONTRACTOR. Reports of these inspections shall be made available to COMPANY representative.

All authorised users of plant tools and equipment are to be adequately trained, experienced and where necessary, licensed and certified. Arrangements for job and skill training and details of any tools or equipment which are restricted to named individuals/ranks shall be made available to COMPANY representative.

4.2 Electrical Equipment and Wiring

The OGP schedules refer to the IAGC Safety Manual for electrical equipment and wiring. Assuming the vessel has been built to an accepted standard, concerns can be limited to the general condition of electrical equipment and wiring, the safety of any modifications, the arrangements for the use of portable electrical tools, and the general practises adopted for electrical installation and repair. The extent of the redundancy of electrical power generation should also be checked.

4.3 Welding Equipment

a) Electric Arc Welding

- Direct current welding preferred
- Electrode holders to have completely insulated heads
- Cable lugs to be insulated
- Cables to be free of damage and no mechanical joints permitted.

b) Gas Welding/Cutting

- Gas hoses to be identified by distinctive colours, in general red for fuel and blue for oxygen
- Hoses to be protected from damage and from kinking
- Hoses to be frequently inspected for leaks wear and loose connections
- Flashback arrestor to be fitted on fuel line immediately after the regulator.

c) Industrial Compressed Gas Cylinders

- Top valve assemblies to be protected by guards or caps
- Be maintained in good condition and clearly show the date of manufacture and the last hydrostatic test
- The name of the gas in the cylinder to be clearly stencilled on the cylinder body.

4.4 Chemicals

- All chemicals to be packed and labelled with contents and stored in accordance with internationally recognised standards
- CONTRACTOR to be familiar with the hazards of all chemicals used
- Personal protective equipment to be provided if required

- All necessary precautionary measures to be taken including availability for fire extinguisher, first aid kit, and eye wash
- Eye wash to be available when handling chemicals and adjacent to battery charging areas
- Chemical spillages to be contained and cleared up
- Waste and containers to be disposed of in an environmentally sound manner
- Freon should not be used as a general solvent and general cleaning agent.

In the US and Europe there are regulations concerning the ready availability of information in the work place about potentially harmful chemicals that may be in use. This information is often in the form of "HAZCHEM" sheets and covers the safe transport, safe storage, and safe use of the substance. Information is also provided on the actions to be taken in the event of ingestion, inhalation or splashing. Although not in the OGP Schedules, the ready availability of this advice should be confirmed.

4.5 Lifting Equipment

A register of lifting equipment and tackle is to be kept:

- Inspection certificates to be available (if requested by Client) for annual surveys (inspections) of all cranes, side booms and lifting slings and tackle
- Tests and inspections requested by COMPANY representative also to be carried out
- Safe Working loads (SLW) and radius charts to be available for all lifting equipment and to be marked on equipment.

4.6 Pressurised Systems

Pressure systems to be properly maintained and regularly inspected:

- Where necessary inspected by a competent person in accordance with a written scheme prepared by the CONTRACTOR.
- The interval between inspections to be specified by competent national authority, and in any case not more than five years.

4.7 Air guns and compressors

Air guns shall not be operated in the vicinity of diving operations.

Non essential personnel should be clear of the area.

To minimize risks associated with compressed air, all vessel specific procedures and work instructions should be followed, but at a minimum observe the following:

- Never put your hands in front of the jet air or any pressurized discharge port. A poster warning of the hazards associated with compressed air should be prominently posted
- Only qualified persons should operate the air guns, the handling equipment and the air compressors. All other personnel should stay clear of equipment, including lines, rigging and booms while deploying, retrieving and working on air gun systems
- All personnel in areas where there is a risk of sudden release of air should wear ear and eye protection while the system is operating
- An eye wash station should be located in the airgun area

- The storage tanks, pipes, lines and fittings used to carry and control this high pressure are specialized equipment and must receive special attention
- Never handle, tighten or loosen bolts or fittings or hammer any part of a high pressure system while pressure is applied
- Pressure-relieving valves and other safety devices should never be removed or modified, except for repair or adjustment by qualified personnel
- Any block valves installed upstream or downstream of a relief valve should be locked in the open position
- It is recommended that high-pressure manifolds and all associated assemblies are housed behind a protective screen or cage in a secure space and not in the gun control room.

Another danger of compressed air is the possibility of explosion. When high pressure air reacts with combustible fluids in the piping or other system components, explosions can occur. Explosions can also occur when high temperatures are created by sudden compression in the dead end (compression ignition) or when a gauge valve is opened to a vented gauge containing oil. Even a thin film of lubricating or hydraulic oil in the system piping may explode.

