ODS-GFS-00-001-R1

Functional Specification

Offshore Substation General Requirements

Revision History					
Rev	**Date**	**Description**	**Originator**	**Checker**	**Approver**
R0	09/07/2012	First Issue	ESBI – PE604-F0025-S025-001	Paul Moran	Christy Kelleher
R1	19/11/2018	- Revision of International standards - Removal of HV Submarine Cable Elements - Additional updates to align with recent developments in offshore.	Mott MacDonald	Paul Moran, Conor Farrell	Brendan Murray

Contents

1 GLOSSARY

DCC – Distribution Control Centre

ECC – Emergency Control Centre

NCC – National Control Centre

HV – High Voltage

RTU – Remote Terminal Unit

SCADA – Supervisory, Control & Data Acquisition

2 Scope

The following functional specification outlines the general requirements for a High Voltage AC Offshore Substation connecting at 110 / 220 / 400 kV.

The customer shall design and install the substation using indoor Gas Insulated Switchgear (GIS) technology in line EirGrid Functional Specification for 110/220/400kV Gas Insulated Switchgear (GIS) XDS-GFS-25-001.

The operational / ownership boundaries and configuration of the substation is not considered part of this specification but will be detailed in the EirGrid project specific Single Line Diagram as part of the connection agreement.

3 Health and Safety Requirements

It is the sole responsibility of the customer to produce a suitable & sufficient design risk assessment of the Offshore substation.

A formal safety assessment shall be conducted and submitted in accordance with DNV-ST-0145 “Offshore Substations”.

All design, construction and operational works shall ensure that no single failure will expose a person to a life threatening situation, or to unacceptable damage to the environment or installation.

A Hazard Identification (HAZID) process shall be employed to identify and mitigate against such failures.

4 Specifications and Standards

Except where otherwise stated in the Specification, materials shall be designed, manufactured, tested and installed according to the latest edition of the standards, specifications and codes outlined in Appendix I, Appendix II and Appendix III. The following priority of guidance should be applied with respect to the applicable references from highest to lowest:

1. European Standards (ENs)
2. Cenelec
3. International Electrotechnical Commission (IEC)
4. International Council on Large Electric Systems (Cigré)
5. DNV GL

Where no applicable DNV or IEC standards have been issued to cover a particular subject, a recognised international standard shall be referenced.

In case of conflict between this Specification and any referenced standards or national standards, the requirements listed in this Specification shall take precedence.

The Customer shall state in their submission the codes of practice proposed for any item of plant or equipment not covered by a standard. The customer shall submit two English language copies of these standards not later than the design submission date.

5 Network Parameters

The system design network parameters are outlined in section 3.1.4 of the EirGrid Specification XDS-GFS-00-001 for 110/220/400kV Station General Requirements.

The technical parameters shall be as in line with parameters detailed in the Technical Schedules XDS-GTS-00-001.

The Customer shall submit fully completed and signed Technical Schedules for EirGrid review in advance of equipment order.

Calculation of the offshore collector station voltage level is largely based on optimisation of the HV submarine cable.

All HV offshore cable requirements are described in EirGrid Specification OCDS-GFS-00-001 110/220/400 kV Offshore Cables Functional Specification.

6 Service Conditions

The climatological and maritime conditions at the location of the offshore substation must be considered. It shall be clearly demonstrated, based on site survey data, that the offshore substation is designed to operate satisfactorily under the most severe environmental loading conditions. These include:

- hydrodynamic loads induced by waves and current;
- wave induced inertia forces;
- wind;
- earthquake;
- tidal effects;
- marine growth;
- snow and ice;

The design criteria for environmental loading effects shall be in accordance with DNVGL-OS-C101. Practical information regarding environmental loads and conditions are outlined in DNVGL-RP-C205.

Indoor equipment exposed to the effects of condensation and moisture shall be located in a controlled and regulated environment.

Outdoor equipment design must also consider the effects of wind driven rain, solar radiation, humidity (up to 100%) and exposure to a high wind, salt laden environment.

The air temperatures for outdoor and indoor equipment are outlined in the Service Conditions section of the EirGrid 110 / 220 / 400kV Station General Requirements Specification XDS-GFS-00-001.

7 Offshore Substation Platform And Structure

An offshore platform shall be designed to (1) ensure the safety of personnel required to operate and maintain the substation and (2) protect the assets and the overall integrity of the platform in the event of a catastrophic failure of plant or equipment.

