



GUIDE FOR CLASSIFICATION OF

INDUSTRIAL SYSTEMS AND EQUIPMENT

MAY 2015

**American Bureau of Shipping
Incorporated by Act of Legislature of
the State of New York 1862**

**Copyright © 2015
American Bureau of Shipping
ABS Plaza
16855 Northchase Drive
Houston, TX 77060 USA**

Foreword

This *Guide for the Classification of Industrial Systems and Equipment* has been developed to provide requirements for class review and approval of industrial equipment that may be installed onboard a variety of vessels or offshore units.

This Guide outlines the ABS requirements for the design, construction, installation, and survey after construction of industrial equipment installed onboard ABS classed Vessels, Steel Barges or Mobile Offshore Units (MOUs).

Industrial equipment designed, constructed, and installed in accordance with the requirements of this Guide on an ABS classed vessel or mobile offshore unit, under ABS review and survey, will be classed and identified in the *Record* by an appropriate classification notation as defined herein.

In this edition of the Guide, 1-1/5.1 and Chapter 2 focus on Pipe Laying Equipment, but the concepts in the Guide can be applied to other types of industrial equipment.

The effective date of this Guide is the first day of the month of publication. The application of this Guide and referred Rules and Guides is, in general, based on the contract date for construction between the shipbuilder and the prospective Owner (e.g., Rules which became effective on 1 September 2014 are not applicable to a vessel or unit for which the contract for construction was signed on 31 August 2014). At the Owner's request and upon agreement by ABS, this Guide may be applied to existing vessels or units or to those projects for which the contract date of construction has been signed before 1 August 2014. See also 1-1-4/3 of the *ABS Rules for Conditions of Classification (Part 1)*.

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

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



GUIDE FOR CLASSIFICATION OF INDUSTRIAL SYSTEMS AND EQUIPMENT

CONTENTS

CHAPTER 1	Scope and Conditions of Certification	1
	Section 1 General.....	2
CHAPTER 2	Pipe Laying Systems and Equipment.....	4
	Section 1 General.....	6
	Section 2 Classification of Pipe Laying Systems and Equipment	10
	Section 3 Design Review of Pipe Laying Systems and Equipment	15
CHAPTER 3	Surveys	24
	Section 1 General.....	25
	Section 2 Survey of Industrial Systems and Equipment During Manufacture.....	26
	Section 3 Installation, Commissioning and Survey After Construction	28
APPENDIX 1	References.....	31

This Page Intentionally Left Blank



CHAPTER 1 Scope and Conditions of Certification

CONTENTS

SECTION 1	General	2
1	Application	2
3	Scope	2
5	Class Notations.....	2
5.1	☒ IE (Pipe Lay) – Industrial Equipment (Pipe Laying).....	2
5.3	Equipment Built Under ABS Survey	2
5.5	Equipment Not Built Under ABS Survey.....	2
7	Approval Process.....	3
9	ABS Approvals.....	3

CHAPTER 1 Scope and Conditions of Certification

SECTION 1 General

1 Application

This Guide has been developed to provide requirements for the design, construction, installation and survey of industrial systems and equipment onboard vessels and/or mobile offshore units classed with ABS. The requirements as specified in this Guide are additional to all other relevant requirements of ABS Rules and Guides.

3 Scope

This Guide addresses the engineering and safety aspects related to industrial systems and equipment installed onboard vessels or mobile offshore units classed with ABS other than those covered by the *ABS Rules for Building and Classing Facilities on Offshore Installations*. The scope of the Guide is limited to industrial systems and equipment necessary for pipe laying operations of a dedicated offshore support vessel or unit. However, the requirements of this Guide may be applied to other types of industrial equipment installed onboard vessels and/or mobile offshore units such as cable laying, pile driving, offshore construction maintenance, or anchor handling considering equivalent recognized standards where recognized standards are referenced in this Guide.

The specialized offshore industrial systems and equipment may be permanent, temporary or portable.

5 Class Notations

5.1 ☒ IE (Pipe Lay) – Industrial Equipment (Pipe Laying)

At the request of the owner, **☒ IE (Pipe Lay)** may be assigned for industrial systems and equipment reviewed, approved and constructed under ABS Survey for installation onboard an ABS classed vessel or unit for a dedicated pipe laying service.

