Requirements for Building and Classing

Offshore Spaceports

May 2023

REQUIREMENTS FOR BUILDING AND CLASSING

OFFSHORE SPACEPORTS
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American Bureau of Shipping
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Foreword

An offshore spaceport is an offshore unit or installation for testing, recovery, and/or launching spacecraft at sea. This document has been developed to provide requirements on design, construction, and survey for class review and approval of offshore spaceports.

This document is applicable to offshore spaceports of the following types: barge-type units, column-stabilized units, offshore installations, and self-elevating units.

A class notation will be offered to a new construction or an existing vessel converted to an offshore spaceport. The notation will be:

- **Spaceport (Recovery, Launch) (hull type)**

The intended service (recovery, launch, or both recovery and launch) and hull type will be included in the notation.

This document addresses two major elements:

- The hull structure
- Onboard machinery, equipment, and systems that are not part of the spacecraft systems.

The requirements for the autonomous and/or remote control systems of the onboard machinery and equipment are associated with the **AUTONOMOUS** and/or **REMOTE-CON** notations. If the remote control operations are limited to dynamic positioning (DP) system during recovery and/or launching operation, a specific set of requirements is provided in 4/6.1, which is a subset of ABS *Requirements for Autonomous and Remote Control Functions*.

This document is to be used in conjunction with the following ABS Rules and Guides, as well as applicable Statutory Regulations:

- ABS *Rules for Building and Classing of Steel Barges (Barge Rules)*
- ABS *Rules for Building and Classing Mobile Offshore Units (MOU Rules)*
- ABS *Rules for Building and Classing Offshore Installations (Offshore Installations Rules)*
- ABS *Guide for Dynamic Positioning Systems (DPS Guide)*
- ABS *Requirements for Autonomous and Remote Control Functions*

This document becomes effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this document is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.

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OFFSHORE SPACEPORTS

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SECTION 1
General

1 Application

This document applies to offshore spaceports defined in 1/7.2 primarily intended for spacecraft testing, launching and/or recovery offshore. The following types of offshore spaceports are covered by this document:

i) Barge-Type Units

ii) Column-Stabilized Units

iii) Offshore Installations

iv) Self-Elevating Units

Other types of offshore spaceports and floating site-specific spaceports will be considered by ABS on a case-by-case basis.

2 Classification

The requirements for conditions of classification are contained in the separate, generic ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

Additional requirements specific to offshore spaceports are contained in the following Sections. Generally, the "core" vessel is to be designed with the applicable requirements for the specific vessel type. Specifically:

- ABS *Rules for Building and Classing Steel Barges (Barge Rules)* for Barge-Type Units
- ABS *Rules for Building and Classing Mobile Offshore Units (MOU Rules)* for Column-Stabilized Units and Self-Elevating Units
- ABS *Rules for Building and Classing Offshore Installations (Offshore Installations Rules)* for Offshore Installations

The requirements for the "core" (or "base") vessels in the listed Rules for submittals, materials, design, construction, and surveys are to be complied with where applicable. Additional requirements for spaceport specific structures, machinery, and equipment are listed in Section 3 and Section 4 of this document.

Note:

If a Barge-Type spaceport is self-propelled, the design of hull structure and machinery, equipment, and systems that are normally on barges follows the *Barge Rules*, while the design of propulsion machinery and special equipment and systems that are normally not on barges follows the *MOU Rules*.

2.1 Scope

The classification of an offshore spaceport addresses two major elements which are subject to the requirements of this document:

i) Hull structure

ii) Onboard machinery, equipment, and systems that are not part of the spacecraft systems

Structural loads and safety hazards due to the presence of the spacecraft system are to be considered for offshore spaceports. Classification of additional equipment and systems may be offered if requested by the Owner.

This document has been developed around unmanned launch and recovery operations on the spaceport. If the spaceport will be manned during launch and/or recovery operations, additional considerations regarding personal safety are required and will be considered on a case-by-case basis.

2.2 Classification Symbols and Notations

The following class notations apply to the offshore spaceports, as defined in 1/7.2.

The Maltese Cross, ✠, symbol is assigned to offshore spaceports for which the hull construction and/or the manufacture of its machinery and components and any associated required testing, as applicable, is carried out under ABS survey. For offshore spaceports constructed under survey of another recognized Classification Society or Authority, the Maltese Cross, ✠, symbol will be omitted from the hull and/or machinery classification notations.

2.2.1 Offshore Spaceports Built under ABS Survey

Offshore spaceports which have been built and constructed to the satisfaction of ABS Surveyors and to the requirements Sections 1 to 5 of this document or to their equivalent, where approved by the Committee, are to be classed and distinguished in the ABS *Record* by the symbol ✠ **A1** followed by the notation for the intended service and hull type given below:

✠ **A1 Spaceport (Recovery) (hull type)**

✠ **A1 Spaceport (Launch) (hull type)**

✠ **A1 Spaceport (Recovery, Launch) (hull type)**

The intended service for recovery and/or launch is included in the notation, and the relevant requirements provided in this document are to be complied with. The service notation will be appended by one of the following **(Barge-Type)**, **(Column-Stabilized)**, **(Offshore Installation)**, or **(Self-Elevating)** to indicate the hull type. The hull structural configurations of these units are described in Subsection 1/7.

