Requirements for

Offshore Substations and Electrical Service Platforms

June 2023

REQUIREMENTS FOR

OFFSHORE SUBSTATIONS AND ELECTRICAL SERVICE PLATFORMS
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American Bureau of Shipping
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Foreword

Electrical Service Platforms are offshore installations with equipment installed onboard primarily for the transmission of power to an onshore substation or power grid serving other assets or locations.

This document is developed to provide requirements on the design, construction, and survey for Electrical Service Platforms. Requirements are outlined for the power supply for installed electrical equipment and devices, battery systems and distribution equipment installed on board.

This document is applicable to site-specific bottom-founded or floating installations for use as Electrical Service Platforms.

The following notations are offered to Electrical Service Platforms:

For Fixed Platforms:

- **Electrical Service Platform (Offshore Installation)**

For Floating Site Specific Platforms:

- **Electrical Service Platform (Hull Type)**

At the request of the owner, the optional notation **OSS** is offered to the power supply, transmission, battery systems and distribution equipment installed on an Electrical Service Platform solely intended for the installation's function as an offshore Substation.

This document is to be used in conjunction with other applicable Rules and Guides published by ABS, applicable recognized codes/standards and international Regulations.

The effective date of the document is the first day of the month of publication.

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CONTENTS

SECTION 1

Scope and Conditions of Classification

1 Classification

The requirements for conditions of classification are contained in the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*. Additional requirements specific to the offshore substation and electrical service platform are contained within this document.

2 Application

This document is applicable to new construction offshore electrical service platforms as defined in Subsection 1/10.

3 Scope

This document is intended to define classification requirements for the design, installation, and survey of electrical service platforms including substations as defined in Subsection 1/10 on bottom-founded and floating offshore electric service platforms.

This document contains requirements for

- Transmission substations where the transformation of the voltage level from an offshore power plant occurs. For example, transformation of 36 kV to 132 kV, or 150 kV or 220 kV to an onshore substation.
- The design, installation, and surveys (at manufacturer's facility, installation onboard, in-service inspections, annual, periodical surveys, etc.) of offshore substations, in areas of substation protection and control system, metering, remote monitoring, Supervisory Control and Data Acquisition (SCADA), communication systems, cybersecurity, fire protection systems, lightning protection, etc.
- Equipment and systems qualification such as energy storage systems (ESS), computer-based systems, power electronic converters, large power transformers, Medium Voltage (MV), High Voltage (HV) gas insulated switchgear equipment, circuit breakers for DC and AC systems, installed on the offshore electrical substations facilities.
- Fire and gas detection systems, public address/general alarm systems, obstruction/navigation lights, auxiliary systems, emergency source of power, etc. where required.

Export cables or transmission cables (aerial or subsea) to and from the electrical service platform are not within the scope of classification.

4 Class Notations

4.1 Electrical Service Platform

Site-specific installations complying with the requirements in Section 1 through Section 4, parts of Section 5 as referenced in 1/4.3, and Section 6 may be classed and distinguished in the ABS *Record* by adding the classification notation **Electrical Service Platform (Offshore Installation)** for bottom-founded platforms or **Electrical Service Platform (Hull Type)** for floating platforms, where (Hull Type) indicates the type of the floating hull represented by (Ship-Type), (Column-Stabilized), (Tension Leg), or (Spar-type). For example,

- **A1, Electrical Service Platform (Offshore Installation)**
- **A1, Electrical Service Platform (Ship-Type)**
- **A1, Electrical Service Platform (Column-Stabilized)**
- **A1, Electrical Service Platform (Tension Leg)**
- **A1, Electrical Service Platform (Spar-type)**

4.2 Offshore Substation

Upon request of the owner, an offshore substation in compliance with the applicable requirements in 1/4.1 above and Section 5 may be classed and distinguished in the ABS *Record* by the optional notation **OSS**. For example,

- **A1, Electrical Service Platform (Offshore Installation), OSS**
- **A1, Electrical Service Platform (Ship-Type), OSS**
- **A1, Electrical Service Platform (Column-Stabilized), OSS**
- **A1, Electrical Service Platform (Tension Leg), OSS**
- **A1, Electrical Service Platform (Spar-type), OSS**

Note:

The symbol ✠ {Maltese Cross} signifies that the installation or system is in compliance with ABS Rules and verified by ABS during construction of the installation. This includes survey of the machinery at the manufacturer's plant (where required), during installation on board and during trials.

Where an existing installation, not previously classed by ABS, is accepted for class, these class notations are assigned without the ✠ symbol.

4.3 Minimum Requirements

Where an installation is fitted with a substation, but the optional notation **OSS** is not requested, the minimum requirements prescribed in Table 1 below are also to be complied with.

TABLE 1
Minimum Requirements for the Electrical Service Platform without the Optional OSS Notation

Description	*Rules Reference*
General Arrangement and Equipment Layout Drawings	5/2.3
Risk Assessment	5/5

5 Plans and Data to be Submitted

For the **Electrical Service Platform** class notation, plans and documents specified in Subsections 2/1.1, 3/2, and 4/1, together with supporting calculations, as appropriate, are to be submitted for review.

For the optional class notation **OSS**, the submission of design plans and data as specified in Subsection 5/2 are also to be submitted for review in addition to the plans and documents specified for **Electrical Service Platform** notation.

5.1 Stability, Loading and Operating Information

Details of the ballast, hold arrangement and capacities, and fuel supplies where a power generator is installed are to be submitted. In addition, the distribution of fixed and variable weights for each reviewed condition, and information on all loaded and ballasted conditions in which the floating electrical service platform may be operated, are to be submitted.

In accordance with the requirements contained in Subsection 2/3, stability calculations demonstrating that the floating electrical service platform meets the stability criteria in all loading and ballast conditions are to be submitted for review.

Details are to be submitted for intended operating location and of any specific requirements based on applicable local/national codes and standards for review.

5.2 Operating Manual

An operating manual in accordance with Subsection 1/6 is to be submitted for review.

6 Operating Manual

An operating manual, consistent with the information and criteria upon which classification is based, is to be made available on board the electrical service platform for the guidance of the operating personnel. The operating manual is to include the following information, as applicable:

i) A general description of the substation, including incoming and outgoing voltage transformation levels, number of transformers, generators (if provided) and total admissible current for the switchgears

ii) Summaries of approved operation and maintenance conditions including:

- Limiting environmental conditions (e.g., wave height and period, wind velocity, current velocity, service temperature of the installation)
- Design deck loadings, mooring loads, icing loads, variable load, cranes, and types of helicopters for which the helideck is designed
- Identification of “Limited Service” conditions
- The design of the substation as it relates to the permissible safety distance and electric field strength for respective voltage levels to ensure the operator safety for daily operation and maintenance.

iii) Installation Information including:

- General arrangement drawings
- Watertight and weathertight boundaries, location of unprotected openings, and watertight and weathertight closures
- The fire extinguishing systems and equipment if installed onboard

iv) Guidance for planned and unplanned maintenance

v) The type of bus scheme and feeder connection and equipment as it relates to the requirements of operation and maintenance for meeting the system demands

vi) Guidance for the recommended sequence of emergency shutdowns, where applicable

vii) Power Transmission:

- Details on power transmission plant's electrical connections to the export cables to the onshore substation
- Details on the transmission plant's control, protection and communication system as it relates to the requirements of the system architecture and operation mode of AC transmission systems monitoring and associated safety systems
- Guidance on startup, normal, and emergency operating procedures
- Guidance on maintenance requirements
- Guidance on periodic testing and maintenance requirements
- Details of the substation's earthing system as it relates to the daily operation and maintenance, including details of how the step potential and touch potential of the earthing system are limited to a permissible value

The Operating Manual is to be in the language or languages required by the Flag State. If the language is not English, a translation into English is to be included and submitted to ABS.

The Operating Manual is to be submitted for review by ABS. ABS' review is solely limited to verifying that the document contains all the above information and that the technical details are consistent with the design information and limitations considered in the classification of the electrical service platform/ substation transmission. ABS will not review operational guidance and is not responsible for the operation of the installation.

Note:

The administration may require that additional information be included in the Operating Manual.

7 Alternative Arrangements and Novel Designs

7.1 Alternative Arrangements

ABS will consider alternative arrangements and designs that can be demonstrated, through either satisfactory service experience or a systematic analysis based on sound engineering principles, to meet the overall safety, serviceability, and design standards of this document.

7.2 Novel Designs

Electrical service platform/ offshore substations with power supply & distribution systems and equipment that contain novel designs to which the provisions of this document are not directly applicable may be classed, when approved by ABS, on the basis that the requirements in this document, insofar as applicable, have been complied with and that special consideration has been given to the novel design, based on the best information available at that time. For more information on novel designs and concepts, refer to the ABS *Guidance Notes on Review and Approval of Novel Concepts*.

8 Administration Requirements and National Standards

Requirements additional to those given in this document may be imposed by the flag Administration with whom the installation is registered or by the Administration within whose territorial jurisdiction the electrical service platform is intended to operate.

Approval of structural fire protection, fire extinguishing equipment, and/or stability of the electrical service platform by the Administration, in accordance with requirements equivalent to those by Class, may be considered as complying with the Class requirements provided such approval can be satisfactorily documented.

Additionally, for transmission systems and equipment:

i) ABS will consider arrangements or designs of equipment, components, systems, or subsystems that can be shown to comply with the relevant codes/standards recognized in the country, provided the proposed codes/standards are no less effective.

ii) When alternate standards are proposed, comparative analyses are to be provided to demonstrate an equivalent level of safety as those required by this document.

9 Industry Standards

Where applicable, requirements may be imposed by ABS in addition to those in the industry standards to meet the intent of the document. In all cases, the safety system is subject to design review, survey during construction, tests and trials, as applicable, by ABS for purposes of verification of compliance with the industry standard.