7.1 Risk Management And Assessment Process

A design risk assessment (DRA) and management process (ISO or equivalent) is required to identify design risks due to specific potential hazards.

A design risk assessment template can be found in Appendix 2 of EirGrid's Safe by Design Methodology XDS-SDM-00-001 for reference.

The risk assessment must ensure that the design is safe and without risk to health when properly used by a person at a place of work, taking into account the initial installation, time-based inspection, time-based maintenance requirements, operation activities and decommissioning equipment.

The submitted documentation should align with the latest EirGrid asset management policy. The risk management process shall mitigate risks to as low as reasonably practicable. These include but shall not be limited to the following:

- Conceptual design and design modification;
- Electrical Environment:
  - electrocution;
  - high voltage stress/exposure of primary plant and equipment;
  - thermal stress/exposure of primary plant and equipment;
  - earthing requirements;
  - secondary auxiliary systems - optimal cable configuration, resonance and harmonics, effective earthing;
- Physical Environment:
  - structural integrity or foundation failure;
  - fire hazard and explosion due to equipment failure;
  - physical danger;
  - release of toxic or other hazardous substance;
  - radiation;
  - exposure to adverse weather and marine conditions;
  - oil handling and spillage;
  - corrosion;
  - collision – living (marine wildlife avoidance) & inert;
  - noise;

- Operability Aspects;
    - unplanned maintenance - "weather window";
    - communication failure;
    - chemicals (e.g. oil, diesel) management – technical and maintenance requirements;
    - health and safety - transfer and access, escape and rescue;
    - fire and explosion hazards;
    - replacement of equipment– centre of gravity and accessibility considerations;

The DRA methodology shall be clearly defined and demonstrated by the customer.

7.2 General Design Requirements

7.2.1 Operational philosophy

The system design should allow for un-manned operation under normal conditions. It should minimise the requirement for offshore mobilisation as much as practicable under both planned and un-planned maintenance conditions.

7.2.2 Reliability

Based on a structural reliability analysis, the specified design working life of the platform shall be at least 40 years. Verification of the structural reliability shall consider:

- reliability class or class of failure;
    - classified as low (I), medium (II) or high (III);
    - consequence of failure – loss of human life, economical and environmental;
    - reliability index β;
- offshore location and water depth;

Reliability levels shall be based on ISO 2394, DNV Classification Note 30.6 and BS EN 1990. These documents are considered the fundamental standards for target reliability requirements.

7.2.3 Layout

A typical offshore platform will include rooms to accommodate the following plant and equipment:

- Power Transformers;
- Auxiliary transformer (neutral treatment);
- HV Gas Insulated Switchgear (GIS);
- HV Control & Protection Cabinets;

- DC Distribution Boards, Battery Chargers and Enclosures;
- LT Distribution Board;
- Communications Equipment;
- Battery Cells (220VDC , 48VDC and 24VDC);
- Emergency Overnight Accommodation;
- Temporary Refuge (incl. emergency food & water store);
- LV Switchgear (not considered part of this document);
- LV Control & Protection, Battery, Distribution and Communication requirements (not considered part of this document);
- HVAC (heating, ventilating and air-conditioning) system;
- Storage area – spares, portable devices e.g. trolleys, lifting frames, SF6 gas handling truck, etc;
- All plant as specified by EirGrid in the SLD

The HV GIS equipment must be located in a dedicated ‘HV GIS’ room. All associated control and protection equipment shall be located in a separate ‘HV Control’ room. The DC battery cells shall be located in a dedicated ‘Battery’ room with adequate ventilation.

Additional spacing shall include provision for welfare facilities, back-up LT supply, filter banks (if applicable), fire fighting facilities, platform auxiliary equipment (building services, water handling, drainage, etc), platform cranes and cable decks.

The layout design shall consider the effects of the platform’s centre of gravity due to physical location, size and weight of heavy components, particularly during periods of maintenance when equipment will be relocated or replaced.

Expandability for future high voltage bays is not considered as it must be addressed on a case by case basis according to EirGrid’s strategic offshore grid development – the configuration and arrangement for the high voltage bays shall be outlined in the Single Line Diagram provided by EirGrid.

7.2.4 Access and Transfer

Platform access and transfer shall be by sea (boat landing). Any provision for air access (heli-deck) must be agreed with EirGrid on a project by project basis.