Examples of notations for offshore spaceports are:

✠ **A1 Spaceport (Recovery) (Barge-Type)**

✠ **A1 Spaceport (Recovery, Launch) (Column-Stabilized)**

✠ **A1 Spaceport (Launch) (Offshore Installation)**

✠ **A1 Spaceport (Launch) (Self-Elevating)**

2.2.2 Offshore Spaceports Not Built under ABS Survey

Offshore spaceports that are not built under ABS survey but submitted for classification will be subjected to a special classification survey. Where found satisfactory and thereafter approved by the Committee, they will be classed and distinguished in the ABS *Record* by the symbols and

notations as described in 1/2.2.1 and the following Sections but omitting the symbol ✠ signifying survey during construction.

2.2.3 Other Types of Offshore Spaceports

Offshore spaceports which do not fall into the categories listed in Subsection 1/1 will be treated on an individual basis and assigned an appropriate classification designation.

2.2.4 Anchoring (Temporary Mooring) Equipment for Self-Propelled Offshore Spaceports, Ⓔ

For self-propelled offshore spaceports (e.g., self-propelled barge-type units, column-stabilized units) with temporary mooring equipment, the requirements of temporary mooring equipment for anchoring are to be in accordance with Section 3-4-1 of the *MOU Rules*.

2.2.5 Propulsion Machinery

Propulsion machinery and boilers (if any) required for propulsion, and which have been constructed and installed to the satisfaction of the Surveyor to the full requirements of the *MOU Rules* or their equivalent, found satisfactory after a trial, and approved by the Committee, will be classed and distinguished in the ABS *Record* by the notation ✠ **AMS**. This notation is mandatory for classification of self-propelled offshore spaceports built under ABS survey, classed, and distinguished in the ABS *Record* by the notation ✠ **A1**. See also 3-1-1/1.5 of the *MOU Rules*.

Propulsion machinery and systems used for short field moves of non-self-propelled offshore spaceports and complying with the requirements of the *MOU Rules* as applied to self-propelled offshore spaceports manufactured and installed under ABS survey and found satisfactory after trials will be distinguished in the ABS *Record* by the notation ✠ **AMS-NP**, as appropriate. See also 3-1-1/1.7 of the *MOU Rules*.

2.2.6 Autonomous and/or Remote Control Systems, AUTONOMOUS and/or REMOTE-CON

The autonomous and/or remote control systems of the onboard machinery and equipment are to be in accordance with the requirements of the ABS *Requirements for Autonomous and Remote Control Functions*, manufactured and installed under ABS survey, and found satisfactory after trials, and will be distinguished in the ABS *Record* by the notation **AUTONOMOUS** and/or **REMOTE-CON**, as appropriate.

2.3 Optional Class Notations

Upon the Owner's request, offshore spaceports which comply with the ABS Rules and Guides listed below may be assigned the optional class notations described below.

A listing of Classification Symbols and Notations available to the Owners may be viewed and downloaded from the ABS website: http://www.eagle.org. This Section introduces notations that may be applicable for offshore spaceports.

2.3.1 Dynamic Positioning System, ✠ DPS-0, ✠ DPS-1, ✠ DPS-2, ✠ DPS-3

When requested by the Owner, dynamic positioning systems, when used to maintain the spaceport's position during offshore spaceport operations, are to be in accordance with the requirements of the ABS *Guide for Dynamic Positioning Systems (DPS Guide)*, manufactured and installed under ABS survey, and found satisfactory after trials, and may be distinguished in the ABS *Record* by the notation ✠ **DPS-0**, ✠ **DPS-1**, ✠ **DPS-2** or ✠ **DPS-3**, as appropriate.

2.3.2 Crane Register Certificate, CRC

The Crane Register Certificate notation CRC signifies that an ABS Register of Lifting Appliances is issued under the provisions of the ABS *Guide for Certification of Lifting Appliances (Lifting Appliance Guide)*.

2.3.3 Thrusters, ✠ PAS or ✠ APS

Thruster machinery for propulsion assist or athwartship thrust complying with the applicable requirements of Section 4-3-5 of the ABS *Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*, manufactured and installed under ABS survey, and found satisfactory after trials, may be distinguished in the *Record* by the notation ✠ **PAS** or ✠ **APS**, as appropriate.

2.3.4 Position Mooring Equipment and Systems, Ⓜ or Ⓟ

When requested by the Owner, position mooring with anchors, cables, and mooring winches when used to maintain the spaceport's position during offshore spaceport operations, are to be in accordance with the requirements for the class notation Ⓜ or Ⓟ (see Section 3-4-1 of the *MOU Rules* and the ABS *Requirements for Position Mooring Systems*). Safety precautions are to be considered to prevent damaging seabed equipment and units by anchor deployment, recovery, and station keeping.

When requested by the Owner, position (pre-laid) mooring systems, position (pre-laid) mooring equipment, pre-laid mooring system with automatic position control system, and/or pre-laid mooring system with manual position control system are to be in accordance with the requirements for the class notation **(P-PL)**, **(M-PL)**, **TAM-PL** and/or **TAM-PL (Manual)**, respectively (see Section 5 of the ABS *Requirements for Position Mooring Systems*).

2.4 Administration Requirements

Requirements additional to those given in each Section of this document may be imposed by the flag Administration with whom the offshore spaceport is registered or by the Administration within whose territorial jurisdiction the offshore spaceport is intended to operate.