10 Definitions

- *Accommodation spaces (Living quarters):*
  - Spaces used for public spaces, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, pantries containing no cooking appliances, and similar spaces.
  - Public Spaces are those portions of the accommodation which are used for halls, dining rooms lounges and similar permanently enclosed spaces.
- *Air Insulated Switchgear (AIS):* Switchgear whose bays consist entirely of AIS technology components. Substations containing dead-tank circuit breakers are also considered to be AIS substations.
- *Auxiliary Services System:* All support systems (e.g., fuel oil system, lubricating oil system, cooling water system, compressed air, electrical systems and hydraulic systems, etc.) which are required to operate the installation as an electrical service platform.
- *Auxiliary Power System:* The power system provided to power all support systems (e.g., fuel oil system, lubricating oil system, cooling water system, compressed air, electrical systems and hydraulic systems, etc.) which are required to operate the installation as an electrical service platform.
- *Battery System:* A system composed of a battery energy storage device, a converter (if necessary), controls, and ancillary components and equipment, including a battery management system (BMS). It is capable of delivering/capturing electrical energy to/from a load at the required voltage and rate (power) and can accommodate the load rate change of power.
- *Blackout:* A situation in which the main and auxiliary machinery installations, including the main power supply, are out of operation but the services for bringing them into operation (e.g., compressed air, starting current from batteries, etc.) are available.
- *Battery Management System (BMS):* An electronic system possessing a battery module/pack that can cut power in case of overcharge, overcurrent, over-discharge, and overheating. It monitors and/or manages its state, calculates secondary data, reports that data, and/or controls its environment to influence the battery's safety, performance, and/or service life. [Refer to IEC 62619]

- *Bottom Founded Platform:* A buoyant or non-buoyant platform, supported by or attached to the sea floor. Examples include fixed platforms characterized as pile supported or gravity platforms and various forms of compliant structures.
- *Centralized Control and Monitoring Station (CCMS):* A control station on the installation fitted with instrumentation and control systems enabling machinery to be controlled and monitored without requiring regular local attendance.
- *Column-Stabilized Floating Platform:* Platforms consisting of surface piercing columns, submerged pontoons and a deck supported at column tops. Buoyancy is provided by the submerged pontoons, surface piercing columns and braces, if any.
- *Control Room:* A location where controllers or actuators are fitted with monitoring devices, as appropriate, for purposes of effecting desired operation of specific machinery.
- *Corona:* A localized incomplete dielectric failure; it may cause a hissing sound. It occurs when a high value of electric field strength at a conductor surface causes the air to become electrically ionized and conduct.
- *Cylindrical Hull:* An alternative to a ship-shaped hull in terms of its functionality. Its geometry is similar to a spar platform. The requirements for ship-shaped platform and spar platform are to be followed where appliable.
- *Distribution Substation:* A combination of switching, controlling, and voltage step-down equipment arranged to reduce sub-transmission voltage to primary distribution voltage for the final industrial or commercial loads.
- *Dead-tank Circuit breaker:* A circuit-breaker with interrupters in an earthed metal tank.
- *Electrical Service Platform:* An installation where electrical service/substation equipment is installed for the purpose of transferring or distributing electrical power externally to an onshore substation or power grid.
- *Energy Management System (EMS):* A computerized control system designed to regulate the energy consumption of a vessel by controlling and monitoring the operation of energy storage systems, electrical loads and the production of power. The system can monitor environmental, and system loads and adjust operations in order to optimize energy usage and respond to demand conditions. For the purpose of this document, the EMS can also have similar functionalities as a PMS.
- *Energy Storage System (ESS):* A system composed of an energy storage transformation device, a converter (if necessary), controls, and ancillary components and equipment. It is capable of delivering/capturing electrical energy to/from a load at the required voltage and rate (power) and can accommodate the load rate of change of power.
- *Export Cable:* A cable connecting the offshore substation to the onshore system grid or other offshore substations or platforms used to export power from the power plant.
- *Floating Platform:* Floating platforms include column-stabilized, spar-type, tension leg platform (TLP)-type, ship-type floating platforms and other configurations of floaters. The platforms are attached to the sea floor using moorings, tendons and other means.
- *Hazardous Area:* An area where flammable or explosive gases, vapors, or dust are normally present or likely to be present.
- *High Voltage:* The nominal system voltage in the range from 1 kV AC to 15 kV AC and above 1.5 kV DC to the offshore substation.
- *Gas Insulated Switchgear (GIS):* Switchgear whose bays consist entirely of GIS technology components. Only external HV connections to overhead or cable lines or to transformers, reactors and capacitors can have external insulation.
- *J-tube:* A vessel's hull structural support interface with the power cable system. It is a J-shaped tube mounted inside or outside the substructure to guide a cable between the seabed and the cable deck on the topsides. The purpose is to protect the cable from environmental loads (wave, current, wind, etc.)

- *Low Voltage:* The nominal system voltage up to and including 1 kV AC and 1.5 kV DC to the offshore substation.
- *Manned Facility:* A facility with permanent occupied living accommodations or one that requires continuous presence of personnel for more than 12 hours in successive 24-hour periods.
- *Main Power Systems (Substation Equipment):* Equipment necessary to receive the incoming power from the offshore wind or solar power plants and transform or convert the power for export to onshore receiving substation.
- *Mixed Technology Switchgear (MTS):* Switchgear whose bays consist of both AIS and GIS technology components. Switchgear, that consists of bays where some of the bays are made of AIS technology components and some of the bays are made either of GIS technology components only or of a mix of AIS and GIS technology components.
- *Point of common coupling (PCC):* The connection point to the onshore grid, at the individual turbines, or at the connection point to an offshore substation.
- *Point of Interconnection (POI):* A physical location where the offshore substation is connected to the onshore grid, or another substation or receiving facility. A POI can be considered as a machinery space of category A.
- *Power Management System (PMS):* A complete switchboard and generator control system which controls and monitors power generation and distribution including multiple switchboards and ring bus systems. The PMS on board a vessel is responsible for functions such as load sharing among different power sources, load shedding, and starting reserve generators when power is insufficient. For the purpose of these Requirements, the PMS can also have similar functionalities as an EMS.
- *Power Plant Systems:* Industrial equipment provided onboard for power generation, battery systems for electric power storage and distribution externally of electric power to shore or other vessels.
- *Remote Control and Monitoring Station (RCMS):* A designated, normally attended, and permanent control station fitted with means of remote control and monitoring of cargo and machinery related to essential systems on the installation. In the context of these Requirements, RCMSs are not located on the subject installation but rather the associated onshore substation or a manned platform nearby.
- *Ship-type platform:* Ship-type platforms are single displacement hulls, either ship-shaped or barge-shaped, which have been designed or converted to a floating production and/or storage system. They may have propulsion machinery and/or station keeping systems.
- *Smart Functions:* Systems installed and services deployed to continuously collect, transmit, manage, analyze, and report data for enhanced health and condition awareness, operational assistance, operational optimization, and decision-making support.
- *Spar-type platform:* Deep draft, vertical floating structures, usually of cylindrical shape, supporting a topside deck and moored to the seafloor. The hull can be divided into upper hull, mid-section and lower hull.
- *Special Purpose Equipment:* Special purpose equipment is equipment aboard used to perform an intended specific industrial work function.
- *Substation:* An assemblage of equipment (e.g., switches, interrupting devices, circuit breakers, buses, and transformers) through which electric energy is passed for the purpose of distribution, switching, or modifying its characteristics.
- *Tension Leg Platform:* Platforms which are vertically moored, buoyant structural systems wherein the excess buoyancy of the platform maintains tension in the mooring system. TLPs consist of buoyant pontoons and columns, a column top frame or a topside deck and a tendon system with its seafloor foundations.
- *Transmission Substation:* A combination of switching, controlling, and voltage step-down equipment arranged to reduce transmission voltage to sub-transmission voltage for distribution of electrical energy to distribution substations. Transmission substations frequently have two or more large transformers, and often function as bulk power distribution centers.

- *Ultra-High Voltage:* The nominal system voltage above 15 kV AC to and from the offshore substation.
- *Unmanned Facility (Normally Unattended Installation):* A Facility without permanent occupied living accommodations or which is fitted with an office/rest compartment/deck house that lacks the continuous presence of personnel for more than 12 hours in successive 24 hour periods.

11 Abbreviations and Acronyms

- *AC:* Alternating Current
- *AIS:* Air Insulated Switchgear
- *ATS:* Automatic Transfer Switch
- *BMS:* Battery Management System
- *CCMS:* Centralized Control and Monitoring Station
- *CCTV:* Closed Circuit Television
- *DC:* Direct Current
- *EMS:* Energy Management System
- *ESD:* Emergency Shutdown System
- *ESS:* Energy Storage System
- *FMEA:* Failure Modes & Effects Analysis
- *GIS:* Gas Insulated Switchgear
- *GS:* Metal Clad Switchgear
- *GPR:* Ground Potential Rise
- *MTS:* Mixed Technology Switchgear
- *OS*: Operation System
- *RCMS:* Remote Control and Monitoring Station
- *SCADA:* Supervisory Control and Data Acquisition
- *SOLAS:* the International Convention for the Safety of Life at Sea
- *UPS:* Uninterrupted Power Supply
- *UHV:* Ultra High Voltage

12 References

12.1 ABS Publications

- ABS *Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*
- ABS *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways (River Rules)*
- ABS *Rules for Building and Classing Mobile Offshore Units (MOU Rules)*
- ABS *Rules for Building and Classing Floating Production Installation (FPI Rules)*
- ABS *Rules for Building and Classing Offshore Installations (Offshore Installations Rules)*
- ABS *Rules for Materials and Welding (Part 2)*
- ABS *Rules for Survey After Construction (Part 7)*
- ABS *Requirements for Autonomous and Remote Control Functions*

- ABS *Requirements for Hybrid Electric Power Systems*
- ABS *Requirements for Position Mooring Systems*
- ABS *Requirements for Power Service for Marine and Offshore Applications*
- ABS *Requirements for Use of Lithium-ion Batteries in the Marine and Offshore Industries (Lithium-ion Batteries Requirements)*
- ABS *Guidance Notes on Alternative Design and Arrangements for Fire Safety*
- ABS *Guidance Notes on Review and Approval of Novel Concepts*

12.2 Industry Codes and Standards

- API Recommended Practice 2A-WSD: *Planning, Designing, and Constructing Fixed offshore Platforms – Working Stress Design*
- MODU Code: *IMO Code for the Construction and Equipment of Mobile Offshore Drilling Units*
- FSS Code: *International Code for Fire Safety Systems*
- SOLAS: *International Convention for the Safety of Life at Sea, 1974, as amended*
- NFPA Codes/Standards : *National Fire Protection Association Codes/Standards*
- NFPA 70: *National Electrical Code*
- IEC 62619: *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*
- IEC 62620: *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications.*
- IEC TS 63042-201: *UHV AC Transmission System – Part 201: UHV AC Substation Design*
- CIGRE-TB 483: *Guidelines Design and Construction - AC Offshore Substations - Wind Power Plants*
- BSEE Project Number: E14PC00006: *Offshore Substation Design Development of Standards*

SECTION 2

Hull Construction and Equipment

1 General

This section provides requirements for hull construction, foundation and position keeping systems of Electrical Service Platforms.

In addition to these *Requirements*, the following ABS Rules are to be complied with where appliable,

i) *Offshore Installations Rules,* for bottom-founded electrical service platforms

ii) *FPI Rules*, for floating electrical service platforms

The structural design is to meet the criteria specified in the following ABS Rules. In general, the design requirements of these Rules are specified in terms of a Working Stress Design (WSD). ABS will give special consideration to the use of alternative specification formats, such as those based on probabilistic or semi-probabilistic limit state design concepts. Alternative structural design criteria in a Load and Resistance Factor Design (LRFD) format are provided in the ABS *Guide for Load and Resistance Factor Design* (LRFD) Criteria for Offshore Structures. In general, WSD and LRFD criteria are not to be combined or mixed within the analysis.

i) Bottom-founded electrical service platforms: Part 3, Chapter 2 of the *Offshore Installations Rules*

ii) Ship-type floating electrical service platforms: Part 5A, Chapter 3 of the *FPI Rules*.

iii) Column-stabilized floating electrical service platforms: Section 5B-1-2 of the *FPI Rules*

iv) Tension leg floating electrical service platforms: Section 5B-2-3 of the *FPI Rules*

v) Spar-type floating electrical service platforms: Section 5B-3-3 of the *FPI Rules*

For bottom-founded electrical service platforms, the geotechnical design of foundations is to be in accordance with Section 3-2-5 of the *Offshore Installations Rules*.