For example, a pipe laying vessel with a notation **☒ A1 Offshore Support Vessel (Pipe Lay)** may be assigned with industry equipment notation **☒ A1 Offshore Support Vessel (Pipe Lay), ☒ IE (Pipe Lay)**. A mobile offshore unit with notation **☒ A1 Pipe Lay Service** may be assigned with industry equipment notation **☒ A1 Pipe Lay Service, ☒ IE (Pipe Lay)**.

With appropriate modifications this Guide can also be used to class the industrial systems installed on ABS classed vessels used for other services such as but not limited to Cable Laying, Anchor Handling, Pile Driving, Offshore Construction, Maintenance / Utility. ABS is prepared to provide similar notations.

5.3 Equipment Built Under ABS Survey

The symbol “☒” (Maltese Cross) signifies that the equipment, and/or components were built, installed and commissioned to the satisfaction of the ABS Surveyor.

5.5 Equipment Not Built Under ABS Survey

Equipment, and/or components that have not been built under ABS survey, but which are submitted for Classification, will be subjected to special consideration. Where found satisfactory and thereafter approved by the Committee, they may be classed and distinguished in the *Record* by the notation described above, but the symbol “☒” signifying survey during construction will be omitted.

7 Approval Process

The ABS classification requirements for industrial systems and equipment are a four-step process as outlined below:

- i) Design Review of the Industrial Systems and Equipment, including installation.
- ii) Survey of Industrial Systems and Equipment at Vendor's Shop during manufacture.
- iii) Survey of installation and commissioning onboard the Vessel.
- iv) Survey after construction.

The ABS review process for industrial systems and equipment commences with drawings and documentation detailing the general arrangements/assembly drawings of equipment, structural fire protection of enclosures where applicable, electrical configuration, structural design, machinery and piping systems being submitted to the ABS Technical Office for engineering review. Upon completion of the technical review, the submitter will be notified, and the reviewed drawings and documentation will be made available to the attending ABS Surveyor.

Once a vessel for the industrial equipment notation is specified, design review for installation approval can be commenced. Upon receipt of the documentation detailing the industrial systems and equipment and the proposed location onboard the vessel, the ABS technical office can review the arrangements. Once the ABS engineers have determined that the proposed location onboard the vessel is suitable for the subject industrial systems and equipment, the proposal will be accepted and made available to the attending ABS Survey office. Upon receipt of these drawings, the ABS Surveyor will attend the vessel to confirm that the installation of the industrial equipment is in accordance with the previously approved arrangements.

9 ABS Approvals

ABS approval of industrial systems and equipment may be achieved through one of the following means:

- i) Design review, which is a review of individual materials, components, products and systems for compliance with ABS Rules, Guides or other recognized standards. This includes a review of individual components, testing and approval, per applicable ABS Rules.
- ii) Equipment approval through the ABS Type Approval Program and a system design review in which:
 - a) According to Rule requirements, individual equipment components have already had a design review and type testing resulting in a valid Product Design Assessment (PDA), these components may or may not need additional unit certification.
 - b) The system for which approval is being sought is submitted to Engineering for review which incorporates equipment in ABS Type Approval Program and are listed in the bill of materials [see 1-1-4/7.7 of the *ABS Rules for Conditions of Classification (Part 1)*].



CHAPTER 2 Pipe Laying Systems and Equipment

CONTENTS

SECTION 1	General	6
1	Scope	6
3	Definitions	6
5	Design of Pipe Laying Systems and Equipment.....	7
5.1	General.....	7
5.3	Equipment Layout.....	7
5.5	Materials	8
5.7	Welding and Nondestructive Examination	8
5.9	Design Specifications	8
5.11	Design Considerations.....	8
SECTION 2	Classification of Pipe Laying Systems and Equipment	10
1	Requirements for Pipe Laying Systems and Equipment	10
3	Plans and Data to be Submitted	13
3.1	Industrial Equipment and Systems	13
3.3	Installation Plans.....	13
TABLE 1	Pipe Laying System Types Classification Requirements.....	10
TABLE 2	Pipe Laying Systems and Equipment Classification Requirements.....	11
TABLE 3	Standard Components Classification Requirements	12
TABLE 4	Table Key for Technical Review and Survey Requirements.....	13
SECTION 3	Design Review of Pipe Laying Systems and Equipment	15
1	Pipe Laying Systems	15
1.1	S-Lay	15
1.3	J-Lay.....	15
1.5	Flex-Lay.....	16
1.7	Reel-Lay	16
3	Pipe Laying Equipment	16
3.1	Winch and Accessories	16
3.3	Cranes	17
3.5	Firing Line Equipment.....	18
3.7	Pipe Loading Systems	18
3.9	Tensioners.....	19
3.11	Carousels, Reels, Pipe Racks and Support Structure	19
3.13	Hang-Off Clamps.....	19