Approval of structural fire protection, fire extinguishing systems, and/or stability of the offshore spaceport by a National Administration may be considered as complying with the class requirements provided such approval can be satisfactorily documented.

3 Risk Evaluations for Alternative Arrangements and Novel Features

Risk assessment techniques may be used to demonstrate that alternatives and novel features provide acceptable levels of safety in line with current offshore and marine industry practice. The ABS *Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries* provide guidance on how to prepare a risk evaluation to demonstrate equivalency or acceptability for a proposed design.

Risk evaluations for the justification of alternative arrangements or novel features may be applicable either to the offshore spaceport as a whole or to individual systems, subsystems, or components. ABS will consider the application of risk evaluations for alternative arrangements and novel features for offshore spaceports. Portions of the offshore spaceport or any of its components not explicitly included in the risk evaluation submitted to ABS are to comply with any applicable parts of the ABS Rules and Guides. If any proposed alternative arrangement or novel feature affects any applicable requirements of a flag or Coastal State, it is the responsibility of the Owner to discuss with the applicable authorities the acceptance of alternatives based on risk evaluations.

For new or novel concepts, (i.e., applications or processes that have no previous experience in the environment being proposed), the guidance encompassed in the class Rules may not be directly applicable to them. The ABS *Guidance Notes on Review and Approval of Novel Concepts* offers ABS clients a methodology for requesting classification of a novel concept. The process described in those Guidance Notes draws upon engineering, testing, and risk assessments to determine if the concept provides acceptable levels of safety in line with current industry practices.

4 Hazard Identification (HAZID)

All hazards that may affect the offshore spaceport due to offshore operations are to be identified with implementation of effective risk control options. A systematic process is to be applied to identify situations

where a combination or sequence of events could lead to undesirable consequences (property damage, personnel safety, and environmental damage), with consideration given to all reasonably foreseeable causes. ABS participation in this HAZID study is required.

The identified risk control options (prevention and mitigation measures) deemed necessary to be implemented are to be considered part of the design basis of the offshore spaceport.

2/2.4 of the ABS *Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries* provides guidance on hazard identification techniques.

5 Submission of Plans and Design Data

Hull and machinery plans, as required below, are to be submitted to ABS for review and approval. All plan submissions originating from manufacturers are understood to be made with the cognizance of the spaceport builder.

The Hazard Identification (HAZID) report in accordance with Subsection 1/4 is to be submitted for review.

5.1 Hull, Design Data and Calculations

Plans showing the scantlings, arrangements, and details of the principal parts of the structure of each offshore spaceport to be built under survey and supporting analyses and calculations are to be submitted for review and approved before the work of construction is commenced, as described in the following.

- Section 1-1-7/1 and 1-5-4/1 of the ABS *Rules for Conditions of Classification (Part 1)* for barge-type units
- Section 3-1-2 and 5-1-1/1.9 of the *MOU Rules* for column-stabilized units and self-elevating units
- Section 1-1-4 and 3-1-1/3 of the *Offshore Installations Rules* for offshore installations

5.2 Machinery Plans

Plans are to be submitted showing the arrangements and details of all propulsion and auxiliary machinery, steering gear, boilers and pressure vessels, electrical systems, bilge and ballast systems, fire extinguishing systems, and other pumps and piping systems as described in the following:

- Section 1-1-7/3 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)* for barge-type units and offshore installations
- Section 4-1-1/5, 4-2-1/7, 4-3-1/5, and 5-2-1/3 of the *MOU Rules* for column-stabilized units and self-elevating units.

5.3 Additional Plans

Where optional class notations or certification under the other Rules, Guides, or regulations, as described in Section 1-1-5 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*, are requested, submission of additional plans and calculations may be required. The submitted design plans and data are to be in accordance with the requirements of this document and the latest edition of the specified codes and/or standards subject to the offshore spaceport's contract date with ABS.

6 Operating Manual

The Operating Manual of the offshore spaceport is to be submitted for review by ABS to verify that operational procedures and conditions are consistent with the design information, criteria, and limitations considered in the classification. ABS is not responsible for the launch vehicle operation of the spaceport, and users are to comply with their licensing authority for flight and ground safety.

A copy of the Operating Manual is preferably to be stored on board the offshore spaceport. Alternatively, the Operating Manual may be retained in a location accessible by operating personnel (e.g., control room on a vessel or onshore) and made readily available to the ABS Surveyor and to service personnel prior to conducting any maintenance or inspection.

Insofar as classification is concerned, the Operating Manual for the offshore spaceport is to include the information in accordance with Section 1-2-5 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*, as appropriate. Spaceport specialized systems, such as launching, recovery, prepping, and storage/securing of spacecraft and storage of propellants and cryogenics, are to be included. ABS review of spaceport specialized systems included in an Operating Manual will be limited to confirming that operational procedure and conditions guidance for the installed systems is included in the Operating Manual, however the assessment of the adequacy and sufficiency of the spaceport specialized systems procedures and conditions is the responsibility of the licensing authority and these procedures will not be assessed or approved by ABS.

Details regarding the manning are to be part of the Operating Manual. This is to include the overall manning approach for the offshore spaceport and is to specifically indicate when and how many people will be on board as well as details of the PPE provided on board.

The Operating Manual required by this Subsection does not need to be in addition to that required by the coastal State or other governmental authorities. These administrations may require that additional information be included in the Operating Manual.

7 Definitions

7.1 Spacecraft

A spacecraft is a vehicle or machine designed to fly beyond the Karman line.