For a floating electrical service platform, a position mooring system is required to keep the installation on station at a specific site. The mooring system design is to comply with the ABS *Requirements for Position Mooring Systems*.

1.1 Plans and Data to be Submitted

All applicable design documentation, such as reports, calculations, plans and other documentation necessary to verify the design of the electrical service platform and its foundation or position mooring system are to be submitted to ABS for review and approval. The submitted design documentation is to include the design environmental conditions. The following additional details are to be submitted:

a) Materials and corrosion control systems as noted in Subsection 2/2

b) Intact and damage stability calculations for floating installations

c) Strength and fatigue assessment as noted in 2/5.3

d) Global performance analysis as noted in Subsection 2/6

For bottom-founded electrical platforms, the requirements on plans and design data to be submitted in Section 1-1-4 of the *Offshore Installations Rules* are to be complied with, where appliable.

For floating electrical platforms, the requirements on plans and design data to be submitted in Section 1-1-4 of the *FPI Rules* are to be complied with, where appliable.

2 Materials and Welding

2.1 Structural Steels

The materials used for the construction of electrical service platforms are to meet the requirements specified in the ABS *Rules for Materials and Welding (Part 2)*. All materials are to be suitable for intended service conditions, they are to be of good quality, defined by a recognized specification and free of injurious imperfections.

Details of corrosion control systems (such as coatings, sacrificial anodes or impressed current systems) are to be submitted with adequate supporting data to show their suitability. Such information is to indicate the extent to which the possible existence of stress corrosion, corrosion fatigue, and galvanic corrosion due to dissimilar metals is to be considered. Where the intended sea environment contains unusual contaminants, any special corrosive effects of such contaminants are also to be considered. Appropriate coatings are to be used to achieve satisfactory corrosion protection for miscellaneous parts such as bolts and nuts.

3 Stability

For a floating offshore electrical service platform, the intact and damage stability is to be evaluated in accordance with the *FPI Rules*.

4 Positioning Systems

For a floating electrical service platform, a mooring system is to be provided to keep the platform on position. The mooring system is to meet the following requirements:

i) Mooring system design: ABS *Requirements for Position Mooring Systems*

ii) Installation, hook-up and commissioning: Part 3, Chapter 4 of the *FPI Rules*.

iii) Surveys during construction, installation and commissioning: Subsection 6/2

iv) Surveys after construction: Subsection 6/3

5 Electrical Service Platform Design Consideration

5.1 General Design Basis

The platform structure is to be designed to meet the safety and operability requirements during their design life at the project site, transit, and installation. The consideration includes the following:

i) Serviceability

ii) Strength

iii) Fatigue

The serviceability limits and design life of the platform are specified by the owner/operator. The serviceability limits may include:

i) Excessive motions and accelerations

ii) Structural deflections and deformations

The strength limit includes the structural failures under design environmental loads and design operational loads. The design assessment can be performed through a direct analysis approach or model tests if applicable.

5.2 Environmental Conditions

For bottom-founded electrical service platforms, the environmental criteria are provided in Section 3-1-2 of the *Offshore Installations Rules* for environmental design criteria.

For floating electrical service platforms, the environmental criteria are provided in Section 3-2-4 of the *FPI Rules*.

5.3 Strength and Fatigue Life

Strength assessment includes hull structure, topside structures, supporting structure and interface structures. The assessment includes yielding, buckling and ultimate strength for design environment conditions and design operation conditions. Where applicable, punching shear is to be evaluated.

Fatigue assessment is to be carried out for platform structural members using site specific environmental conditions.

ABS Rules provided in Subsection 2/1 are to be followed in the strength and fatigue assessment.

6 Global Performance Analysis

The global performance analysis for a floating electrical service platform is aimed at determining the global effects of environmental loads on the overall platform structure and its components. The key function of the analyses is to establish that the platform meets all the preservice and in-service requirements. The global response analysis is to be performed for each of the most critical design phases. The following aspects are to be included in the global performance analysis:

i) Platform motions and accelerations in six degrees of freedom

ii) Static and dynamic loads

iii) Deck clearance or air gap

iv) Mooring line tensions, including the maximum and minimum tensions and mooring line fatigue life for floating substations, where appliable

v) Tendon tension and fatigue life, where appliable

vi) Pile holding capacity where applicable

For analysis methodology, refer to the *FPI Rules*.

SECTION 3

Machinery, Piping and Electrical Systems

1 General

This Section is applicable to machinery, piping, and electrical systems utilized to support the electrical service platform/offshore substation operations, excluding the main power plant systems which is covered in Section 5 of this document. The ABS Rule set, as noted in Subsection 2/1, as applicable for the installation's notation, applies in full for machinery, piping, and electrical systems, except as modified herein.

For ship type electrical service platforms/substations installations, the applicable requirements in the *Marine Vessel Rules* are to be complied with. For electrical service platforms/substations and offshore installations other than ship type, the applicable requirements in Section 4-1-2, Part 4 Chapter 2, Part 4 Chapter 3 and Part 6 of the *MOU Rules* are to be complied with.

1.1 Summary of Minimum Requirements for Manned and Unmanned installations

Where the installation is expected to be manned or unmanned, Table 1 shows the minimum requirements for each installation type.

TABLE 1

Description	***Reference in this document***[1]			
	Floating Platforms Requirements		***Fixed Platform Requirements***	
	Manned	***Unmanned***	***Manned***	***Unmanned***
Machinery Systems	3/3.1	3/3.1	3/3.1	3/3.1
Marine Piping systems	3/3.2.1	3/3.2.2	3/3.2.1	3/5.3.2
a) Bilge System	See note 1	3/3.2.2 a)	See note 1	3/3.2.2 a)
b) Ballast System	See note 1	3/3.2.2 b)	See note 1	See note 1
c) Vents and Sound	See note 1	3/3.2.2 c)	See note 1	3/3.2.2 c)
Electrical Systems	3/3.3	3/9.1	3/3.3	3/9.1
Marking and Instructions	3/3.3.1	3/3.3.1	3/3.3.1	3/3.3.1
Accommodation Spaces	3/3.3.2	See note 1	3/3.3.2	See note 1
Lighting System	3/3.3.3	3/9.1.3	3/3.3.3	3/9.1.3

Description	*Reference in this document*[1]			
	Floating Platforms Requirements		*Fixed Platform Requirements*	
	Manned	*Unmanned*	*Manned*	*Unmanned*
Internal Communication: *a)* Public address and General Alarm system *b)* Voice Communication System	3/3.3.4 See note 1	See note 1 N/A	3/3.3.4 See note 1	See note 1 N/A
Lightning Protection	3/3.3.5	3/3.3.5	3/3.3.5	3/3.3.5
Cable Termination and Protection	3/3.3.6 through 3/3.3.11	3/3.3.6 through 3/3.3.11	3/3.3.6 through 3/3.3.11	3/3.3.6 through 3/3.3.11
Helicopter Facilities	3/3.4	3/3.4	3/3.4	3/3.4
Supply Voltage	3/3.5	3/3.5	3/3.5	3/3.5
Power System Capacity	3/3.6	3/9.1.1	3/3.6	3/9.1.1
Electrical Power Distribution for Auxiliary System	3/3.7	3/3.7	3/3.7	3/3.7
Power Quality	3/3.8	3/3.8	3/3.8	3/3.8
Emergency Power System	3/3.9	3/9.1.2	3/3.9	3/9.1.2
Earthing	3/4	3/4	3/4	3/4
Systems powered by Substation and/or battery Systems	3/5	3/5	3/5	3/5
Prime Movers and Generators	3/6	3/6	3/6	3/6
Control and Instrumentation	3/7	3/7.4	3/7	3/7.4
Equipment	3/8	3/8	3/8	3/8
Safety System	4/1 through 4/3	4/1 through 4/3	4/1 through 4/3	4/1 through 4/3
Structure Fire Protection	4/3.1	4/3.1	4/3.1	4/3.1
Lifesaving Appliances	4/4	4/4	4/4	4/4
Survival Craft	4/4.1	See note 1	4/4.1	See note 1
Rescue Boats	4/4.2	See note 1	4/4.2	See note 1
Personal Life-Saving Appliances	4/4.3	4/4.3	4/4.3	4/4.3
Survival craft stowage, Embarkation and Launching Arrangements	4/4.4	See note 1	4/4.4	See note 1
Radio Communication	4/4.5	See note 1	4/4.5	See note 1
Emergency Shutdown	4/5.1	4/5.2	4/5.1	4/5.2
Lithium-ion Battery Systems	4/6	4/6	4/6	4/6

Notes:

1 If an item doesn't have any Rules section identified, the requirements for that item as prescribed in the following rules are to be complied with as applicable.

a) ABS *Rules for Building and Classing Offshore Installations (Offshore Installations Rules),* for bottom-founded electrical service platforms.

b) The applicable requirements in 4-1-2, Part 4 Chapter 2, Part 4 Chapter 3 and Part 6 of the *MOU Rules* are to be complied with.

2 Plans and Data to be Submitted

i) Machinery Systems

a) Plans showing the general arrangement of all machinery spaces are to be submitted for review and approval.

b) Hazardous area Plan and Equipment Data as detailed in 4-8-1/5.3.2 of the *Marine Vessel Rules* or 4-3-3/1.5 of the *MOU Rules* are to be submitted for review and approval

ii) Piping Systems

The following plans are to be submitted for review as referenced in 4-6-1/9 of the *Marine Vessel Rules* or 4-2-1/7 of the *MOU Rules*, as applicable

a) Substation machinery space arrangement, including locations of fuel tanks

b) Booklet of standard details (see 4-6-1/9.5 of the *Marine Vessel Rules* or 4-2-1/7.5 of the *MOU Rules*)

c) Compressed air system

d) Cooling water systems

e) Exhaust piping (for boilers, incinerators, and engines)

f) Fuel oil systems, including storage tanks, drip trays, and drains

g) Hydraulic and pneumatic systems

h) Lubricating oil systems

i) Sea water systems

j) Vent, overflow, and sounding arrangements

k) Steam systems and steam piping analyses, as applicable

l) Tank venting and overflow systems

iii) Electrical Systems

a) Submittal items as detailed in 4-8-1/5 of the *Marine Vessel Rules* or 4-3-1/5 of the *MOU Rules* as applicable

b) Short Circuit Data submittals as documented in 4-8-1/5.1.3 of the *Marine Vessel Rules* or 4-3-2/1.3 of the *MOU Rules*

c) Protective Device Coordination Study submittals as documented in 4-8-1/5.1.4 of the *Marine Vessel Rules* or 4-3-2/1.5 of the *MOU Rules*

d) High Voltage Systems submittals as documented in 4-8-1/5.1.7 of the *Marine Vessel Rules* or 4-3-2/1.9 of the *MOU Rules*. High voltage in this document refers to nominal voltages above 1 kV AC up to 15 kV AC and above 1500 V for DC. For voltages exceeding 15 kV AC and 1.5 kV DC, documentation is to be in accordance with recognized industry standards acceptable to ABS

e) Installation plans submitted as documented in 4-8-1/5.3 of the *Marine Vessel Rules* or 4-3-3/1 of the *MOU Rules*

f) Electrical Equipment submittals as documented in 4-8-1/5.5 of the *Marine Vessel Rules* or 4-3-3/3 of the *MOU Rules*

iv) Inspection, Testing and Trials Test Plan

A Test Plan for the Electrical Service Platform/Offshore Substation installation and systems is to be submitted to the ABS engineering review office at the start of the plan review process. The test plan is to identify all equipment and systems of the substation detailed in the subsections of these requirements and list all performance tests and trials. In addition, the Test Plan is to include all the control, monitoring, fire and safety systems and procedures that are to be verified and tested during Construction and Initial survey.

