Document Reference: ODS-GFS-00-001-R2

Offshore Substation

General Requirements Specification

Revision History					
Revision	**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
R2	27/10/2020	• Updates incorporated from industry consultation	Mott MacDonald	Conor Farrell	Brendan Murray

GLOSSARY

Abbreviation	Definition
DCC	Distribution Control Centre
ECC	Emergency Control Centre
HV	High Voltage
LV	Low Voltage
NCC	National Control Centre
OSP	Offshore Platform
RTU	Remote Terminal Unit
SCADA	Supervisory, Control & Data Acquisition
TAO	Transmission Asset Owner
TSO	Transmission System Operator

1 Scope

The following functional specification is the EirGrid standard outlining general requirements applicable for High Voltage AC Offshore Substation connecting to the transmission system.

To clarify further, the components on the offshore platform (OSP) relating to the HV AC Offshore Substation is applicable. Customer Power Transformer and Medium Voltage switchboard is not specified by the TSO.

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.

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

For the purpose of this specification the term Customer shall refer to any party (Independent Power Producers, Transmission Asset Owner, or other developers) responsible for the design and build of assets for connection to the Irish transmission system.

2 Health and Safety Requirements

A design risk assessment (DRA) and management process (ISO or equivalent) is required to identify design risks due to specific potential hazards when designing and building the Offshore Substation.

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

A Formal Safety Assessment as outlined in DNV-ST-0145 "Offshore Substations" shall be conducted to ensure a systematic process is carried out identifying and evaluating hazards and managing risks.

As far as is reasonably practicable, 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. Single failures include realistic sequences or combinations of failures that result from a single common cause.

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

3 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 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.

4 NETWORK PARAMETERS

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

The Customer shall submit fully completed and signed Technical schedules for outlining the HV switchgear parameters to EirGrid for review in advance of equipment order.

All cable requirements are described in EirGrid Specification OCDS-GFS-00-001 110kV, 220kV & 400kV Offshore Cable Functional Specification.

Calculation of the offshore collector station voltage level is largely based on optimisation of the HV submarine cable and doesn't form part of this specification.

5 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 conditions. These include:

- hydrodynamic loads induced by waves and current;
- wave induced inertia forces;
- wind;

- earthquake;
- tidal effects;
- marine growth;
- snow and ice;

Bore sample shall be taken and a Geotechnical Interpretive Report for all climatic and meteorological conditions above shall be completed.

A site specific logistics plan shall be compiled considering at a minimum: weather conditions, access arrangements for personnel and cargo, asset / maintenance requirements and replacement plans for construction, operation and de-commissioning phases of the installation. The offshore platform design shall be undertaken with reference to this plan.

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 vulnerable 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 shall be selected from EN 62271-1 and consistent with the environment where the equipment is situated.

6 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.

6.1 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.

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 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;
  - electromagnetic fields

  - 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.

6.2 GENERAL DESIGN REQUIREMENTS

6.2.1 OPERATIONAL PHILOSOPHY

The system design shall 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.

6.2.2 RELIABILITY

The specified design working life of the platform shall be at least 40 years.

Structural reliability analysis 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.

6.2.3 LAYOUT

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

- Auxiliary transformer (neutral treatment);
- HV Gas Insulated Switchgear (GIS);
- HV Control & Protection Cabinets;
- DC Distribution Boards, Battery Chargers and Enclosures;
- LV Distribution Board;
- Communications Equipment;
- Battery Cells (220VDC , 48VDC and 24VDC);
- Emergency Overnight Accommodation;
- Temporary Refuge (incl. emergency food & water store) – this room may be the same as the Emergency Overnight Accommodation;
- MV Switchgear (not considered part of this document);
- Power transformers (not considered part of this document);
- LV Control & Protection, Battery, Distribution and Communication requirements;
- HVAC (heating, ventilating and air-conditioning) system;
- Storage area for portable devices and small spares shall be considered (e.g. trolleys, lifting frames, SF6 gas handling trucks etc);

This specification does not stipulate any specific layout requirements to cover shared ownership scenarios where the OSP may be accessible by more than one operator/owner.