7.2 Offshore Spaceport

An offshore unit or installation for launch vehicle testing, launch and reentry operations, recovery, and/or spacecraft integration.

7.3 Launch Vehicle

- A vehicle built to operate in, or place a payload or human beings in, outer space; and
- A suborbital rocket.

7.4 Reentry Vehicle

A vehicle designed to return from Earth orbit or outer space to Earth, or a reusable launch vehicle designed to return from Earth orbit or outer space to Earth, substantially intact.

7.5 Barge-Type Unit

A floating offshore spaceport with a flat bottom, either under its own power or towed by other vessels.

7.6 Column-Stabilized Unit

A floating offshore spaceport with the main deck connected to the underwater hull or footings by caissons. The unit depends upon the buoyancy of columns or caissons for floatation and stability for all afloat modes of operation, or in the raising or lowering of the unit. Lower hulls or footings may be provided at the bottom of the columns for additional buoyancy.

7.7 Offshore Installation

An Offshore Installation is a buoyant or non-buoyant structure, supported by or attached to the sea floor, whose design is based on foundation and long term environmental conditions at a particular installation site where it is intended to remain.

7.8 Self-Elevating Unit

An offshore spaceport with movable legs capable of raising its hull above the surface of the sea and lowering it back into the sea.

7.9 Self-Propelled Unit

A unit designed with means of propulsion capable of propelling the unit during long distance ocean transits without external assistance. The declaration of the unit as self-propelled is to be requested by the Owner, specified in the contract between the Owner and the builder, and confirmed by ABS and the flag Administration.

7.10 Non-Self-Propelled Unit

A unit that is not a self-propelled unit. Units with machinery used exclusively for positioning, unassisted short field moves as allowed by the flag Administration and/or Coastal State, and to provide assistance during towing operations may be considered non-self-propelled units.

The declaration of the unit as non-self-propelled is to be requested by the Owner, specified in the contract between the Owner and the builder, and confirmed by ABS and the flag Administration.

8 Abbreviations and References

8.1 Abbreviations

ABS	American Bureau of Shipping
ASME	American Society of Mechanical Engineers
DP	Dynamic Positioning
FEA	Finite Element Analysis
FMEA	Failure Mode and Effects Analysis
HAZID	Hazard Identification
IMO	International Maritime Organization
MARPOL	International Convention for the Prevention of Pollution
MODU	Mobile Offshore Drilling Unit
MOU	Mobile Offshore Unit
LSA	Life-Saving Appliance
PPE	Personal Protective Equipment
UPS	Uninterruptible Power Supply

8.2 References

The latest editions of the following ABS documents and industry standards are applicable and referenced in this document.

ABS *Rules for Conditions of Classification (Part 1)*

ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*

ABS *Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*

ABS *Rules for Building and Classing Steel Barges (Barge Rules)*

ABS *Rules for Building and Classing Mobile Offshore Units (MOU 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 Position Mooring Systems*

ABS *Guide for Dynamic Positioning Systems (DPS Guide)*

ABS *Guide for Certification of Lifting Appliances (Lifting Appliance Guide)*

ABS *Guide for Portable Accommodation Modules*

ABS *Guidance Notes on Review and Approval of Novel Concepts*

ABS *Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries*

ASME *Boiler and Pressure Vessel Code (BPVC)* VIII

SECTION 2

Materials and Welding

1 General

The materials and welding used for the construction of offshore spaceports are to meet the requirements in the Part 2 of the core rules, specifically,

- ABS *Rules for Materials and Welding (Part 2)* for barge-type units, column-stabilized units, and self-elevating units.
- Part 2 of the *Offshore Installations Rules* for fixed offshore installations

All materials are to be suitable for the intended service conditions and are to be of the quality defined by a recognized specification, and free of injurious imperfections.

The following additional requirements apply depending on the structure type of the offshore spaceport:

- Section 3-1-2/1, 3-1-2/3, 3-1-2/5, and 3-2-12 of the *Barge Rules* for barge-type units
- Section 3-1-4 and 3-2-6 of the *MOU Rules* for column-stabilized units and self-elevating units

2 Materials for the Launching and Recovery Area

The materials for the launching and recovery area are to be suitable for the intended service conditions and are to be of the quality defined by recognized specifications and free of injurious defects. Materials used in the construction of those structures are to be selected with due attention given to their strength and durability in the marine environment (e.g., the consideration of dynamic forces, thermal effects, and fatigue due to launching and recovery). Materials which do not conform to the requirements of this Section may be considered for approval upon presentation of sufficient evidence of satisfactory performance.

Mill certificates are acceptable for materials for the launching and recovery area. ABS Surveyor witnesses sample testing for each heat number to confirm the mechanical properties of the materials.

3 Materials for Cryogenic Tanks

Materials used in cryogenic tanks in contact with cryogenic liquids are to be suitable for the intended purpose and in compliance with Section 5C-8-6 of the *Marine Vessel Rules*. Thermal insulation is to be applied to prevent the extreme cold from being transferred to spaceport structures via conduction.

SECTION 3
Hull Construction

1 General

The hull design and construction of offshore spaceports are to be in accordance with the applicable requirements in the following ABS Rules.