Approach to the platform may be constrained for significant periods due to adverse sea conditions (wave height, swells), wind speeds, weather etc. An average year accessibility level > 90% to the platform is necessary and shall be demonstrated using appropriate site survey data.

Egress from the platform, especially for emergency evacuation purposes shall be provided. Emergency evacuation of persons from the offshore platform shall consider:

- width of access walkways and stairways to evacuation and assembly points;
- provision of suitable stretchers for injured persons;
- type/location of life-rafts and means of descent;
- type/location of descent systems to sea/life-raft/lifeboats for injured and non-injured persons;

- type and location of life saving equipment;
- evacuation alarm, assembly points, evacuation routes, markings etc;

Legislature requirements stipulate the provision of an alternative helicopter route, presence of life-boats and availability of secondary escape routes (i.e. ropes, ladders, access platforms, decent-to-sea systems) for evacuation purposes.

Procedures relating to cessation of works (post construction) due to high sea states should be agreed. The lifting equipment (lightweight cranes, hoist, etc) installed on the offshore platform should be designed to operate within the agreed sea state and wind constraints and for loads appropriate to the work that will be required to be undertaken.

The operating conditions for such equipment shall be clearly defined by the customer.

Transport by sea or air shall be in accordance with local aviation and maritime regulations. The Irish Aviation Authority does not presently have legislation on Helicopter Landing/Winching Areas for offshore helicopter landing areas. However, policy documents (CAA CAP 437: Standards for Offshore Helicopter Landing Areas) produced by the Civil Aviation Authority (UK) may be used as an acceptable standard.

7.2.5 Accommodation

It is generally considered that offshore substation platforms shall be classified as Normally Unmanned Installations (NUI).

However legislative requirements stipulate provision for emergency overnight accommodation on the platform. The extent of the accommodation shall consider the offshore location, planned maintenance requirements, no. of persons, welfare facilities, etc. These requirements shall be clearly identified and defined by the customer.

Legislation also states that a temporary refuge area must be provided for a “distressed” (stranded) mariner.

7.2.6 Vibrations – platform and structure

Structural fatigue due to vibrations from wind and waves can affect the long term withstand capability of the platform and structure.

To mitigate the effects of these vibrations, a site survey of the sea bed conditions is required to determine the rigidity of the platform and foundation.

Exposure to vibrations during the transportation, lifting/assembly and construction stages should also be considered.

7.2.7 Maintenance

Offshore maintenance at the substation platform is highly dependent on weather conditions. Access to the required weather window must allow for the travel and required maintenance timeframes. Long waiting times and limited access to the platform may therefore be encountered.

Implementation of preventative/planned maintenance procedures is advisable, especially during periods of good weather (low winds) when production (wind output) is low. However the following measures shall be adopted to facilitate maintenance requirements:

- Accessibility to platform and individual items of equipment shall be designed to cater for the replacement of major plant components (location, proximity, centre–of–gravity and load distribution accessible spare parts, modularization etc);
- minimal maintenance requirements (built into equipment design);
- utilization (over specification) of plant and equipment;
- adequate platform maintenance facilities (landing, crane, hoists, etc);
- specialist maintenance personnel and training procedures;
- tagging system identifying each item of equipment (presently no agreed standard);
- reliable monitoring equipment;
- use of non-corrosive materials (piping, valves, etc), particularly in exposed areas, require minimal maintenance through the lifetime of the substation;
- Remote automated settings control (relay configurations)
- Remote diagnostic and conditioning controls

Determining the optimum maintenance requirements (including replacement and testing) for equipment, secondary systems and components using a systematic approach to maintenance planning shall be considered. This reliability analysis method shall take into account the effect of failure modes (safety implications, rate of fault, time-to-repair, costs, etc.), detectability and redundancy (N-1 contingency).

7.2.8 Vessel Collision

Risk of collision from sea vessels can be determined from traffic patterns to the substation platform, adjacent offshore installations and commercial shipping lanes (local maritime and coastguards agencies). Consequential environmental hazards may differ between jurisdictions.

In addition to the typical project submission, the location and design of the offshore substation should be transferred in a suitable format for the inclusion in the appropriate marine navigational charts.

Recommended Reference: IMO Regulation “Convention on the International Regulations for Preventing Collisions at Sea”, 1972 (COLREG).