3 System Requirements

3.1 Machinery System Requirements

3.1.1 Machinery Space

The general arrangements of all machinery spaces as defined in 4-1-1/1.9.2 of the *Marine Vessel Rules* or 4-3-2/1.9.4 and 4-3-2/1.9.5 of the *MOU Rules* are to denote at least the following:

i) The layout of the machinery space with essential auxiliaries, specifications of main equipment with information on manufacturer's name, type, rating, and number of the equipment

ii) General arrangement of the switchboards and distribution boards

3.1.2 Auxiliary Services

Any equipment (including cables and pipes) supporting essential services as defined in 4-8-1/7.3.3 of the *Marine Vessel Rules* or 4-1-1/3.5 of the *MOU Rules* is to be arranged so as to prevent loss of such essential services in the event of an incident.

3.1.3 Electrical Power for Auxiliary Services

Where power supply to the electrical service platform is also provided by the grid, in the event of loss of grid power, to safeguard continuity of electrical supply from the electrical service platform's generator or batteries to the required electrical service platform's loads, automatic load-shedding of the substation loads or other equivalent arrangements are to be provided.

3.1.4 Hazardous Areas

Both manned and unmanned electrical service platforms may have hazardous areas due to permanent or temporary equipment onboard required for marine or offshore operations such as machinery utilizing gas or other low flash point fuels, and batteries used for energy storage. The area where such equipment will be installed is to be considered as a hazardous area, and electrical equipment, ventilation, and access to adjacent spaces in this area are to comply with the applicable requirements in Part 5C Chapter 13 of the *Marine Vessel Rules*.

Where electrical service platforms are using gas or other low flash point fuels for power supply for onboard electrical equipment, the hazardous areas due to permanent or temporary equipment onboard for such operation are to be determined based on acceptable recognized codes / standards or as per applicable requirements in Part 5C, Chapter 13 of the *Marine Vessel Rules* or 4-3-3/3.7 of the *MOU Rules*.

For electrical service platforms installations, the requirements in 4-8-4/27 of the *Marine Vessel Rules* or 4-3-6 of the *MOU Rules*, as applicable, are to be complied with.

3.2 Piping Systems Requirements

3.2.1 Piping Systems Requirements for Manned Installations

Each electrical service platform/substation piping systems requirements for manned installations is to be in accordance with Part 4 Chapter 2 of the *MOU Rules* as applicable.

3.2.2 Piping Systems Requirements for Unmanned Installations

3.2.2(a) Bilge System

Where the installations are fitted with below deck machinery spaces or where fixed piping systems are led through void spaces, a satisfactory means is to be provided capable of pumping from and draining such spaces. This means may be by use of suitable hand pumps through fixed bilge piping arrangements or by means of portable power-driven pumps stored onboard. All pumps and arrangements for pumping are to be readily accessible. Alternate arrangements will be considered for installations possessing special conditions.

3.2.2(b) Ballast System

Ballast systems are to meet the requirements in 4-2-4/11 of the *MOU Rules*, as applicable.

The system fitted is to provide the capability to ballast and deballast all ballast tanks that are not used as permanent ballast tanks.

For Floating type installations, at least two ballast pumps are to be provided, one of which is to be permanently connected to the ballast system. The second pump may be a spare held in reserve or an eductor type arrangement permanently connected to the system. If submersible ballast pumps are installed in each ballast tank, one spare pump is to be stored onboard at all times.

The normal or emergency operation of the ballast system is not to introduce a greater risk of progressive flooding due to the opening of hatches, manholes, etc. in watertight boundaries. Where ballast pipes pass through deep tanks, means are to be provided to prevent the flooding of other spaces in the event of a pipe breaking or joint leaking in the tanks.

3.2.2(c) Vents and Sounds

Except for those compartments that are not fitted with a fixed means of drainage, vent pipes are to be fitted on all tanks, cofferdams, voids, tunnels and compartments which are not fitted with other ventilation arrangements in accordance with 4-2-3/1 of the *MOU Rules*.

The requirements for sounding are to comply with the *MOU Rules*. However, to prevent duplication of pipe runs, it is acceptable to sound the void spaces through the vent lines. For sealed vents, a sounding plug is to be provided to permit void space sounding.

3.3 Electrical Requirements for Onboard Installation

3.3.1 Marking and Instructions

All entrances to spaces containing high and ultra-high voltage equipment are to have suitable markings indicating the danger of high voltage and the maximum voltage inside the space.

Where the spaces contain high voltage switchgear, the marking at the entrances is also to include marking indicating that the space is accessible to authorized personnel only.

3.3.2 Accommodation Spaces (Living Quarters)

Accommodation spaces (living quarters) are to be located outside hazardous areas and high voltage and ultra-high voltage areas. Where living areas are exposed to a risk of fire loads, “A-60” and “A” rated bulkheads may be utilized, provided that a risk or fire load analysis is performed and reviewed by ABS, indicating that these bulkheads are acceptable.

3.3.3 Lighting System

The lighting System is to comply with 4-8-2/7.13 of the *Marine Vessel Rules* or 4-3-2/13 of the *MOU Rules*.

Obstruction lights are to be provided as prescribed by the National Authority having jurisdiction. If the installation is located outside the territorial waters of any National Authority or if no lights are prescribed by the authority having jurisdiction, the following is to be provided as a minimum:

i) One 360 degree white light visible for five (5) miles under an atmospheric transmissivity of 0.85, flashing six (6) times per minute, and arranged for operation at least from sunset to sunrise local time.

ii) It is recommended that the floating hoses be marked with winker lights.

3.3.4 Public address and General Alarm System

The public address and general alarm system is to comply with 4-8-2/11.8 of the *Marine Vessel Rules* or 4-3-2/15.9 of the *MOU Rules*.

3.3.5 Lightning Protection

Lightning protection is to comply with 4-8-5/9.7 of the *Marine Vessel Rules*.

3.3.6 Electric Cables

Low and high voltage electric cables are to comply with 4-8-3/9 and 4-8-5/3.7.6 of the *Marine Vessel Rules* or 4-8-5/1.9.3 of the *MOU Rules*.

Ultra-high voltage electric cables are to comply with a standard acceptable to ABS (e.g., IEC, IEEE, NFPA).

3.3.7 Cable Termination

Electric cable termination is to comply with 4-8-4/21.27 of the *Marine Vessel Rules* or 4-3-5/1.9.3(d) of the *MOU Rules* for each electrical service platform/substation.

The following additional requirements are to be met:

i) The cable termination is to be suitable for the marine environment.

ii) The design of the j-tubes is to meet the requirements of the cables inside them, generally the minimum internal diameter and bend radius of the bottom part.

3.3.8 Circuit Protection

Low and high voltage system and equipment circuit protection are to comply with 4-8-2/9 and 4-8-5/3.5 of the *Marine Vessel Rules* or 4-3-2/9 & 4-3-5/1.7 of the *MOU Rules* as applicable.

Ultra-high voltage electric equipment and circuit protection are to comply to a standard acceptable to ABS (e.g., IEC, IEEE, NFPA, etc.).

3.3.9 Overload

Protection against Overload is to comply with 4-8-2/9.5 of the *Marine Vessel Rules* or 4-3-2/9.1.3 of the *MOU Rules* as applicable. The following additional requirements are to be met:

i) The power supply to the electrical service platform is to be fully automated such that the required electrical service platform's essential loads are always available.

ii) Overload protection devices are to give an alarm initially with sufficient performance and time margins to take the corrective actions either manually by remote control or by automated systems if necessary.

3.3.10 Short Circuit

Low and high voltage system and equipment short circuit is to comply with 4-8-2/9.3 of the *Marine Vessel Rules* or 4-3-2/9.1.2 of the *MOU Rules* as applicable. Ultra-high voltage electric equipment and system short circuit ratings are to comply to a standard acceptable to ABS (e.g., IEC, IEEE, NFPA, etc.).

Arrangements are to be made for protection from grid faults in shore connection in accordance with 5/3.3.

3.3.11 Arc Flash

Low and high voltage system arc flash is to comply with 4-8-5/3.7.4 (e) of the *Marine Vessel Rules* or 6-1-7/15.2(f) of the *MOU Rules* as applicable.

3.3.12 Total Harmonic Distortion

Low and high voltage system total harmonic distortion are to comply with 4-8-2/7.21, 4-8-2/9.22 and 4-8-2/9.23 of the *Marine Vessel Rules* or 4-3-2/9.18 of the *MOU Rules* as applicable.

3.4 Helicopter Facilities

Where they are provided, helicopter facilities are to comply with 4-7-2/5.3 of the *Marine Vessel Rules* or 5-2-3/9 of the *MOU Rules*. The design and construction of the helideck are to include, but are not limited to, the requirements of 3-8-9/9.9 of the Offshore Installation Rules.

3.5 Supply Voltage level requirement

The supply voltage requirements are to comply with the following:

3.5.1 Low Voltage

The low voltage requirements are to comply with Section 4-8-2 of the *Marine Vessel Rules* or Section 4-3-2 of the *MOU Rules* as applicable.

3.5.2 High Voltage

The high voltage requirements for the power used on the electrical service platform are to comply with Section 4-8-5 of the *Marine Vessel Rules* or Section 4-3-5 of the *MOU Rules* as applicable.

3.5.3 Ultra High Voltage

In addition to the requirements of 3/3.5.2, the following requirements apply:

i) Short-circuit current: The ultra-high voltage (UHV) equipment is to be designed and installed to reliably withstand the thermal and mechanical effect caused by the short-circuit current in all types of short circuits, such as three-phase, phase-to-phase, phase-to-earth, and double phase-to-earth.

ii) Overvoltage: The UHV equipment is to withstand the switching overvoltage and lightning overvoltage with insulation coordination and overvoltage protection.

iii) Electromagnetic interference: The UHV equipment and conductors with voltage levels above 345 kV phase-to-phase are to be fitted with corona shields such that they do not produce visible corona on clear nights.

3.6 Power System Capacity

At least two generator sets are to be provided with a combined capacity sufficient to maintain the installation in normal operational conditions, including any special purpose equipment. Additionally, the capacity of these sets is to be sufficient to maintain the installation in normal operating conditions, excluding any special purpose equipment, with any one generator in reserve.

Where the electrical power system receives power from the main power system through a transformer, the transformer is to have the capacity to supply power to all services necessary for maintaining the electrical service platform /offshore substation in normal operational and habitable condition without using the emergency source of power, and one generator set is acceptable provided its capacity is sufficient to maintain the installation in normal operating conditions, excluding any special purpose equipment.