- Part 3 of the *Barge Rules* for barge-type units
- Part 3 of the *MOU Rules* for column-stabilized units and self-elevating units
- Part 3 of the *Offshore Installations Rules* for offshore installations

2 Structural Design Requirements

The following requirements for structure design are to be complied with, as applicable. The structures in the launching and recovery area are to be reinforced to sufficiently sustain the loads from the impact of the spacecraft during launching and recovery operations. Effects on the spaceport structures due to launching and recovery operations are to be considered, such as impact loads, rocket engine thermal heat, and cryogenic spills. For offshore spaceports temporarily sitting on the bottom or on a pre-laid frame, the loads from the bottom support are also to be considered in the structure design, and the structure of the pre-laid frame is to be designed to sufficiently support the offshore spaceport.

The launching/landing loads are to be considered in the global and local finite element analysis (FEA) for the launching/landing structure. Launching/landing loads are to be calculated using an acceptable approach. For FEA, 3-2-20/1 through 3-2-20/9.1 of the *Marine Vessel Rules* is to be followed, and the stress limits for static and dynamic loads may be used, as applicable.

2.1 Barge-Type Units

The requirements for hull structures and arrangements in Part 3, Chapter 2 of the *Barge Rules* are to be complied with, as applicable.

2.2 Column-Stabilized Units

The requirements for hull structures and arrangements in Part 3, Chapter 2 of the *MOU Rules* are to be complied with, as applicable.

2.3 Offshore Installations

The requirements for hull structures and arrangements in Part 3, Chapter 2 of the *Offshore Installations Rules* are to be complied with, as applicable.

2.4 Self-Elevating Units

The requirements for hull structures and arrangements in Part 3, Chapter 2 of the *MOU Rules* are to be complied with, as applicable.

3 Subdivision and Stability

The intact and damage stability of the offshore spaceport are to be evaluated in accordance with the requirements of the flag and Coastal States. Ship-type installations are to comply with the IMO Code on Intact Stability, the 1966 Load Line Convention, IMO MODU Code as applicable, and MARPOL 73/78. The following requirements are to be complied with, as applicable:

- Part 3, Chapter 6 of the *Barge Rules* for barge-type units
- Part 3, Chapter 3 of the *MOU Rules* for column-stabilized units and self-elevating units
- 3-2-6/5.5 and 3-2-5/9.3 of the *Offshore Installations Rules* for offshore installations

The liquid fuel storage for spacecraft, and the weight and the center of gravity of the rocket are to be included in the stability assessment of the offshore spaceport.

3.1 Overturning Moment

In calculating overturning moments for offshore spaceports, the effect of the spacecraft weight and impact loads with the maximum design wind force associated with the normal operation condition is to be determined. The full range of spacecraft positions, elevations, and weights is to be considered in order to investigate the most critical scenarios. The wind area of the spacecraft is to be considered in the calculation of the overturning moment. Potential dynamic forces from the rocket that could generate an overturning moment to the spaceport are to be considered in the design of offshore spaceports.

4 Safety Requirements and Fire Protection

Offshore spaceports that are either permanently or temporarily manned are to comply with the flag Administration requirements for all requirements relating to safety of personnel on board. This includes but is not limited to muster areas, means of escape, life-saving appliances, and fire protection. In the absence of any specific requirements from the flag Administration, the requirements listed in 4/4.1 to 4/4.5 are to apply at a minimum. For unmanned offshore spaceports, the requirements listed in 4/4.4 and 4/4.5 are also applicable. The launching and/or recovery operations are considered unmanned in this document. If launching and/or recovery operations are manned, they are subject to special consideration and will be reviewed by ABS on a case-by-case basis.

4.1 Muster Areas

For manned offshore spaceports, a designated muster station(s) where personnel can gather prior to entering the lifeboats is to be included in the design plan, conforming to the following requirements.

- All materials that comprise the muster stations routes are to be of steel or equivalent material.
- The muster station is to be of sufficient area to accommodate the number of personnel to be gathered.
- The muster station is to be located in a safe location.
- The muster station may be a meeting room inside the accommodations or may be part of the lifeboat embarkation station.

4.2 Means of Escape

At least two (2) means of escape are to be provided for all continuously manned areas and areas that are used on a regular working basis. The two (2) means of escape must be through routes that minimize the possibility of having both routes blocked in an emergency situation. Escape routes are to have a minimum width of 0.71 m (28 in.). Dead-end corridors (pathway which has no exit when used during an escape) exceeding 7 m (23 ft) in length are not permitted.

Escape route paths are to be properly identified and provided with adequate lighting.

An escape route plan is to be prominently displayed at various points in the facility or is to be included in the Fire Control or Fire/Safety Plan and submitted as one of the submittals listed in Subsection 1/5.

4.3 Life-saving Appliances

Offshore spaceports with personnel are to maintain at least two access/exit gangways during operations to facilitate personnel escape in the event of an emergency situation on the spaceport. Alternatively, at least two widely separated fixed metal ladders or stairways may be provided extending from the deck to the surface of the water. The gangways, fixed metal ladder or stairways and sea areas in the vicinity should be adequately illuminated by emergency lighting.

Offshore spaceports are to comply with the applicable provisions of the International Life-Saving Appliance (LSA) Code on lifeboats, rafts, and vests during manned operations or the following requirements at a minimum. The locations of life-saving appliances are to be protected from blast and heat from the launching/landing pad.