7.2.9 Corrosion Protection

Corrosion protection shall consider exposure to saline and moisture air, extreme winds and waves associated with a harsh marine environment.

All exposed surfaces shall be protected by tried and tested marine paint coating systems applied to existing offshore oil and gas installations.

Corrosion protection is a major consideration for secondary wiring/terminals and SF6 seals on HV GIS equipment.

Corrosion protection for steel structure components located in the “atmospheric” and “splash” zones shall be in accordance with DNVGL-OS-C101.

7.2.10 Hazardous Substances

All hazardous substances used on the platform shall be managed and contained using standard control and monitoring systems. Depending on the nature of the leak, suitable containment systems (gas), level switches and separator tanks (oil) shall be installed.

Storage of hazardous substances shall be shall be confined to areas suitably located on the platform. These areas shall be segregated at a safe distance from occupant areas, escape routes and sources of ignition. A suitably assessed inventory of hazardous material shall include SF6, diesel, fire suppression gas, consumables, aviation fuel, etc. Items such as transformer oil and battery systems are not typically stored on the platform with the exception of maintenance periods.

7.2.11 Lightning Protection

The lightning protection design shall be assessed, dimensioned and installed in accordance with EN/IEC 62305 parts 1-4. The metallic structures located on the platform shall be used as part of the air termination and down conductor system.

7.2.12 Earthing

All exposed and extraneous conductive parts of the electrical installation shall be bonded to the main earthing system. An Earthing Study shall be carried out and shall include:

- calculation of required cross section for different components of earthing system with regard to thermal stress;
- determination of tolerable touch and step voltages;
- maintain tolerable limits in accordance with standards IEEE 80;
- determine impedance to earth of the earthing system;
- calculation of ground potential;
- environmental impact due to earth faults, e.g. risk to marine life, etc.

Aspects of the earthing protection requirements shall be in accordance with EirGrid Earthing and Lightning Protection Specification XDS-GFS-12-001**.**

7.2.13 System Studies

System studies carried out by the customer shall consider the following:

- short-circuit contribution levels from the transmission network;

- neutral treatment of the main power transformer(s) – the 110kV, 220kV and 400kV neutral points are typically earthed (direct) at selected locations on the network. However reactive compensation may require the installation of an auxiliary transformer (reactor) at the neutral point.

8 HIGH VOLTAGE SUBSTATION ELECTRICAL EQUIPMENT

8.1 HV SWITCHGEAR

To protect against exposure of live elements to the marine environment (atmospheric corrosion due to high humidity, condensation and pollution), installation of Gas Insulated Switchgear (GIS) equipment is required.

Alternative technologies such as AIS and MTS will not be considered. The HV switchgear type that shall be utilized is metal-enclosed SF6 (Sulphur Hexafluoride).

High voltage interface connections can be installed using cables (long runs) or gas insulated busbar (GIB) ducting for short runs. Connection type shall depend on current rating, turning radius, support structures, proximity to heat sources, cables, equipment sensitive to interferences and interface requirements.

The customer's HV GIS components and auxiliary equipment shall be designed and installed as outlined in EirGrid Specification XDS-GFS-25-001 for 110/220/400kV Gas Insulated Switchgear (GIS) for all components including but not limited to:

- Surge Arresters
- Circuit Breakers
- Disconnectors
- Fault Making Earthing Switches
- Maintenance Earthing Switches
- Current Transformers
- Voltage Transformers

The switchgear configuration, voltage and current ratings, shall be included in the project specific Single Line Diagram.

The design working life of all high voltage equipment should be designed to meet the design lifetime of the platform.

8.2 HV SUBMARINE CABLES

EirGrid Specification OCDS-GFS-00-001 outlines HV Submarine Cable requirements.

8.3 VIBRATIONS – PLANT AND EQUIPMENT

Equipment (primary and secondary systems) fatigue due to vibrations from wind and waves can affect the long term operating performance of electrical equipment.

In addition, vibration due to magnetostriction or "electric hum" from high power electrical devices (main transformers) can be transmitted to the platform causing maloperation of adjacent equipment. The effects of vibration from electrical sources can be dampened by installing special absorption anti-vibration pads consisting of non-resistive stiff rubber material.

The customer shall clearly demonstrate that the equipment and measures provided are designed to meet the vibrations effects due to wind and waves.