The HV GIS switchgear equipment shall be located in a dedicated ‘HV GIS’ room. Adequate space shall be provided in the GIS room for cable termination, ongoing maintenance and for all potential repair and replacement and HV testing activities.

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

Space shall be included for LV and HV power cable routing, handling and termination.

Adequate spacing shall include provision for welfare facilities, back-up LV supply, reactors (if applicable), fire suppression system, platform auxiliary equipment (building services, water handling, drainage, etc), platform cranes and cable decks.

A Fire Suppression System shall be installed matching the outcomes of a Fire Risk Assessment to be undertaken by the customer.

An HVAC system shall be provided for temperature and humidity control. The system may be centralized or decentralized and shall be demonstrated to be suitable for operation within a marine environment.

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 SLD arrangement for the high voltage bays shall be outlined and agreed in the Customer's connection application.

6.2.4 ACCESS AND TRANSFER

Platform access and transfer shall be by sea (boat landing). Any provision for air access (heli-deck or heli-hoist) shall be considered on a project specific basis.

Approach to the platform may be constrained for significant periods due to adverse sea conditions (wave height, swells), wind speeds, weather etc.

The average year accessibility to the platform shall designed 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;

Statutory requirements shall be met regarding helicopter routes, life-boats and availability of secondary escape routes (i.e. ropes, ladders, access platforms, descent-to-sea systems) for evacuation purposes.

Procedures relating to cessation of works (post construction) due to high sea states should be assessed during the detailed design. The lifting equipment (lightweight cranes, hoist, etc) installed on the offshore platform should be designed to operate within the 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.

6.2.5 Accommodation

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

The offshore substation should at a minimum include:

- Protection from weather, vibration, noise and strong electromagnetic fields;
- Toilet facilities;
- Emergency water and food supplies;
- Temporary beds and sleeping bags;
- Desk space for working with computers.

The extent of the accommodation shall consider the offshore location, planned maintenance requirements, no. of persons, welfare facilities, etc.

The requirements will have an obvious impact on the platform layout and therefore should be clearly identified and defined by the customer at an early state to ensure the functionality is suitable and safely integrated into the design.

For NUIs where no overnight stays are planned, there should be adequate welfare facilities for the number of workers likely to be present. Sufficient emergency accommodation should be provided to account for the rare occasion when planned departure from the substation platform cannot be achieved. Temporary beds should be provided for the number of people expected to sleep in this scenario.

Further to the above, all necessary statutory requirements shall be met for provision for emergency overnight accommodation on the platform and shall also be met for provision of a temporary refuge area for a “distressed” (stranded) mariner.

6.2.6 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.

A site survey of the sea bed conditions is required to determine the rigidity of the platform and foundation and mitigate effects of vibrations.

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

6.2.7 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);
- 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, requiring 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) and shall align with good industry practice.

6.2.8 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).

6.2.9 CORROSION PROTECTION

Additionally to those requirements outlined in XDS-GFS-25-001, the following should be noted.

Aluminium alloys of the 2000 series are not suitable for use in Ireland due to accelerated corrosion (in outdoor locations) occurring with the high copper content of this alloy and shall not be permitted.

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

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

The Customer should ensure that all externally assembled flanges are treated following installation to C5-VH (previously C5-M according to ISO12944-2 2018) standard to eliminate moisture ingress.

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

Testing of materials and components proposed in accordance with NORSOK standards shall be included for components located outdoors in coastal locations or offshore as detailed in the enquiry documentation.

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

6.2.10 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 equipment, suitable containment systems (gas), level switches and separator tanks (oil) shall be installed to contain leaks as per relevant European agreements and standards.

Storage of hazardous substances 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.
The Customer shall declare all substances classified as hazardous material as outlined further in the EirGrid Functional Specification XDS-GFS-00-001.

6.2.11 LIGHTNING PROTECTION

The lightning protection design shall be assessed, dimensioned and installed in accordance with DNV-OS-D201. The metallic structures located on the platform shall be used as part of the air termination and down conductor system.

6.2.12 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 and demonstrated to be suitable for installation and operation in a marine environment.

6.2.13 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 HV neutral point;

Treatment of the MV neutral shall remain the responsibility of the Customer.