4.3.1 Lifeboats

Lifeboats of an approved type are to be provided, with a total capacity to accommodate twice the total number of people on board the offshore spaceport. The lifeboats are required to be installed on at least two (2) sides of the offshore spaceport, in which there will be accommodation for 100%, in case one of the stations becomes inoperable. Alternatively, for ship-type units, free-fall lifeboats with aggregate capacity to accommodate the total number of persons on board, where provided, are subject to acceptance by the flag Administration. The lifeboats are to be stowed in a secure and sheltered position and protected from damage by fire and explosion.

4.3.2 Liferafts

Inflatable liferafts of an approved type are to be provided on board such that their total capacity is sufficient to accommodate the total number of people expected to be on board the offshore spaceport. Liferafts are to be placed in or next to areas where personnel may be working, in sufficient quantity to hold the maximum number of people that might be present in the area at any one (1) time. The liferafts are to be stowed in a secure and sheltered position and protected from damage by fire and explosion.

The liferafts for self-elevating spaceports should be davit launching type unless two access/exit gangways are located near liferaft store location and can reach to the water surface so that the people on board can embark to liferafts when the self-elevating spaceport is in elevated mode.

4.3.3 Life Jackets

At least one (1) life jacket of an approved type, is to be provided for each person on a manned offshore spaceport. Life jackets are to be stored in readily accessible locations. Life jackets numbering the same quantity as the maximum aggregate capacity of each lifeboat station are to be stored next to the lifeboat station.

4.3.4 Work Vests

When personnel baskets are used to transfer personnel from the facility to work boats, or vice versa, a work vest is to be provided and kept with the personnel basket for each person riding in the basket.

4.3.5 Personal Protective Equipment

For asphyxiation and toxicity risks, personal protective equipment (PPE) for responders and/or personnel escaping to muster stations are to be available on board the offshore spaceport in sufficient quantities as determined by the HAZID study (see Subsection 1/4) and specified in the Operating Manual (see Subsection 1/6).

4.4 Safety Zones and Restricted Areas

Safety Zones and restricted areas are to be defined for each launch and recovery operation to keep vessels other than the offshore spaceport from entering the launch and recovery area while an active spacecraft launch/recovery is taking place. Operators are to comply with their governing launch license requirements for launch essential personnel and assets as approved by their license authority.

4.5 Fire Protection

Fire and gas hazards arising from dockside operation, transit, and normal operation are to be evaluated based on the specific offshore spaceport risk assessment. Firefighting or suppression systems (e.g., water suppression) for the launching, recovery, fuel storage, etc., are to follow applicable industry or manufacturer standards.

The design basis/philosophy of an offshore spaceport are to be provided to ABS for review and are to be aligned with the applicable fire safety requirements in the *MOU Rules*, such as

- Installation of materials which contain asbestos is prohibited.
- Structural fire protection is to follow applicable requirements in 5-1-1/3 of the *MOU Rules*.
- Protection of accommodation spaces, service spaces, and control stations is to follow applicable requirements in 5-1-1/5 of the *MOU Rules*.
- Portable fire extinguishers are to follow applicable requirements in Section 5-2-4 of the *MOU Rules*.

SECTION 4

Machinery, Equipment and Systems

1 General Requirements

Machinery, equipment, and systems that support marine operations are to be in accordance with the applicable requirements of:

- Part 4 and Section 3-3-1 of the *Barge Rules* for barge-type units
- Part 4 and Part 6 of the *MOU Rules* for column-stabilized units, offshore installation, and self-elevating units.

2 Marine Piping Systems

Piping systems that support marine operations are to be in accordance with the applicable requirements of:

- Section 4-1-2 of the *Barge Rules* for barge-type units
- Part 4, Chapter 2 of the *MOU Rules* for column-stabilized units, offshore installation, and self-elevating units.

If a system is serving marine operations and offshore spaceport operations (e.g., hydraulic power to offshore spaceport operations, cooling systems, etc.), the design criteria of the system is to meet the above requirements, as applicable. If a part of the system serves only offshore spaceport operation and can be isolated from the part serving marine operations, other recognized industrial standards or manufacturer standards may be applied to that part of the system up to but not including the isolating valve.

3 Electrical Systems

Electrical equipment and systems are to be in accordance with the applicable requirements of:

- Section 4-1-3 of the *Barge Rules* for barge-type units
- Part 4, Chapter 3 of the *MOU Rules* for column-stabilized units, offshore Installation, and self-elevating units.

If a system is serving marine operations and offshore spaceport operations (e.g., power supply to offshore spaceports), the design criteria of the system is to meet the above requirements, as applicable. If a part of the system serves only offshore spaceport operation and can be isolated from the part serving marine operations, other recognized industrial standards or manufacturer standards may be applied to that part of the system up to but not including the isolating circuit.

4 Control and Remote Operation

A central control station is to be provided for controlling or coordinating the operations of onboard machinery, equipment, and systems. The central control station is to be able to provide an overview of all systems and activities associated with normal operations. Computer-based systems are to comply with Section 4-9-3 of the *Marine Vessel Rules*. The requirements of remote control station are listed in 4/6.1.

Controls, displays, and alarms are to provide for safe and reliable performance of all the required functions carried out from the control station.

When control of the onboard machinery, equipment, and systems is possible from more than one control location, control is to be possible only from one control location at a time, except for those safety related functions (emergency shutdown, etc.). A clear method to transfer control between stations is to be provided. At each control location, there is to be an indicator showing which location is in control. Means of communication are to be provided between the central control station and the local control stations for the onboard machinery, equipment, and systems. Communication systems are to be installed to minimize disturbances or interference generated by foreign sources of energy.