These risks have to be minimized by following IAGC standards.

The air gun is the system components that requires the most handling and maintenance and, consequently, present the greatest danger to personnel.

When the airguns are being handled, the main switches for disabling/enabling, triggering and pressure control must be controlled and operated from the deck by the crew working on the guns, not from a remote location.

A flashing warning light and audible alarm will operate whenever any pressure is applied to the system when the guns are on deck. Such warning equipment should be provided at each entrance to the gun deck accompanied by a sign explaining the purpose of the warning.

If a person is exposed to the risk of falling overboard during the deployment or retrieval of guns, it is recommended that an attached safety harness be worn. A Personal Flotation Device (PFD) must be worn.

Air gun operations involve high-pressure air hoses, electrical lines and towing cables. Care should be taken to prevent personnel from becoming entangled in or tripping over lines. Handle the high pressure hose and electrical cables carefully to prevent excessive bending, abrasion, or undue strain on the recovering.

4.8 Coring

Coring performed from a geophysical survey vessel usually use free fall winch and lifting gear. Coring equipment shall be operated by qualified persons. Auxiliary personnel, working in the area of cranes and winch associated to corer shall be instructed and familiar with the operation and safety procedures of this equipment. The use of these equipment is hazardous and the operator should examine the cranes foundations, cables, drum, dogs, brakes, boom, guard, pins, sheaves, load hook, and wire line for defects. Any defects must be repaired before the coring equipment is used.

Only necessary personnel shall be on deck during coring operations.

Protecting equipment including, hard hat, gloves, coverall and PFD is compulsory.

A restricted area shall be clearly defined on the deck.

A coordinator shall be designed for the duration of coring operations. The coordinator shall be fully aware of the different tasks, but not affected to a specific task.

All hydraulic connections on lifting equipment shall be protected with wire socks.

Geotechnical analysis of cores, to be in agreement with **GS GEO 101**, will only be performed after the cores are secured. Special care to H₂S will be taken when opening the cores.

Proper, safe and adequate means for cutting the cores will be utilised.

Storage of core samples should be done in a safe place.

4.9 Small boat and shore operations

The mission of the small boat should be compatible with the boat's size, propulsion system, impending weather and time of day.

Small boat operations should consider such hazards as predators (sharks, snakes, alligators), floating debris, low hanging limbs, shallow water, currents, tides, tidal bores, flash floods and any hazardous to the boat and its passengers.

Boats should be at least equipped with the following:

- Approved flotation devices for each person and a life ring
- Fire extinguisher
- Extra line or rope
- Paddles
- First aid kit
- Ample fuel
- Waterproof radio.

Night operations shall be restricted to the minimum.

When working in transition zone actual methods and procedures for deployment and retrieval of units should be determined in accordance with COMPANY procedures with absolute reference to safe and efficient personnel operations.

4.10 Streamers, and towed bodies deployment and recovery

All lifting equipment should be in accordance with § 4.5.

Length, type, way of deployment and number of streamers and tow bodies are different and continually evolving. Each vessel crew must devise a safe system of work that suits their operation. This procedure should be written and regularly reviewed. A clear procedure must be understood by all concerned before deploying or recovering trailing equipment. Prior to deploying any trailing gear, the ship's officers should be informed on the type of equipment to be deployed. During deployment and recovery, there must be close cooperation between the marine and geophysical crew.

A check on the expected weather conditions, water depth, and vessel traffic (including fishing boats) should be made before commencing any marine or geophysical operation.

The officer on watch must monitor all vessel traffic in the area and warn the back deck personnel of any situation that might involve a course change or other evasive manoeuvre.

The operation and condition of all components of the streamers and towed bodies shall be checked before starting work. A high voltage hazard exists on some towed bodies. Be certain that proper procedures are followed.

Communications and video equipment between the back deck and the bridge and recording room should be checked. Never begin deployment without adequate communication between back deck personnel and helmsman.

Safety harness and anchor points must be provided on the stern of the vessel. Harnesses should be worn where conditions dictate, or at the direction of the person in charge.

The correct personal protective gear should be worn including life jacket, non slip safety shoes, wet weather gear, gloves, or any other equipment that may be necessary.