9 SUBSTATION SECONDARY SYSTEMS

Optimum design of the substation secondary systems shall consider the effect of failure modes (failure rate, time-to-repair, modularisation, etc.) and redundancy (N-1 contingency), particularly during periods of restricted access to the platform.

The scale of the design shall take into account the number of components, degree of complexity and flexibility. The working life of all secondary system equipment should be maximised to reduce the requirement for replacement during the design lifetime of the platform.

9.1 CONTROL AND PROTECTION

A human machine interface (HMI) with view only access should be installed at the onshore substation for the exclusive use of the System Operator and Transmission System Owner. This HMI design shall be suitable for upgrade to permit control functionality if required.

All protection relay requirements will be outlined in the project specific protection specification. Protection relay test sockets and connections shall be in accordance with the relevant elementary diagrams issued.

Protection relay test switches shall be in accordance with the relevant specification.

Control and Protection requirements for 110/220/400kV installations shall be in accordance with EirGrid specification XDS-GFS-06-001 where applicable.

9.2 DC AUXILIARY POWER SUPPLIES

A fully redundant DC system shall be provided to supply all associated load requirements during normal operating and standby periods.

The reliability of the DC power supply system shall consider the substation location, time taken to mobilize and access the substation, investment costs (primary and secondary plant) and level of protection required.

The battery and charger monitoring system shall be robust and provide indication of transition from normal to standby operation. The monitoring of supply restoration to all DC loads must also be provided.

The offshore substation shall provide for the following DC power supply requirements:

- All stations shall be provided with dual 220V and 24V/48V DC battery systems. Each system shall be duplicated and segregated both electrically and physically so that in the event of loss of one system the other supply shall be maintained and capable of supplying load. Each battery shall have a separate dedicated charger.
- For lead acid type battery installations (including charger, stands and fuse enclosures), the functional requirements shall be in accordance with EirGrid specification XDS-GFS-09-001, 110/220/400kV Station 220V, 48V and 24V Lead Acid Batteries and Chargers. Alternative solutions include sealed VRLA, and nickel-cadmium (both vented and sealed) type batteries;

- Suitable ventilation and filtration system for lead acid type battery installations;
- 48V DC battery and switched mode power supply (SMPS) for Telecoms requirements. The SMPS requires a 230V AC 32A rotary switch powered from the station AC board. The battery positive shall be earthed;
- Duplicate 220V DC distribution boards and a 24V/48V DC distribution board in accordance with EirGrid specification XDS-GFS-10-001, 110/220/400kV Station 220V/48V/24V DC and 230/400V/110V AC Distribution Boards.

9.3 LT Auxiliary Power Supplies

The station shall provide for the following **AC** power supply requirements:

- dual 400V supply (including back-up) from the main MV distribution board. The back-up source may be selected from the following options:
    - diesel generator;
    - inverter backed AC supplies;
    - fuel cells;
- 230/400/110V AC distribution board in accordance with EirGrid specification XDS-GFS-10-001.
- connection of a portable generator to the AC Distribution board through a changeover switch;

9.4 Telecommunication Systems

Telecommunication requirements shall be implemented using a fibre optic cable. The number of channels required for all communications shall be clearly communicated to the Export cable supplier for the design of the export cable.

- embedded in the submarine cable for three-core cable installations or
- separately installed for single core submarine installations;

The service availability and life of communications equipment located on the platform shall consider the physical environment, location of equipment, enclosure design, protective finish and electro-magnetic effects. A communications marshalling kiosk shall be provided close to the cable hang-off.

9.4.1 SCADA

A SCADA communications link to NCC and DCC shall be provided via the submarine fibre optic cable and onshore RTU interface.

9.4.2 Protection Communications

A high-speed direct fibre connection shall be installed to provide a communications path for the HV cable differential relays. A direct or multiplexed (Mux) fibre connection shall be provided for the impedance protection relays.

The Mux fibre protection scheme includes a single mode fibre via a Mux, fibre termination cabinet, Mux cabinet and relay interfaces.

9.4.3 VOICE

Radio systems (VHF band) are required for communications with boats, helicopters and rescue services. Use of back-up satellite or GSM mobile phone systems shall depend on the availability of mobile network coverage at the platform location.

9.4.4 DATA

Provision for electronic communications (email, internet, etc), measurement and metering data, video surveillance, engineering tools i.e. remote interrogation (fault analysis, protection relay settings) etc shall be provided.