3.7 Electrical Power Distribution for Auxiliary System

The auxiliary power system is to comply with the requirements of 4-8-2/3.11 of the *Marine Vessel Rules* or 4-3-2/3.1.6 of the *MOU Rules* in addition to:

i) Voltage, circuit configuration and control/protection method of the auxiliary power system is to be designed based on the bus scheme, number of substation equipment and reliability. The capacity of the auxiliary transformer is to be designed such that it can sustain the final load calculated during the planning stage.

ii) In case of loss of power supply, an automatic changeover function is to be provided.

3.8 Power Quality

The power quality requirements are to comply with 4-8-2/7.21 and 4-8-3/1.9.1 of the *Marine Vessel Rules* or 4-3-2/7.9 and 4-3-5/3.3.5 of the *MOU Rules*.

3.9 Emergency Power Systems

The requirements for emergency power system is to comply with 4-8-2/5 of the *Marine Vessel Rules* or 4-3-2/5 of the *MOU Rules*.

4 Earthing

4.1 Equipment Earthing

4.1.1 General Requirements

Earthing requirements for low voltage and high voltage installations are to comply with 4-8-4/ 23.1 of the *Marine Vessel Rules* or 4-3-3/7 of the *MOU Rules* as applicable.

In addition to the requirements of 3/4.2 below, earthing requirements for UHV installations are to comply with a standard acceptable to ABS (e.g., IEC, IEEE, NFPA, etc.)

4.1.2 Equipment Earthing Methods

Low and high voltage system earthing methods are to comply with 4-8-4/ 23.3 of the *Marine Vessel Rules* or 4-3-3/7.5 of the *MOU Rules* as applicable. Earthing requirements for UHV installations are to comply with a standard acceptable to ABS (e.g., IEC, IEEE, NFPA, etc.).

4.1.3 Lightning Earth Conductors

Requirements for lightning earth conductors are to comply with 4-8-4/23.5 of the *Marine Vessel Rules* as applicable.

4.2 System Earthing

4.2.1 Ultra-high Voltage Installation earthing

To avoid dangerous step and touch voltages, the system earthing is to be designed to limit the maximum earth fault current. Since the earth fault current is sufficiently high in UHV AC transmission, auxiliary earthing mesh is to be laid under the UHV switchgear to reduce the electromagnetic-induced surge voltage in the secondary circuits during an earth fault.

4.2.2 System Earthing Methods

System earthing for low and high voltage systems are to comply with 4-8-4/25 of the *Marine Vessel Rules* or 4-3-3/Table 2 of the *MOU Rules*. The following additional requirements are to be met:

i) The neutral point of a star connected transformer is to be used for earthing in a three-phase system

ii) A special arrangement, such as a zig-zag transformer, is to be used for delta connected systems

iii) The multiple point earthing method is to be used for gas insulated lines or switchgear

5 Systems Powered by the Substation and/or Battery Systems

If a battery system is installed in lieu of a generator, it is to be built, tested, certified and marked by the manufacturer to a recognized industry standard. Onboard safety systems where battery systems are installed are to comply with Subsection 4/6.

When the source of power for onboard electrical systems is the grid/substation and/or a battery system, the following additional requirements are to be met:

i) Auxiliary services as detailed in 3/3.1.2.

ii) The electrical distribution arrangements for the electrical systems are to be clearly indicated in the general equipment arrangement drawings.

iii) The main source of electrical power for the support systems of the electrical service platform/substation is to be so arranged such that, in the event of the loss of incoming power to the electrical service platform/substation, switchgears or transformers in service, the electrical supply to the equipment necessary for support systems are maintained or restored.

iv) A self-contained emergency source of electrical power is to be provided, as required by 4-8-2/5 of the *Marine Vessel Rules* so that in the event of a failure of the main source of electrical power, the emergency source of power will become available to supply power to services that are essential for safety in an emergency as per 4-7-1/11.21.1 of the *Marine Vessel Rules*.

v) Instrumentation is to be provided at the marine system switchboard showing energized status of the connected electrical service platform/substation switchboard. Means are to be provided for checking the polarity (for DC) or the phase sequence (for three-phase AC) of the power plant supply in relation to the marine system.

6 Prime Movers and Generators

6.1 Prime Movers

Prime movers (internal combustion engines and their turbochargers, gas turbines, and steam turbines) for which certification is required as indicated in 6-1-3/5 TABLE 1 of the *MOU Rules* are to be designed, constructed, tested, certified and installed in accordance with Part 4, Chapter 2 of the *Marine Vessel Rules* or 6-1-3/3 & 5 of the *MOU Rules*.

Prime movers not related to additional optional notations, such as **OSS**, need not be inspected manufacturer's facility, but will be accepted subject to verification of safety features fitted as per 8-2-1/7 of the *MOU Rules* and satisfactory performance witnessed by the Surveyor after installation.

6.2 Electrical Generators and Motors

Electrical rotating machines (generators and motors) for which certification is required as indicated in 6-1-7/Table 1 of *MOU Rules* are to be designed, constructed, tested, certified and installed in accordance with Part 4, Chapter 2 of the *Marine Vessel Rules* or 6-1-7/5 of the *MOU Rules*.

Electrical rotating machines not related to additional optional notations, such as **OSS**, need not be inspected at the manufacturer's facility, but will be accepted subject to satisfactory performance witnessed by the Surveyor after installation.

7 Control and Instrumentation

7.1 Control Room

The control room for a manned electrical service platform/offshore substation is to be located above the weather deck and outside the machinery space(s) and any hazardous area.

7.2 Power Management System (PMS)

The Power Management System is to comply with 4-8-5/5.3.3 of the *Marine Vessel Rule*s or 4-3-5/3.3.3 of the *MOU Rules* as applicable.

7.3 Energy Management System (EMS)

The EMS is to comply with 3/7.5 of the ABS Requirements for Hybrid Electric Power Systems.

The EMS will have several functionalities to supply, schedule, optimize (minimize/maximize) and interact with different energy transformation device's and/or energy storage's management systems.

The energy management system may consist of monitor(s), communications equipment, controller(s), timer(s), or other device(s) that monitor and /or control electrical loads, power production and/or storage sources.

Automatic control systems are to be designed to achieve safe and effective operation in accordance with the applicable parts of 4-9-3 of the *Marine Vessel Rules*.

7.4 Control, Monitoring, Alarm and Safety Systems

The substation control system is to be employed with the networked, distributed and systematic hardware structure that complies with 4-9-2 of the *Marine Vessel Rules* or an appropriate international standard acceptable to ABS. The Control, Monitoring, Alarm and Safety Systems are to comply with 4-9-2, 4-9-3, 4-9-9, 4-9-13, or 4-9-14 of the *Marine Vessel Rules* as applicable, in addition to:

i) The control system is to be fitted with at least the functions of data acquisition and processing, switchgear and transformer tap control, synchronization for circuit breaker closing, event and alarm record, database management, graphical screen generation and display, measurement trend and energy record.

ii) Electrical service platforms fitted with Remote Control Functions as defined in Subsection 1/10 is to comply with the ABS *Requirements for Autonomous and Remote Control Functions*.

Where new technologies are utilized, they are to be qualified and / or approved in accordance with the ABS *Guidance Notes on Qualifying New Technologies*.

7.4.1 Centralized Control and Monitoring Station (CCMS)

In addition to 3/7.1 and 3/7.4, the control station is to display information from the substation operation parameter control, power, fire, and safety systems so that correct functioning of these systems can be maintained and monitored. The operator is to have easy access to information on displays.

7.4.2 Data Communication

A means of data communication is to be provided between the CCMS and the remote Control and Monitoring station (RCMS), which is fitted with remote control for essential system and

equipment capable of providing the same degree of safety and operability as is provided at the CCMS. The RCMS may be located in an onshore substation or on a nearby manned platform.

Where hard-wired cable connections are made for communications, control, and monitoring between the CCMS onboard and the RCMS on the onshore substation or a manned platform nearby, details of the hard-wired connections are to be submitted.

Where wireless data communication equipment is used for data communication between the CCMS and the RCMS. Documentation demonstrating that the data communication equipment provides an improvement in the safety of the installation compared to wired data communication is to be provided in accordance with 4-9-1/7.3.10 of the *Marine Vessel Rules*.

7.4.3 Automatic Control and Safety System

In addition to 3/7.4, an automatic control system is designed to automatically lead machinery being controlled to a predetermined less critical condition in response to a fault which may endanger the machinery or the safety of personnel and which may develop too fast to allow manual intervention.

The fail-safe state for essential systems and actions required to reach the less critical condition, as identified by the risk assessment required in Subsection 5/5, are to be provided with appropriate indicators and alarms at the CCMS and RCMS in association with actions taken.

7.5 CCTV Systems

The CCTV system when fitted is to meet the following requirements:

i) CCTV systems are to be provided with timelapse video recording allowing images to be recorded at appropriate intervals

ii) The system is to be employed with the facilities to copy images onto removable media for long term retention

iii) The system is also to be configured to monitor the approach and docking of vessels to the platform

iv) Additionally, the system is to be arranged such that it provides a visual and audible warning signal of the close approach of vessels to the platform in a normally manned space

7.6 SCADA Systems

A SCADA System, when fitted, is to comply with 4-9-2 of the *Marine Vessel Rules*.

7.7 Cyber Security Systems

The Cyber Security System is to comply with Sections 4-9-13 and 4-9-14 of the *Marine Vessel Rules*.

7.8 Smart Functions

Electrical service platforms fitted with Smart functions as defined in Subsection 1/10 to comply with ABS *Guide for Smart Functions for Marine Vessels and Offshore Units*.

8 Equipment

8.1 Transformers

Transformers are to comply with 4-8-3/7 of the *Marine Vessel Rules* or 6-1-7/15.3.3 of the *MOU Rules.*

Where the main ultra-high voltage power distribution transformer has a tertiary winding used to supply power to the substation loads, then the transformer is to be designed, constructed and tested according to a standard acceptable to ABS (e.g., IEC 60076).

Where liquid-filled transformers are utilized, they are to be installed outdoors. All liquid-filled transformers are to be provided with adequate curbing to confine any transformer liquid spilled to prevent pollution and to confine any burning oil. Other design considerations, acceptable to ABS may be made when low flammability biodegradable oil filled transformers are used.

In addition, where liquid immersed type transformers are installed, the following requirements are applicable:

i) Permanently attached nameplates of corrosion resistant material. Nameplate is to be provided with the connection diagram, the name of the manufacturer, rated kilovolt-amperes, frequency, primary and secondary voltages, percent impedance, class of insulation, and the temperature rise for the insulation system.

ii) High-quality exterior coating for the entire enclosure, including mounting brackets and other peripheral components, to resist corrosion, unless the components are of corrosion-resistant materials.

iii) Full load temperature rise is not to exceed 55 °C (131 °F) OA.

iv) Low oil-level indication is to be provided.

v) High oil-temperature indication is to be provided.

vi) Field replaceable cooling fin assemblies, if provided with cooling fins. Replaceable cooling fin assemblies made of painted 304 stainless steel are be considered.

vii) Where aluminum windings are utilized, the winding-to-terminal pad connection is to be oil-immersed.