5. Technical requirements for geotechnical drilling vessels

5.1 Drilling equipment and personnel

The geotechnical drilling equipment specifications and operation procedures shall be vessel specific. However, some ISO and API technical specifications for drilling equipment for the oil drilling industry may be used as reference documents for the equipment operated on board geotechnical survey vessels, with some modifications where appropriate, in particular:

- **API Spec. 4F** for the derrick and substructure
- **ISO 11961**, **ISO 15546** and **API Spec. 5D** for drill pipes
- **ISO 10407**, **API Spec. 7** and **API RP 7G** for the rotary drilling equipment
- **ISO 13500** and **API Spec. 13A** for the drilling fluid materials.

Specific geotechnical drilling equipment shall be subject to systematic maintenance, including:

- Drill string, with drill bits, drill collars and pipes (steel or aluminium pipes)
- Power swivel
- Mud preparation and circulation systems
- Seabed frame
- Heave motion compensator, for both the seabed frame and the drill string
- Associated draw works, engines/power generators and heavy lift winches.

In addition to indicating the extent and frequency of controls, the maintenance programme of the drilling systems shall also record equipment failures and replacements. The vessel OWNER/Manager with the Master, the chief engineer and the drilling supervisor, have the responsibility to ensure that maintenance, repairs and/or modifications are carried out in such a way that an adequate level of safety is maintained.

The vessel should be equipped with a remote controlled pipe handling system, to be used for storing, connecting/disconnecting and suspension of drill string and collars under the power swivel, and transport of drill pipes, etc., from storage location to the drill floor and vice versa.

Access in connection with drilling operations and maintenance of equipment shall be catered for by suitable and safe access from deck or installed work platforms. In particular, guiding of geotechnical tools through the power swivel shall be made from a fixed work platform or by means of a remote controlled system.

The vessel shall have the capability of mixing both normal drilling mud (i.e. specific gravity of up to 1.05), as well as heavy mud to be used as barrier against shallow gas hazard (i.e. specific gravity of up to 1.30). The vessel shall have sufficient dry mud storage capacity in order to have both normal drilling mud and heavy mud available on board. In addition, two or more surge tanks for mud preparation and mixing are required.

For vessels being temporarily used as geotechnical drilling vessels, with set-up of all required drilling equipment on board (e.g. over the side or over a moon-pool), the vessel OWNER/Manager is responsible for ensuring that appropriate arrangements are made to conduct the requested drilling operations with an adequate level of safety. Moreover, the stability of the vessel must be verified under all conditions, and the vessel OWNER/Manager shall confirm that the modifications made to the vessel do not invalidate any of the vessel's certificates. If necessary, the derrick and all heavy loaded equipments shall be properly load-tested and certified by an appropriate Regulatory Body. After CONTRACTOR has confirmed that all requirements outlined in this document are complied with, acceptance of the vessel remains subject to satisfactory inspection by COMPANY. Acceptance of the vessel by COMPANY does not prejudice the Master's responsibility for the safety of the vessel and its crew.

Personnel engaged in drilling operations shall have the necessary qualifications. Before participating to any drilling operation on board a geotechnical survey vessel, drillers and assistants shall carry out any necessary training programme under the supervision of experienced personnel. Full records of training received/given should be recorded on board of the vessel in addition to any training log carried by the individual.

Special care shall be paid to geotechnical drilling operations with the objective to minimise soil disturbance close to the drill bit. It is then recommended that all drillers have been through a theoretical course with emphasis on specific geotechnical drilling techniques, including open-hole drilling, mud mixing, well control and handling of shallow gas kicks.

5.2 Drilling operations in suspected shallow gas area

5.2.1 Background

Shallow gas hazard in geotechnical drilling operations can be divided in four categories:

- Gas kick resulting in toxic gas on the vessel deck, for example hydrogen sulphide H₂S
- Gas kick with risk of combustion or hydrocarbons
- Blow out with survey equipment related hazard, i.e. geotechnical down-hole tool expelled from the drill string and falling on deck
- Blow out with serious or catastrophic loss of vessel buoyancy.

Shallow gas hazard may be identified from a high resolution geophysical survey and/or previous drilling at the proposed geotechnical survey site. In certain suspected shallow gas areas, a review of the geophysical survey report for the drilling location may not reveal the presence of a shallow gas hazard but, due to the inherent uncertainties related to seismic data interpretation, the possibility of encountering a gas pocket of limited extent can not be entirely discounted.

In such cases, specific procedures shall be defined to establish safe drilling operations down to the target penetration of the boreholes at the proposed geotechnical drilling locations.

After completion of the drilling operations, the geotechnical boreholes should be grouted or filled with heavy mud, in agreement with the requirements of the Particular Technical Specification.