9.5 TARIFF/REVENUE METERING

Tariff/Revenue Metering Current and Voltage transformers shall be provided for connection to Customer Revenue Meters. This equipment will be installed and located in the onshore network substation, details of which will be provided in the project specific operational specifications.

9.6 SECURITY

In the event of an abnormal condition on the platform, e.g. smoke / gas detection, activation of fire protection systems, plant failure, etc, an audible and visual alarm system is required to alert personnel in any location on the platform.

Strategic location of CCTV surveillance cameras facilitate the monitoring of staff, plant and planned/unplanned vessels approaching the platform, particularly from possible threat situations where an immediate response plan can be implemented.

9.7 NAVIGATION AIDS

Legislature requirements stipulate the provision of navigation aids and markings to minimize the risks of collisions from airborne and seaborne traffic. Relevant standards include:

- IMO Regulation “Convention on the International Regulations for Preventing Collisions at Sea”, 1972 (COLREG);
- DNVGL-ST-0145 “Offshore Substations”;
- IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) Recommendation O-139; “The Marking of Man-Made Offshore Structures” December 2013;

Navigation aids systems are required to have two independent power supplies. A change-over facility shall be provided in the event of a supply failure. Initiation of an alarm to NCC is required for a power supply fault.

9.8 FIRE PROTECTION

A methodology (HAZID analysis) detailing the fire protection strategy (safety philosophy and design principles) must be provided. The methodology shall also include the objectives set out by the

- Passive Fire Protection (PFP) system – prevention of fire escalation, protection of personnel (temporary safe area), structural integrity;
- Active Fire Protection (AFP) system – fire and gas detection systems, i.e. extinguishment and control, damage limitation, etc;

Installation of fire detection and fire alarm systems shall be in accordance with DNVGL-OS-D301 and EN 54.

9.9 Explosion Protection

Explosion protection detailing the measures (blast protection, explosion venting, etc.) adopted to reduce the probability of explosions/explosion loads, and probability of escalation must be provided.

Recommended Reference: **ISO 13702** Petroleum and natural gas industries - Control and mitigation of fires and explosions on offshore production installations - requirements and guidelines.

10 Commissioning Requirements

10.1 Pre-Commissioning

All plant and systems shall be pre-commissioned to best industry practice, ensuring that all plant and systems are installed correctly as per design, and are functionally operational. All pre-commissioning requirements shall be in accordance with a methodology submitted by the customer and the EirGrid Pre- commissioning Specification XDS-GFS-20-001.

The pre-commissioned plant and equipment shall be formally handed over to the relevant party for commissioning.

10.2 Commissioning: Pre-Energisation

All commissioning requirements shall be in accordance with a methodology submitted by the customer.

Everything that can be done onshore before the substation platform leaves the construction yard should be done so that only those activities which can only be performed offshore are left to be completed when the platform is installed on its foundation. The onshore testing should be as comprehensive as possible to identify any problems before the substation is transported.

Furthermore, all equipment should be as completely installed and assembled as possible onshore. Dismantling of any parts of the equipment for transport on the barge and the reassembling offshore should be avoided. The equipment needs to be designed such that it can withstand the forces which it will experience when being transported on the barge. This is particularly relevant to oil filling of transformers and gassing up of GIS switchgear equipment.

Equipment which has been thoroughly tested onshore shall be subjected to the minimal offshore testing to verify that the equipment has not been damaged in transit and that it is functioning correctly.

Certain activities such as submarine cable and fibre optic terminations shall be performed offshore.

10.3 COMMISSIONING: POST-ENERGISATION

A clear set of post-energisation checks (visual, audible, smell, touch, etc) as agreed with the equipment suppliers shall be conducted following commissioning of the equipment, cables and associated plant.