5 Station Keeping Systems

A station keeping system is to be provided to keep the spaceport on position, within an operationally defined radius. Dynamic positioning systems are to be in accordance with 1/2.3.1. For mooring system, the station keeping system is to meet applicable requirements of:

- 3-4-1/3 and 6-1-10/3 of the *MOU Rules* for temporary mooring equipment
- ABS *Requirements for Position Mooring Systems* for mooring systems, if any

6 Autonomous and Remote Control System

The autonomous and remote control system is to be in accordance with the applicable requirements of the ABS *Requirements for Autonomous and Remote Control Functions*. For autonomous and remote control system is limited to DP operations as defined in 4/6.1, the minimum requirements listed in 4/6.1 are to be satisfied.

6.1 Remote Controlled DP Operations

For remote controlled DP operations that are limited to the following:

i) During recovery and/or launching operations, the spaceport is operated using DP system and is remotely controlled.

ii) Support vessels are on standby and are at a safe distance from the spaceport.

iii) No marine traffic is nearby in launch and landing operations hazard zone.

iv) Comply with coastal state/federal regulations and flag agreement.

The remote controlled DP system is to satisfy the following requirements as a minimum:

i) The DP system is to at least satisfy ABS DPS-2 requirements.

ii) Identify hazards related to remote controlled DP operations in HAZID workshop. The purpose of the HAZID is to identify potential hazards and hazardous situations, consider their consequences, and address them with appropriate prevention or mitigation measures. The major hazards in marine and offshore industries can be found in Appendix 2 of the ABS *Requirements for Autonomous and Remote Control Functions*.

iii) Failure Mode and Effects Analysis (FMEA) and sea trials of the DP systems to include remote controlled DP operations.

The remote control function is to comply with the following requirements:

i) The remote control station is to be constantly manned.

ii) The remote operator is to be designated and will have responsibility over the function being controlled in a remote location.

iii) The remote operator is to be able to monitor the system and operations under remote control at all times.

iv) The remote operator is to be able to control the function in real-time from the remote location.

The remote control station is to satisfy the following requirements:

i) Requirements pertaining to remote operator training and qualifications do not fall under the purview of ABS. The flag Administration is to be consulted for instructions and guidance on the minimum qualification and training requirements of these operators. The competence requirements of the operators are to be defined and documented in the Operating Manual.

ii) Computer and communication systems are to be supplied power from uninterruptible power supply (UPS). In the event of a loss of power, the UPS is to have sufficient power for operations of the remote control function to safely terminate and successfully transfer control to an onboard operator or to transition to a safe state. Calculations and justifications in this regard are to be submitted to ABS for review. Loss of power and transfer of power to the UPS is to be alarmed at the remote control station and on board the spaceport.

iii) Alarms requiring the attention of the remote operator are to be provided with visual and audible alarms.

iv) The remote operator is to be provided with a sufficient level of situational awareness of the operations being carried out by the function on board the spaceport. The level of situational awareness required is dependent on the nature of the operations.

v) Live visual feed of the operations being carried out by the function on board the spaceport is to be provided at the remote control station. In the case of partial or full failure of video feeds, the operator is to have demonstrably effective backup operational capabilities for situational awareness and decision support.

7 Telemetry and Communication System

Telemetry and Communication systems on board are to comply with the applicable requirements of 4-9-3/13 of the *Marine Vessel Rules*.

8 Lifting Appliances

The lifting appliances (cranes), if in the class scope, are to be in accordance with the applicable requirements of the *Lifting Appliance Guide*, including offshore recovery of crewed capsules and fairings as well as personnel and material transfer.

9 Spacecraft Propellant Station

If on board, the spacecraft propellant system is to be arranged so that no hydrocarbon or toxic propellant is discharged to the environment during normal propellant transfer operations. Means are to be provided to relieve residual pressure and for draining the liquid from the propellant transport lines at propellant transporting completion.

The cryogenic tanks are to be in accordance with the applicable requirements of recognized pressure vessel standards such as the ASME Boiler and Pressure Vessel Code (BPVC) VIII, as well as additional Class requirements and statutory regulations. Materials used in cryogenic tanks are to comply with the requirements of Subsection 2/3 of this document. Safety measures are to be taken to prevent structure

damage occurring from cryogenic liquid leaks, spills, or drips. Valves are to be designed to be suitable for cryogenic service to prevent leaks at low ambient temperatures. Safety procedures are to be in place for personnel handling cryogenic fluids.

All pipelines, hoses, or components which may be isolated in a liquid full condition, or where liquid may accumulate, are to be protected by relief valves. The outlet from these pressure relief valves is to be led to the cryogenic tanks. Alternatively, they may discharge to the vent mast if means are provided to detect and dispose of any liquid cargo which may flow into the vent system.

Personnel on board are to be safeguarded from any hydrocarbon or toxic propellant release.

Fire extinguishing systems are to be provided for each cryogenic tank area in accordance with Part 5 of the *MOU Rules*, as applicable.

10 Portable Accommodation Modules

Portable accommodation modules are to be in accordance with the applicable requirements of the ABS *Guide for Portable Accommodation Modules*. The results of risk assessments and other evaluations (such as fire/blast analysis) are to be considered in the design of the location and safety of the portable accommodation modules.