5.2.2 Requirements related to barriers against shallow gas

For geotechnical drilling operations in suspected shallow gas area, two independent barriers shall be available as a minimum. The first barrier shall be the use of heavy mud with a minimum specific gravity of 1.15 and up to 1.30.

The second barrier against shallow gas shall be within the following or a combination thereof:

- During drilling, use of a non-return valve in the heavy mud system
- When connecting/disconnecting and pulling pipes, use of a non-return valve in the bottom-hole assembly
- During down-hole wire-line sampling/CPT operations, use of a safety valve on the power swivel which can close around the umbilical of the tool and withstand a minimum of 40 bars excess pressure.

Considering that a gas kick may still occur, a gas diverter system shall be installed in the mud circulation system. Such a diverter should ensure safe evacuation of the gas to leeward through the drill string, and limit as far as possible gas escaping via the drilling annulus to the seabed and bubbling into water with a risk of losing vessel buoyancy.

5.2.3 Specific procedures in suspected shallow gas area

Vessel specific procedures for handling shallow gas hazard shall be established.

Such procedures shall include but not be limited to a combination of the following:

- Position the vessel optimally with respect to wind and current to minimise accumulation of gas on deck
- Use the vessel echo-sounder to detect gas bubbles in the water column
- Perform pilot holes to depth in excess of the target geotechnical survey holes

Note: Pilot holes may be drilled without any indication of shallow gas presence, but gas blowing out can be stimulated by the swabbing action when pulling-out the drill string.

- During drilling, after each stand of pipe is drilled down, circulate with heavy mud to stabilise the borehole and to maintain maximum hydrostatic pressure in the drill string
- Pull-out down-hole tools slowly from soil with drill string to avoid swabbing

Note: Special care to be exercised when an interface between clay and sand layers is indicated by drilling parameters since shallow gas would preferably accumulate in more permeable sandy formations.

- Prior to pulling the drill string at completion of drilling, circulate with heavy mud to stabilise the borehole; pull-out pipe slowly to avoid swabbing; when the drill string is disconnected, monitor for any backflow from the drill string bore; if any backflow is observed, reconnect the power swivel and circulate with heavy mud to stabilise the borehole.

When the risk to encounter shallow gas is considered as particularly severe, additional precautions may be taken, including:

- Installation of shear rams on the seabed frame
- Installation of a sub-sea camera on the seabed frame to detect gas bubbles at seabed level
- Offset the vessel with respect to borehole position to avoid gas on deck; when penetrating suspected layers with shallow gas, normal drilling operations can be carried out with a deviation of about 10% of the water depth
- Installation of fixed gas detectors at critical locations (e.g. moon-pool, driller's console, drill deck, engine room, etc.), and portable gas detectors; in case of possible toxic gas (e.g. H₂S), breathing apparatus shall be made available for all personnel on board the drilling vessel.

Note: The type of gas detectors and the alarm levels should depend on the type of gas likely to be encountered, e.g. 10% and 20% of lower explosion level (LEL) for flammable gas, and 10 and 20 ppm for H₂S.

- Use of spark-proof engines and lighting on deck
- Use of a standby boat with fire fighting equipment ready for use.

Crew and survey personnel awareness on safety procedures against shallow gas hazard shall be maintained at all times, with the following actions from the Master to be repeated at least daily or at each change of working shift:

- Ensure that crew and all personnel on board is briefed and that safety procedures are well understood; if necessary, enforce safety drills/exercises, in particular fire fighting and abandon ship exercises
- Perform active and passive drift-off tests with the vessel
- Conduct "bubble tests" to determine gas bubble zone area in the event of blow out; perform bubble watch
- Function test gas alarm systems and gas detectors
- Function test mud system and valves, in particular the valves for gas diverter/mud line
- Enforce no smoking and hot work ban on deck
- Maintain permanent bridge attendance
- Function test communication systems between bridge, engine room and drill floor
- Establish daily contact with OIM/RSES and/or onshore COMPANY facilities
- Close ventilation ducts to/from open deck and engine room whichever not required for drilling operations; close watertight doors, windows and portholes during drilling
- Pressurise fire line on deck with a fire hose connected and open.

5.3 Geotechnical survey equipment

The geotechnical survey tools (e.g. sampling, CPT or vane testing tools, etc.) which are operated from the survey vessel are covered by the General Specification **GS GEO 101**.



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The vessel shall be equipped with an offshore soil laboratory for early testing of the recovered soil samples. The requirements for offshore laboratory testing are covered by the General Specification **GS GEO 101**.