8.2 Voltage Regulator

The requirements for voltage regulator are to comply with 4-8-3/3.13.2 of the *Marine Vessel Rules* or 6-1-7/5.17 and 6-1-7/5.19 of the *MOU Rules.*

The following additional requirements are to be met:

i) If the system is affected by a significant voltage fluctuation, the on-load regulation is to be implemented; else, the off-circuit tap-changer is to be implemented.

ii) The voltage regulation winding of the autotransformer is to be installed at the end of the high voltage side winding, or the neutral side.

8.3 Power Electronic Components (PECs)

The requirements for Power electronic components such as Semiconductor Converters for Adjustable Speed Motor Drives are to comply with 4-8-3/8 of the *Marine Vessel Rules* or 6-1-7/12 of the *MOU Rules.*

8.4 Circuit breakers, voltage and current transformers, grounding switches

Circuit breakers, voltage and current transformers, grounding switches are to comply with 4-8-3/5.3.3, 4-8-5/3.5.3, 4-8-5/3.7.2 of the *Marine Vessel Rules* as applicable.

8.5 Corrosion Protection

Protection against corrosion either by rust-proofing or embedding in a protective material is to be provided.

8.6 Switchgear

Requirements for switchgear are to comply with 4-8-3/5.3.2 and 4-8-5/3.7.4 of the *Marine Vessel Rules* or 6-1-7/15.3.2 of the *MOU Rules* as applicable. The following additional requirements are to be met where Gas Insulated Switchgear (GIS) are installed:

i) GIS is to be installed indoor in a room equipped with HVAC.

ii) While using GIS, adequate space is to be allowed for a gas cart to be used during filling and/or maintenance operations.

iii) The multiple-earthing method is to be employed to reduce electromagnetic induced current in secondary circuits.

8.7 Point of Common Coupling (PCC)

At the point of common coupling, the following data is to be documented and submitted for review:

i) Percentage of total harmonic distortion[1] of the voltage

ii) Percentage of positive and negative steady state voltage variation[2] for AC substation connected to the DC-link

iii) Percentage of positive and negative steady state frequency variation[2] for AC substation connected to the DC-link

iv) Maximum calculated short circuit current[3]

v) Fault clearance time in seconds[4]

Notes:

1 See 4-8-2/7.21 and 4-8-5/5.3.5 of the *Marine Vessel Rules*

2 See 4-8-3/1.9 of the *Marine Vessel Rules*

3 See 3/2 *iii)* b

4 See 3/2 *iii)* c

9 System Requirements for Unmanned Installations

9.1 Electrical Systems Requirements

For unmanned installations, the design criteria of electrical systems associated with marine systems are to be in accordance with applicable requirements described in Part 4, Chapters 1 and 3 of the *MOU Rules* or Part 4, Chapter 8 of the *Marine Vessel Rules*, except as modified in this Subsection.

9.1.1 Power System Capacity

A power system is to be fitted with sufficient capacity to supply power to all services necessary for maintaining the electrical service platform/offshore substation in normal operation.

It is acceptable to utilize a transformer for receiving power from the main power system and for powering the supporting systems provided the transformer or all necessary supporting systems are capable of being restored or restarted after a blackout condition.

Using an emergency source of power for starting or restoring operation may be acceptable provided that the emergency power source of power has sufficient capacity for the operation.

9.1.2 Emergency Power System

An independent source of power (example: generator, battery, etc.) is to be provided for use as an emergency power with sufficient capacity to supply power for at least 18 hours[1] that supports all services necessary for safety in an emergency, particular attention being given to the following:

- Navigation and special purpose lights and warning systems
- Emergency lighting for machinery spaces, control stations, alleyways, stairways, exits
- General alarm and communications systems
- Fire detection and alarm systems

- Fire extinguishing systems
- Control, monitoring and safety systems fitted with remote communication system to the onshore grid substation
- Ballast pump and control system for maintaining floating type installations' safety and stability[2].

Notes:

1 When an installation is situated within a short distance to an onshore supporting station and an adequate standard of safety is attained, a period less than 18 hours, but not less than 12 hours may be accepted.

2 When verified, the ballast system or failure of the ballast system does not affect installations' safety or stability, emergency power for ballast pump and control system may be waived.

9.1.3 Lighting System

Machinery Spaces, the CCMS and spaces fitted with essential systems are to be provided with lighting and provided with backup power supply for the same period of emergency lighting as required for the installation.

Obstruction lights are to be provided as prescribed by the National Authority having jurisdiction. If the installation is located outside the territorial waters of any National Authority or if no lights are prescribed by the authority having jurisdiction, the following is to be provided as a minimum.

- Navigation lights are to be provided as detailed in 4-8-2/11.3 of the *Marine Vessel Rules*.
- Relay-controlled, battery-operated lanterns may be used as emergency lighting provided the batteries are automatically recharged and the battery-operated lamps provide light for the same period as required for the installation.

SECTION 4
Safety Systems

1 General

Electrical service platforms are to meet the requirements of this document with regard to fire and safety measures and features as well as lifesaving appliances and equipment.

The following list of drawings together with supporting data and particulars as noted in the 5-1-1/1.9 of the *MOU Rules* are to be submitted for review:

i) Structural Fire Protection

- ***a)*** General arrangement
- ***b)*** Structural fire protection layout plan for decks and bulkheads
- ***c)*** Plans or a booklet of joiner work details of construction for all decks, bulkheads and doors
- ***d)*** Ventilation plan showing all horizontal and vertical duct work listing all materials, duct size and gauge
- ***e)*** Penetration details through bulkheads and decks to accommodate ventilation, piping, electrical, etc.
- ***f)*** Escape plan (depicting escape routes as determined by 5-3-1/1 of the *MOU Rules*.

ii) Fire Fighting Systems

- ***a)*** Arrangement and details of fire main systems
- ***b)*** Foam smothering systems
- ***c)*** Other fire extinguishing arrangements.
- ***d)*** Fire control plans
- ***e)*** Fire detection systems
- ***f)*** Fixed fire extinguishing systems
- ***g)*** Fire extinguishing appliances
- ***h)*** Control station for emergency closing of openings and stopping machinery
- ***i)*** Gas detection systems (if applicable)
- ***j)*** Fireman's outfits
- ***k)*** The most severe service condition for the operation of the emergency fire pump (e.g. lightest draft as shown in Trim and Stability Booklet, etc.)

l) Calculations and pump data demonstrating that the emergency fire pump system can meet the operational requirements specified in 5-2-2/1.1 of the *MOU Rules* with the proposed pump location and piping arrangements (e.g. adequate suction lift, discharge pressure, capacity, etc.) at the most severe service condition

iii) Fire Control Plans

a) Locations of fire control stations

b) Various fire sections enclosed by various classes of fire divisions

c) Arrangement of fire detectors and manual fire alarm stations

d) Arrangement of combustible gas detectors

e) General alarm actuating positions

f) Arrangement of various fire-extinguishing appliances

g) Locations of firefighter's outfits

h) Location of helicopter crash kit (if applicable)

i) Arrangement of water spray nozzles and sprinklers (if fitted)

j) Locations of emergency shutdown (such as oil fuel source shutdown, engine shutdown, etc.) stations

k) The Ventilating system including fire dampers positions, ventilating fans control positions with indication of identification numbers of ventilating fans serving each section

l) Arrangement of fire/watertight doors and their remote control positions

m) Escape route and means of access to different compartments, decks, and areas.

n) Locations of Emergency Escape Breathing Devices (EEBD); and

o) Arrangement of emergency muster stations and life-saving appliances.

2 Manned and Unmanned Facility

Manning is established by the flag Administration if applicable.

For manned electrical service platforms without accommodation, the flag Administration or coastal authority requirements with respect to safety (e.g., fire protection and protection of personnel onboard) are to be complied with.

For unmanned electrical service platforms, safety systems are to be evaluated based on the operational profile of the substation. Where a review of all or part of the requirements covered in this Section has been conducted by the flag Administration and found to be acceptable, the same will be acceptable to ABS in addition to the requirements of 3/7.6, 3/7.7, and 3/7.8. The designer or builder is to submit evidence that the flag Administration has reviewed the arrangements and that the details are acceptable to that flag Administration.

3 Safety Requirements for Manned and Unmanned Facilities

Depending on the installation's flag of registry and the installation's intended area of operation, the coastal state may have additional requirements/regulations which may need to be met; therefore, the appropriate governmental authorities are to be consulted for each installation.

3.1 Structural Fire Protection

Structural fire protection is to meet the requirements in 5-1-1/3 of the *MOU Rules*. It includes following considerations:

i) Construction materials and methods of construction

ii) Fire integrity of bulkheads and decks

iii) Doors, ventilations, penetrations, and escape plan.

3.2 Firefighting Systems

i) Spaces housing battery systems or power supply machinery such as engines, turbines or boilers are to be appropriately protected by fixed firefighting systems per international standards (e.g. FSS Code, applicable NFPA Codes/Standards etc.). This is to be to the satisfaction of the flag Administration or coastal authority. The designer or builder is to submit evidence that the flag Administration has reviewed the arrangements and that the details are acceptable to that flag Administration. Alternatively, the system may be certified by ABS.

ii) In addition to the above fixed firefighting systems, electrical service platforms/substations are to be provided with portable fire extinguishers and semiportable fire extinguishing systems in accordance with the requirements of 4-7-2/1.7 of the *Marine Vessel Rules* or 5-2-4/1 of the *MOU Rules*.

3.3 Fire Control Plans

Fire control plans are to be permanently exhibited for the guidance of operating personnel, clearly denoting

for each deck the provision, location, controls and particulars, as detailed in 4/1 iii).

4 Lifesaving Appliances

For substation operations, the requirements of the flag and/or coastal Administration are to be complied with. Substations are to maintain at least two access/exit gangways during operations to facilitate personnel escape in the event of an emergency.

In the absence of specific safety requirements from the flag Administration, a manned platform is to be provided with survival craft of such capacity as will accommodate twice the total number of persons on the platform, as follows:

4.1 Survival Craft

i) One or more lifeboats on each side of the platform complying with the requirements of Sections 4.6, 4.7, 4.8 and 4.9 of the LSA Code, as appropriate, of such aggregate capacity as will accommodate at least 50% of all persons onboard.

ii) In addition, one or more life rafts as necessary complying with the requirements of Sections 4.2 and 4.3 of the LSA Code, capable of floating and breaking free in case the platform becomes submerged, of such aggregate capacity so that there will be survival craft on each side of the platform to accommodate all persons on board.

iii) In lieu of compliance with i) and ii) above, where a review of all or part of the requirements covered in this paragraph has been conducted by the Flag Administration and found acceptable, the same will be acceptable to ABS. The designer or builder is to submit evidence that the Administration has reviewed the arrangements and that the details are acceptable to the Flag Administration.

iv) Exemptions granted by or instructions received from the Flag Administration based on the operation distance from shore and number of persons on board and other emergency procedures will be accepted by ABS.

4.2 Rescue Boats

A manned platform is to carry at least one rescue boat complying with the requirements of Chapter V of the LSA Code. A lifeboat may be accepted as a rescue boat, provided that it also complies with the requirements for a rescue boat. Exemptions granted by or instructions received from the Flag

Administration based on the operation distance from shore and number of persons on board and other evacuation measures will be accepted by ABS.