11 Appendix I: EirGrid References

1. EirGrid Specification XDS-GFS-00-001: 110/220/400kV Station General Requirements
2. EirGrid Specification OCDS-GFS-00-001: 110 kV, 220 kV & 400 kV Offshore Cable Functional Specification for IPP Projects.
3. EirGrid Specification XDS-GFS-12-001: Earthing and Lightning Protection
4. EirGrid Specification XDS-GFS-25-001: 110/220/400kV Gas Insulated Switchgear (GIS) Connected to the Transmission System
5. EirGrid Specification XDS-GFS-06-001: 110/220/400kV Control, Protection and Metering
6. EirGrid Specification XDS-GFS-09-001: 110/220/400kV Station 220V, 48V and 24V Lead Acid Batteries and Chargers
7. EirGrid Specification XDS-GFS-10-001: 110/220/400kV Station 220V/48V/24V DC and 230/400V/110V AC Distribution Boards
8. EirGrid Specification XDS-GFS-25-001 SAT250 Substation Control System for Contestable Built Substations
9. EirGrid Specification XDS-GFS-20-001: 110/220/400kV Pre-commissioning Requirements

12 APPENDIX II: NORMATIVE REFERENCES FOR OFFSHORE SUBSTATIONS

Reference	Title	Overview
DNVGL-OS-A101	Safety principles and arrangements	Provides general safety and arrangement principles for offshore units and installations
DNVGL-OS-C101	Design of offshore steel structures, general (LRFD method)	General guidance for design of offshore steel structures by load and resistance factor design method
DNVGL-OS-C401	Fabrication and testing of offshore structures	Provide a standard to ensure the quality of all welding operations used in offshore fabrication, through identifying appropriate welding procedures, welder qualifications and test methods
DNVGL-OS-C502	Offshore concrete structures	General guidance for design of offshore concrete structures by load and resistance factor design method
DNVGL-OS-D201	Electrical Installations	
DNVGL-OS-D202	Automation, Safety and Telecommunication Systems	
DNVGL-OS-D301	Fire protection	Fire protection for offshore structures
DNVGL-OS-E401	Helicopter decks	Design loads, load combinations, strength requirements, safety Requirements
DNVGL-ST-00145	Offshore Substations	General platform design guidance based on safety assessment principles

13 Appendix III: Informative References For Offshore Substations

Reference	Title
CIGRE Working Group B3.26 Technical Brochure 483	Guidelines for the Design and Construction of an AC Offshore Substations for Wind Power Plants
CAP 437	Standards for offshore helicopter landing areas
DNVGL-ST-0126	Support Structures for Wind Turbines
DNV Classification Note No. 30.6	Structural reliability analysis of marine structures
DNVGL-RP-B401	Cathodic Protection Design
DNVGL-RP-C204	Design against accidental loads
DNV-RP-C205	Environmental conditions and environmental loads
EN 54	Fire detection and fire alarm systems
EN 353	Personal protective equipment against falls from a height
BS EN 1990	Basis of Structural Design, CEN 2002
IEC 61892-7	Mobile and fixed offshore units - Electrical installations - Part 7: Hazardous areas
ISO 2394	General Principles on Reliability for Structures
ISO 9001	Quality management systems - Requirements
ISO 13702	Petroleum and natural gas industries - Control and mitigation of fires and explosions on offshore production installations - Requirements and guidelines
ISO 14122	Parts 1-4 - Safety of machinery - Permanent means of access to machinery
ISO 17776	Petroleum and natural gas industries - Offshore production installations – Guidelines on tools and techniques for hazard identification and risk assessment
ISO/DIS 19900	Petroleum and natural gas industries - General requirements for offshore structures
ISO 12944-9	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures
MODU Code	Mobile offshore drilling unit code
NORSOK M-120	Material data sheets for structural steel
NORSOK M-501	Surface preparation and protective coating
NORSOK N-004	Design of steel structures
SOLAS	International Convention for the Safety of Life at

	Sea, 1974, as amended
Douglas Sea Scale - used to define the sea state and wave height	
Beaufort Scale - used to identify wind speeds	

14 APPENDIX IV: SAFETY LEGISLATION

Reference
The Safety, Health and Welfare at Work Act 1989 and 2005 revised updated to 30 April 2018;
The Safety, Health and Welfare at Work (Construction) Regulations 2013;
The Safety, Health and Welfare at Work (General Application) Regulations 1993, 2007 & 2016;
S.I. No. 422/1981 — Safety in Industry (Diving Operations) Regulations, 1981;
Diving at Work Regulations 1997 (UK), ACOP Commercial diving projects inland/inshore;
Diving at Work Regulations 1997 (UK), ACOP Scientific and archaeological diving Projects;
Code of Practice for inland/inshore diving (Safety, Health and Welfare at Work (Diving at Work) regulations 2008) _DRAFT;