All other system studies required for the design of the substation shall also be undertaken by the customer. Any other system studies as required by the Grid Code and as requested in the TSO Connection Agreement shall also be carried out.

7 HIGH VOLTAGE SUBSTATION ELECTRICAL EQUIPMENT

7.1 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 (GIS) equipment indoor is required. Alternative technologies such as AIS and MTS will not be considered. The HV switchgear type that shall be utilized is metal-enclosed gas insulated type.

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 Specifications XDS-GFS-25-001 for 110/220/400kV Gas Insulated Switchgear (GIS) for all components including but not limited to:

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

Cable terminations shall meet the requirements as specified in OCDS-GFS-00-001.

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

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

7.2 HV SUBMARINE CABLES

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

7.3 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 customer shall demonstrate through calculation that risks associated with vibration due to magnetostriction or "electric hum" have been suitably mitigated.

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

8 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 shall be maximised to reduce the requirement for replacement during the design lifetime of the platform.

The environmental conditions shall be as specified in EN 60255-1.

8.1 Control and Protection

All protection, control and signalling requirements that are required from the offshore and onshore substations shall be outlined in the project specific operations specifications and signals lists.

EirGrid Control and Protection requirements for 110/220/400kV installations are contained in specification XDS-GFS-06-001.

8.2 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 transmission substations shall be provided with dual 220 V 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.
- 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.
- Suitable ventilation and filtration system for lead acid type battery installations;
- 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.

8.3 LV AUXILIARY POWER SUPPLIES

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

- dual 400V supply (including back-up) from the main 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;

The back-up supply shall cover essential loads on the platform and is not required to provide back-feed to the turbines.

8.4 CONDITION MONITORING

Condition monitoring shall be implemented where it provides a demonstrable reduction in maintenance requirements and is reliable in the offshore environment.

8.5 TELECOMMUNICATION SYSTEMS

Telecommunication requirements shall be implemented using a fibre optic cable either:

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

as per OCDS-GFS-00-001.

The number of channels required for all communications shall be clearly communicated to the Export cable supplier for the design of the export cable and shall include at least the number of fibres required, to be determined on a project specific basis.

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.

8.5.1 SCADA

All data from assets on the platform shall be collected via RTUs on the offshore platform to a SCADA system situated at the onshore substation. The SCADA system shall include at a minimum:

- Duplicated master-slave server
- Archiving
- Workstation
- Facilities for remote interrogation
- Facilities to interface with NCC and DCC as required.

8.5.2 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.

8.5.3 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.

8.5.4 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), condition monitoring etc. shall be provided.

8.6 TARIFF/REVENUE METERING

Tariff/Revenue Metering Current and Voltage transformers shall be provided for connection to 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.

8.7 CCTV AND SECURITY SYSTEMS

CCTV and associated security system shall be provided for remote monitoring of:

- The Personnel for safety reasons;
- Monitoring of vessel approaching the platform and;
- Monitoring of equipment.

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 accessible location on the platform is required.
The design of the system shall provide safety monitoring to comply with legislation enacted by the statutory authority responsible for offshore installations.
In the design and construction of the surveillance system, the reliability and availability of the system shall consider the climatic conditions envisaged.
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.

8.8 NAVIGATION AIDS

Statutory requirements shall be met regarding the provision of navigation aids and markings to minimize the risks of collisions from airborne and seaborne traffic.

Requirements as specified by CIL and IAA and any other relevant competent authority shall be met.

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.

8.9 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.

8.10 M&E Requirements

M&E Requirements shall be met as per EirGrid Specification XDS-GFS-14-001 and shall further be designed and demonstrated to be suitable for installation and operation in a marine environment.

8.11 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.

9 COMMISSIONING REQUIREMENTS

9.1 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 further requirements are outlined in 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.

9.2 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 installed and assembled as far as possible onshore. Dismantling of any parts of the equipment for transport and the reassembling offshore should be avoided if at all possible.

The equipment shall be designed such that it can withstand the forces which it will experience when being transported to the platform. 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 minimum offshore testing required 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.

9.3 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.

10 Appendix I: EirGrid References

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

11 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

12 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	

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;