4.3 Personal Life-Saving Appliances

Personal life-saving appliances are to comply with SOLAS Regulation III/32.

4.4 Survival craft stowage, Embarkation and Launching Arrangements

All survival craft stowage, embarkation and launching arrangements are to comply with SOLAS Regulation III/13 and III/33.

4.5 Radio Communication Installations

Each platform is to be provided with:

i) A radiotelephone station complying with the provisions of Chapter IV of the 1974 SOLAS Convention, as amended.

ii) An efficient means of communication between the radiotelephone station and the rest of the platform.

iii) At least one emergency position-indicating radio beacon (EPIRB).

5 Emergency Shutdowns (ESD)

5.1 ESD System for Manned Installations

The substation transmission equipment/machinery is to be provided with a self-monitoring emergency shutdown system. A means of control is to be situated outside the space in which the machinery/equipment is located so that they may be stopped in the event of fire or emergency.

In addition to the above requirement, shutdown systems are to comply with the following:

i) Emergency control stations are to be provided.

ii) At least one of the stations is to be located in a normally manned space (for manned substation)

iii) The other is to be at a suitable location outside of any hazardous area.

iv) Shutdown is to take place within 45 seconds or less as may be considered necessary for the safety of the plant after activation of the ESD system at a manual ESD station, or after detection of a trouble condition by an automatic shutdown device.

v) Electric circuits essential to ESD that rely on the continued operation of the cable for correct operation of the system are to be of the fire resistant type, (e.g., mineral insulated cable or otherwise complying with IEC 60331)

vi) The emergency control stations are to be provided with the:

- *a)* Manually operated switches for actuating the general alarm system.
- *b)* An efficient means of communication with locations vital to the safety of the installation.
- *c)* Means for shutdown, either selectively or simultaneously, of the following equipment, except for electrical equipment required to be operational during an emergency as specified in 4-8-2/5.5 of the *Marine Vessel Rules*: main substation transformer, power electronic equipment associated with the platform's power.

5.2 ESD System for Unmanned Installations

A functional flow chart of the ESD system and related systems is to be provided at the CCMS and the associated RCMS in onshore substation or on manned platform nearby. The ESD functions capable of being activated by automatic initiation are to be identifiable.

Any additional initiations are only to be included in the ESD system if it can be shown that their inclusion does not reduce the integrity and reliability of the system overall.

Where an ESD system utilizes a relay control system where stops are connected to relay contacts and the ESD energizes or de-energizes the relay to open or close the contacts, a theory of operation, along with the desired fail-safe state of the equipment controlled (e.g., fail AS IS or Fail Stop) for failure of the relay system is to be provided or included in the risk assessment.

Where the risk assessment shows that feeder circuit power failure to the relay panel results in an undesired fail-safe state, automatic changeover to an alternate power source is to be provided.

A UPS with a maintenance bypass switch, dedicated to the ESD, and properly sized to maintain the ESD system until normal power failure can be restored, is acceptable. Indication of UPS failure and UPS battery alarm is to be provided at the CCMS and RCMS.

6 Safety Requirements for Lithium-ion Battery Systems

Where lithium-ion battery systems are installed as part of the electrical service platform/substation for power export, the installation is to comply with the applicable requirements in the *Lithium-ion Batteries Requirements* as referenced in this Subsection. This subsection applies to lithium-ion battery types as described in Subsection 1/5 of the ABS *Lithium-ion Batteries Requirements*.

6.1 Plans and Data to be Submitted

Refer to the Subsection 1/13 of the ABS *Lithium-ion Batteries Requirements* for the data and plans to be submitted to ABS for review including the additional requirement of Manufacturers Certificate certifying the battery system is built, tested, certified and marked to a recognized industry standard.

6.2 Onboard Documentation

Detailed stage-by-stage firefighting procedures are to be kept on board for easy reference by the crew.

6.3 Design Requirements

Refer to Section 3 of the Lithium-ion Batteries Requirements for applicable design requirements as listed in Table 1 below:

TABLE 1
Lithium-ion Batteries Requirements for applicable design requirements

Item	*Rule reference in Lithium-Ion Battery Requirements*
Battery Space	3/3
Fire Safety for Battery Space	3/3.1
Hazardous Area Requirements	3/3.3

6.4 Containerized Battery System Installation

Containerized battery system installations are standalone containers that house the battery systems and associated equipment; they are not part of the hull or superstructures and are installed on the open deck area. The location of containerized battery systems is to consider hazardous areas as discussed in 3/3.1.4.

Each container is standalone and can be treated as industrial equipment. The container and battery systems are to be built, tested, certified and marked to a recognized industry standard. Manufacturers' certificates for the battery systems, containers and fire safety systems are to include the following systems:

i) Ventilation

ii) Environmental control

iii) Fixed fire extinguishing system

iv) Fire detection and alarm system

v) Combustible and toxic gas detection and alarm system

SECTION 5

Substation Power Supply, ESS, Distribution Systems and Equipment

1 General

This Section contains provisions for the design, construction, installation, and survey of main power supply and distribution equipment including battery systems, where installed, for transmission of power to onshore substation or grid. Installation whose systems and components meet the full requirements of this Section may receive the optional notation **OSS**.

The scope of this Section includes power supply, battery systems and distribution systems and equipment installed on board the electrical service platform/substation. Electrical service platforms/offshore substations systems may be used to transfer power to onshore substation/grid, and the arrangements are to be in accordance with Subsection 3/3.

Lithium-ion Battery systems are to comply with the Lithium-ion Batteries Requirements.

The following Subsections describe the minimum design plans and data submission requirements for associated power supply, transmission, and distribution systems, subsystems, equipment and/or components.

2 Plans and Data to be Submitted

2.1 Electrical Systems and Components

The following plans and data are to be submitted for review:

i) *One Line Diagram* - One line diagram of main and emergency power distribution systems to show:

- *Generators:* kW rating, voltage,rated current, frequency, number of phases and power factor
- *Motors:* kW or hp rating, voltage and current rating
- *Motor controllers:* type (direct-on-line, star-delta, etc.), disconnect devices,overload and undervoltage protections and remote stops, as applicable
- *Transformers:* kVA rating, rated voltage and current,winding connection
- *Circuits:* designations, type and size of cables, trip setting and rating of circuit protective devices, rated load of each branch circuit, emergency tripping and preferential tripping features
- *Batteries:* type, voltage, rated capacity, conductor protection and charging and discharging boards

ii) *Schematic Diagrams* – Schematic diagrams for the following systems are to be submitted. Each circuit in the diagrams is to indicate type and size of cable, trip setting and rating of circuit protective device, and rated capacity of the connected load

- Interior communications
- General emergency alarm
- Intrinsically safe systems
- Fire detection and alarm system(if independent from vessel marine systems)

iii) *Risk Assessment*

2.2 General Equipment Details

Plans and data for equipment and components are to provide the following, as applicable:

i) Model and size

ii) Design specifications, including design codes, standards, and references

iii) Design parameters: loads,temperature, environmental conditions, etc.

iv) Design analysis and/or calculations, as applicable

v) Dimensional details and drawings

vi) Fabrication details and welding configurations

vii) Material specifications and material properties

2.3 General Arrangement and Equipment Layout Drawings

General arrangement and layout drawings are to denote:

i) The layout of the substation machinery with essential auxiliaries, specifications of main equipment with information on manufacturer's name, type, rating, and number of the equipment

ii) General arrangement of the switchboards, transformers, and distribution boards

3 Design Requirements

3.1 General Arrangement and Equipment Layout

UHV equipment intended for transmission of power within the electrical service platform/offshore substation is to be arranged as follows:

- The equipment is to be separately installed by unit and voltage, e.g. UHV switchgear unit, main transformer unit
- Adequate space for maintenance and disassembly is to be provided in case of failure.

3.2 Equipment Design

In general, power supply and distribution machinery and electrical systems are to be built and constructed in accordance with ABS Rules or recognized industry standards. ABS design review verifies that the design of systems, subsystems, equipment, and/or components meets the requirements of this document.

3.3 Protection from Shore Distribution Faults

The electrical service platform/ offshore substation provides power to shore, which may also augment other shore power supply sources, substation or the main onshore electrical grid as a parallel power source. The connection from the electrical service platform/offshore substation to the shore distribution system is

to be protected from shore power faults, frequency, and voltage variations in accordance with the applicable recognized codes/standards in the country where it is providing power.

3.4 Environmental Suitability

The design of the system and components for electrical service platform/offshore substation plant applications are to be suitable for the inclination and vibration requirements of the host installation.

4 Power Distribution Systems

4.1 ESS Capacity

i) **Lithium-ion Batteries**

For installations fitted with lithium-ion batteries, see the requirements in the ABS *Requirements for Use of Lithium-ion Batteries in the Marine and Offshore Industries*.

ii) **Supercapacitors**

For installations fitted with supercapacitors, see the requirements in the ABS *Requirements for Use of Supercapacitors in the Marine and Offshore Industries*.

4.2 Reverse power protection

The direction of real power flow is normally from the electrical power generation plant to the installation. The installation is not normally expected to be a power supply source to the electrical power generation plant. The installation is to be fitted with a reverse power flow relay to prevent the flow of power from the installation to the electrical power generation plant.

4.3 Communication

The communication system is to comply with the requirements of the system architecture and operation mode of AC and DC transmission systems in addition to these:

i) The communication equipment in the substation is to be configured according to the flag administration requirements.

ii) The communication protocols of a substation control system is to follow IEC 61850

iii) In case of a failure, the communication station level equipment or network, shore side equipment is to be capable of monitoring and controlling the substation equipment remotely and independently.

5 Risk Assessment

To minimize the risk of fire and explosion, a risk assessment is to be carried out to identify technical risks and uncertainties associated with the proposed electrical service platform.

The risk assessment is to demonstrate the installation safety and the continuity of power supply in case of failure of power distribution systems, subsystems, equipment (e.g., oil filled transformers), and any other systems e.g., piping systems and material handling of large primary plant items.

The risk assessment is to be carried out in accordance with ABS *Guidance Notes on Risk Assessment Application for the Marine and Offshore Oil and Gas Industries*, ABS *Guidance Notes on Failure Mode and Effects Analysis (FMEA) for Classification*, or other ABS industry standards recognized by (e.g., IEC 60812).

All foreseeable hazards, their causes, consequences (local and global effects), and associated risk control measures are to be documented. The power distribution system risk assessment report is to be submitted for ABS review, and at a minimum is to address the following aspects:

i) All normal and foreseeable abnormal operating conditions

ii) Equipment layout, arrangement, and location

iii) Mechanical faults, electrical faults and human errors and associated alarms (e.g., earth fault, fire, flooding, cooling/heating failure, and operation exceeding the designed operating parameters)

iv) Software development, version updating, compatibility, and integrity

v) Electrical power system protection philosophy (e.g., loss of cooling power, loss of heating power, loss of control power, loss of power input to main supply, loss of power supply, loss of power on a single bus segment, breaker or other protection device failure, earth fault, short-circuit fault)

vi) Control component failure (e.g., temperature/pressure sensor failure, generator rectifier/ load inverter failure, bus-tie failure, main propulsion thruster drive failure, DP function thruster drive failure, loss of communication)

vii) Electrical shock precautions. The consideration that personnel cannot access energized equipment is to be given to the system design and equipment layout

viii) Energy storage device hazards if applicable (e.g., lithium-ion battery thermal runaway, see details of ESS operation hazards in the ABS *Lithium-ion Battery Requirements and the Supercapacitor Requirements*)

SECTION 6
Surveys

1 General

The requirements of Subsections 6/2 and 6/3 are provided for surveys during and after construction for classification of electrical service platforms. The requirements of Subsection 6/4 are provided for surveys during and after construction for the optional **OSS** notation.