11 Removable Equipment

Removable equipment is not a permanent part of an offshore spaceport and is intended to be removed after a finite period of time (e.g., pre-service stage, spacecraft launch/recovery stage). Removable equipment can present new hazards to the offshore spaceport during its installation, use, and removal. The use of the removable equipment and its location are to be accounted for in the risk analyses so that potential hazards due to use of the removable equipment are identified, assessed, and controlled. Temporarily revised management and control arrangements for safe operation and maintenance of removable equipment are to be established and implemented. Specification of interface on board for the removable equipment is to be sufficiently detailed.

Removable equipment is to be designed and installed to:

- Fulfill its intended functions
- Avoid jeopardizing the safety of personnel and permanent structure and equipment
- Be safely transported and installed
- Comply with regulatory requirements

1 Surveys During Construction

1.1 General

Surveys during construction of offshore spaceports are to be in accordance with the core Rules listed in Subsection 1/2, as applicable.

2 Surveys After Construction

2.1 General

Surveys after construction of offshore spaceports are to be in accordance with the core Rules listed in Subsection 1/2 and the ABS *Rules for Survey After Construction (Part 7)*, as applicable.

2.2 Annual Surveys

In addition to the surveys referenced in 5/2.1 above, the following are to be carried out in the presence of an ABS Surveyor on an annual basis, as applicable:

i) Examination of any critical structure identified during design review and HAZID workshop, as applicable.

ii) Operational test of all emergency stops, controls, and remote controls.

iii) Review of calibration record, Operating Manual defined in Subsection 1/6, and logbooks.

iv) Examination and testing of fire/safety alarms and detectors.

v) Testing of all means of communication, including internal, external, and spacecraft-to-spaceport communication.

vi) Examination of all piping systems.

vii) Functional tests of equipment integrated or associated with the spaceport's systems.

viii) Examination and testing of electrical systems and related equipment.

ix) Operational test of all spaceport equipment alarms.

x) Onboard PPE is to be provided in sufficient quantities as determined by the HAZID study (see Subsection 1/4) and specified in the Operating Manual (see Subsection 1/6). PPE is to be examined in order to confirm it is in suitable condition and not expired or in need of periodic servicing.

xi) Examination and testing of the Remote Operator Station (for Autonomous functions with Operations Supervision Levels RO1, RO2 or RO3) and/or the Remote Control Station (for Remote

Control functions). Testing involving the Remote Operator Station or Remote Control Station arrangements are to be conducted in conjunction with the spaceport in the presence of attending Surveyors at both the spaceport and the Remote Operator Station or Remote Control Station. Refer to Section 7-9-38 of the ABS *Rules for Survey After Construction (Part 7)* for details.

xii) Examination and testing of the Thrusters and Dynamic Positioning Systems (PAS, APS, DPS-0, DSP-1, DPS-2, DPS-3), arrangements are to be conducted in conjunction with the spaceport in the presence of attending Surveyors. Refer to Section 7-9-6 of the ABS *Rules for Survey After Construction (Part 7)* for details.

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

2.3 Special Periodical Surveys (Every 5 Years)

In addition to the applicable requirements noted in 5/2.2 above for Annual Surveys, the following is to be carried out in the presence of an ABS Surveyor:

i) Examination of structure and hull connection weld points, supplemented by NDT of the connection welds for items identified in 5/2.2i).

ii) Examination of electrical equipment wiring, wireways, junction boxes, and electrical panels for damage, corrosion, or loose connections.

iii) Examination and testing of insulation resistance of cables related to autonomous and remote control systems. Refer to Section 7-9-38 of the ABS *Rules for Survey After Construction (Part 7)* for details.

iv) Calibration of essential safety alarms, detectors, and equipment.

v) Onboard PPE is to be provided in sufficient quantities as determined by the HAZID study (see Subsection 1/4) and specified in the Operating Manual (see Subsection 1/6). PPE is to be examined in order to confirm it is in suitable condition and not expired or in need of periodic servicing.

vi) Examination and testing of the Remote Operator Station (for Autonomous functions with Operations Supervision Levels RO1, RO2 or RO3) and/or the Remote Control Station (for Remote Control functions). Testing involving the Remote Operator Station or Remote Control Station arrangements are to be conducted in conjunction with the spaceport in the presence of attending Surveyors at both the spaceport and the Remote Operator Station or Remote Control Station. Refer to Section 7-9-38 of the ABS *Rules for Survey After Construction (Part 7)* for details.

vii) Examination and testing of the Thrusters and Dynamic Positioning Systems (PAS, APS, DPS-0, DSP-1, DPS-2, DPS-3), arrangements are to be conducted in conjunction with the spaceport in the presence of attending Surveyors. Refer to Section 7-9-6 of the ABS *Rules for Survey After Construction (Part 7)* for details.

2.4 Additional Surveys (after each Launch and/or Recovery)

After each launch and/or recovery, an inspection by the onsite crew is to be carried out to check for potential structural damage and equipment malfunctioning that occurred during launch and/or recovery operations. The inspection report is to be made available to ABS for review during scheduled surveys. Damage, failure, or deterioration to hull, machinery, or equipment detected by the Owner's inspection which affects or may affect classification, is to be submitted by the Owners or their representatives for examination by an ABS Surveyor at first opportunity. All repairs found necessary by the Surveyor are to be carried out to the Surveyor's satisfaction. Refer to 1-1-8/1 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.