For bottom founded electrical service platforms/substations installations, the applicable requirements in the *Rules for Building and Classing Offshore Installations* are to be complied with. For floating electrical service platforms/substations installations, the applicable requirements in the *Rules for Floating Production Installations* are to be complied with.

2 Surveys During Construction and Commissioning, Testing, and Trials

2.1 Surveys during Construction and Commissioning

This Subsection provides requirements for initial surveys during manufacturing, installation and commissioning of equipment/systems on electrical service platforms/offshore substations.

The requirements in Subsection 5/3 of the *Lithium-ion Batteries Requirements* are to be complied with for Surveys during Construction for lithium-ion battery systems.

During construction, ABS Surveyors are to be provided access to manufacturers' or fabricators' facilities to witness construction and/or testing as required by Part 4 of the *Marine Vessel Rules*, and the applicable design codes and/or standards.

The manufacturer/fabricator is to contact the ABS Surveyor to make necessary arrangements to examine systems, subsystem, equipment, and/or components

The purpose of the initial onboard survey of equipment is to verify that the installation is in compliance with the ABS approved plans, with particular emphasis on examination of the following, as applicable:

i) Hazardous areas and Electrical equipment installed therein

ii) Equipment installation, including supporting structural arrangements, foundations, securing details, and protective coatings

iii) Visual and/or NDT examination of assembled and installed equipment, attachment on board, including underdeck support

iv) Hook-up and integrity of equipment piping,electrical, machinery, and ventilation system, including watertight penetrations and integration with associated ship systems

v) Main and auxiliary power systems and transformers to be operationally tested. Automatic changeover in case of loss of power supply to be demonstrated

vi) Piping system visual examination, NDT, and pressure test per applicable Rules or codes

vii) Testing of pressure relief and safety valves for hydraulic/pneumatic systems on board

viii) Visual examination of electrical equipment, wiring connections, cable routing, earthing, cable penetrations, multi-cable transits and distribution panels including testing of electrical systems and insulation tests

ix) Lighting systems examination and test

x) Gas-Tight doors, means of escape and ventilation systems examination, ducting arrangements, and penetrations, damper arrangements and operational tests

xi) Control systems, safety devices and systems such as fire and gas detection, and shutdowns to be tested to the satisfaction of the attending Surveyor as per Rule requirements and the relevant subsections of these requirements

xii) Fire/Safety measures such as fire control plan, Emergency Escape Breathing Devices (EEBDs), lifesaving appliances, crew protection, general alarm/ public address system, fire detection, portable extinguishers, escape arrangements, main and emergency lighting, and emergency shutdown systems (ESDs)

xiii) Compliance with any special requirements from the flag Administration, local codes, or regulations

xiv) Commissioning of internal, radio and data communication systems and equipment as per Rule requirements and relevant subsections of these requirements

xv) All electrical service platform/offshore substation systems and equipment are to be checked for proper operation

In addition to the above requirements, the following requirement applies for ultra-high voltage equipment and system:

- Electromagnetic interference: The UHV equipment and conductors with voltage level above 345 kV phase-to-phase, are to be verified fitted with corona shields and records reviewed to confirm that equipment does not produce visible corona on clear nights.

2.2 Inspection, Testing and Trials Test Plan

A Test Plan for the Electrical Service Platform/Offshore Substation installation and systems is to be submitted to the ABS engineering review office at the start of the plan review process. The test plan is to identify all equipment and systems of the substation detailed in the subsections of these requirements and list all performance tests and trials. In addition, all the control, monitoring, fire and safety systems and procedures are to be included, verified and tested.

During the initial trials, the Electrical Service Platform/Offshore Substation is to be confirmed for its satisfactory operation, including all associated controls, alarms and shutdowns.

2.3 Hull Trials and Testing

In addition to the Test and Trials Plan referred in 6/2.2 for electrical service platform/offshore substation installations (bottom founded), the requirements in 5-1-2 and 5-1-3 of the *Offshore Installations Rules* are to be complied with. The requirements in 7-1-1, 7-1-2, 7-1-3, 7-1-5 and 7-1-6 of the *FPI Rules, where applicable,* are to be complied with for Electrical Service Platform (Hull Type).

2.4 Machinery Trials and Testing

In addition to the Test and Trials Plan referred to in 6/2.2 for electrical service platform/offshore substations, the machinery systems are to be tested in accordance with the appropriate sections of the

applicable Rules and Guides specified in Subsection 3/1 of this document and Section 7-1-9 of the *MOU Rules* as applicable.

2.5 Trials and Testing of Shipboard Safety Systems During Commissioning

Refer to the following sections within the *Lithium-ion Batteries Requirements* for applicable items to be verified by the attending Surveyor during construction of safety systems for battery systems. In general, visual inspection is to confirm and verify that the battery systems are installed in accordance with this document and the requirements in 5/3 (i) through (v) of the *Lithium-ion Batteries Requirements*.

The attending Surveyor is to verify that battery systems are marked and labeled according to IEC 62619 or IEC 62620, or equivalent recognized standard according to battery system certification.

3 Surveys after Construction

For lithium-ion battery systems, surveys after construction are to verify required documentation of the detailed stage by stage Fire Fighting Procedures are onboard, as applicable. See 4/6.3. Fixed and portable fire extinguishing, fire detection, combustible gas detection, temperature monitoring and ventilation systems are to be examined as far as practicable and tested to confirm satisfactory operating condition. Means of egress from the battery room are to be examined and confirmed free of obstructions.

For Floating Electrical Service Platforms, the survey requirements in Part 7 Section 2 as applicable of the *FPI Rules* are to be complied with for Surveys after Construction including UWILD, cathodic protection and mooring system.

For Bottom Electrical Service Platforms, the survey requirements in Part 5, Section 2 as applicable of the *Offshore Installation Rules* are to be complied with for Surveys after Construction including UWILD, cathodic protection and mooring system.

3.1 Annual Surveys

In addition to the surveys referenced in Subsection 6/3 above and the ABS *Rules for Survey after Construction (Part-7)* as applicable for Annual Surveys, the following are to be carried out in the presence of an ABS Surveyor on an annual basis, as applicable:

i) Satisfactory examination of all emergency control stations and operational test of emergency shutdown system (ESD) including recommended sequence as detailed in the Operating Manual

ii) Review of calibration record, operating manual records and logbooks, and insulation resistance logs

iii) Examination and testing of fire/safety equipment, alarms, detectors, gas-tight doors and ventilator dampers

iv) Testing of internal, radio and data communication systems

v) Examination of piping systems as far as practicable

vi) Functional tests of emergency power systems to confirm power supply to rules-required emergency services

vii) Satisfactory examination of control, monitoring, alarm, safety and CCTV systems in accordance with Rules requirements. Manned and/or unmanned substations to be examined and equipment therein to be examined/tested and confirmed in line with the requirements detailed in relevant subsections of these requirements

viii) For ultra-high voltage equipment and system:

Electromagnetic interference: The UHV equipment and conductors' records are to be reviewed to verify that equipment does not produce visible corona on clear nights.

ix) Compliance with any special requirements from the flag Administration, local codes, or regulations

3.2 Special Survey (Every 5 Years)

In addition to the requirements noted in 6/3.1 above and ABS *Rules for Survey after Construction (Part 7)* as applicable for Special Surveys, the following is to be carried out in the presence of an ABS Surveyor:

i) Examination of substation electrical equipment, transformers, cables and penetrations, junction boxes, circuit breakers, switchgear, electrical switchboards and panels for damage, corrosion, or loose connections

ii) Where Gas Insulated Switchgear is fitted, the arrangements are to be examined and confirmed in line with the requirements listed in the relevant subsections of these requirements

iii) CCTV system controls and monitoring systems and warnings in case of close approach to the substation are to be functionally tested in accordance with the requirements listed in the relevant subsection of these requirements

iv) Examination and testing of insulation resistance of motors and cables related to power transmission systems

v) Calibration and maintenance records of essential safety alarms, detectors, and equipment

4 Surveys for OSS Notation

In addition to the requirements of 6/2.1, where an electrical service platform/offshore substation is assigned the optional notation **OSS**, the survey requirements in 6/4.1 and 6/4.2 of this document are to be complied with. Annual Machinery Surveys are to be carried out in accordance with 7-6-2/1 of the ABS Rules for Survey after Construction (Part 7) as applicable. Special Machinery Surveys are to be carried out in accordance with 7-6-2/3 of the ABS Rules for Survey after Construction (Part 7) as applicable.

4.1 Surveys during Construction and Commissioning

This Subsection provides requirements for initial surveys during manufacturing, installation, and start-up (commissioning) of power supply and distribution systems installed onboard the substation.

The purpose of the initial onboard survey of equipment is to verify that the installation is in compliance with the ABS approved plans, with particular emphasis on examination of the following, as applicable:

i) Main power supply and distribution equipment to onshore substation or grid including battery systems where installed

ii) Power transmission plant's electrical connections to the export cables to the onshore substation as detailed in Operating Manual

iii) Verification that the installation is fitted with a reverse power flow relay

iv) Communication system as detailed in 5/4.3 of these requirements.

v) All equipment of the installation including safety devices such as reverse power protection, communication failure etc. are to be tested for proper operation

4.2 Surveys after Construction

In addition to Subsection 6/3, surveys after construction of power supply and distribution systems installed on electrical service platform/offshore substation are mandatory for maintenance of the **Electrical Service Platform (Hull Type)** or **Electrical Service Platform (Offshore Installation)** notation.

For lithium-ion battery systems, the requirements in Section 7-9-25 of the ABS *Rules for Survey after Construction (Part 7)* are to be complied with.

4.2.1 Annual Surveys

In addition to the surveys referenced in 6/3.1 and 7-6-2/1 of the ABS *Rules for Survey after Construction* as applicable for Annual Surveys, the following are to be carried out in the presence of an ABS Surveyor on an annual basis, as applicable:

i) Examination and operational testing of power transmission systems to, related equipment, and export cables electrical connections as detailed in the Operating Manual

ii) Operational testing of equipment of the installation and safety devices to the satisfaction of the attending surveyor

4.2.2 Special Survey (Every 5 Years)

In addition to the requirements noted in 6/4.2.1 above and 7-6-2/3 of the ABS *Rules for Survey after Construction* as applicable for Special Surveys, the following is to be carried out in the presence of an ABS Surveyor:

i) Examination of transmission equipment to onshore substation or grid, transformers, cables and penetrations, export cables, switchboards and panels for damage, corrosion, or loose connections

ii) Examination and testing of insulation resistance of motors and cables related to power transmission systems

iii) Calibration and maintenance records of installation equipment