	3.15	Pipe Straighteners	19
	3.17	Pipe Handling Equipment	19
	3.19	PLET Handling System	20
5		Standard Components	20
	5.1	Hydraulic and Pneumatic Systems	20
	5.3	Electrical Systems and Equipment	21
	5.5	Control Systems	22
	5.7	Safety Systems – Equipment	23

CHAPTER 2 Pipe Laying Systems and Equipment

SECTION 1 General

1 Scope

Scope of classification under this Guide is limited to the equipment installed onboard necessary for supporting the pipe laying operations.

3 Definitions

Carousel. Carousels are used for storage during transportation and installation of flexible pipe, umbilicals, risers and other products for offshore applications. The carousel comprises a lower flange located on a central king pin, a hub and an upper flange. The position of the upper flange is adjustable and the flange is locked in place making use of special spacer bars.

Chute or Wheel. A part of the pipe laying system used for installing flexible pipelines, risers and in-line structures. Normally located on tower top.

Flex-Lay. A method for installing flexible pipelines, risers and in-line structures. A Flex-lay system mainly consists of a vertical ramp equipped with one or more tensioners and a chute or wheel on tower top.

Gantry, Mast or "A-Frame". A structural frame, extending above the revolving upper structure to which the boom support ropes are reeved.

Hang-Off Clamps. Hang-off clamps are used to hold the pipe when it is not suspended by other means such as tensioners or traveling blocks.

J-Lay. A method for installing subsea pipelines in deepwater. Pipe stalks with a length up to 6 joints are upended and welded to the seagoing pipe in a near vertical ramp.

Knuckle Boom. Similar to a standard crane, except that the boom articulates at the 'knuckle' near the middle, letting it fold back like a finger.

Line-Up Systems. External line-up tools are used to align new pipe with the seagoing pipe.

Overhead or Bridge Crane. Consisting of parallel runways with a traveling bridge spanning the gap and traveling hoist upon which the ropes are reeved.

Pedestal Crane. A conventional boom crane mounted on a pedestal foundation with a revolving upper structure.

Pipe Straighteners. Pipe needs to be straightened after it is spooled from the reel. It is bent over the aligner before it is overboarded.

PLET Handling System. System allows for PLET (Pipeline End Termination) handling or diameter changes when transporting the PLET from the storage position to the ramp without crane assistance.

Reel. A large spool used for storing of rigid and flexible pipe, umbilicals, risers and other products for offshore applications.

Reel-Lay. A method for installing flexible and rigid subsea pipelines. Long pipe segments are welded, tested and coated onshore and then spooled onto a large vertical pipe reel in one continuous length.

S-Lay. During the S-lay installation method, onboard welded pipe joints leave the vessel horizontally and are guided off the stern by a "stinger" (a structure on the back of the vessel that supports the seagoing pipe string to control its bend radius).

Spooling Device Tensioner. Tensioners are the central elements of most pipe laying systems. They are used onboard pipe laying vessels to keep tension in the pipeline while it is being lowered onto the seabed. The required type of tensioner depends on the pipe specifics as well as the configuration of the pipe laying system.

Tensioner. Tensioners are the central elements of most pipe laying systems. They are used onboard pipe laying vessels to keep tension in the pipeline while it is being lowered onto the seabed. The tensioner is often provided with a sophisticated electric or hydraulic system, by which the tension in the pipe can be controlled even when the vessel is subject to motions. Typical pipe lay tensioners monitor the outboard pipe tension and paid out length as part of the lay process, with feedback going to the lay speed setting or vessel DP system.

5 Design of Pipe Laying Systems and Equipment

5.1 General

The designer is to evaluate pipe laying systems and equipment as a whole, considering the interfacing and interdependence of subsystems.

The required design plans and data related to the pipe laying systems and equipment are to be submitted for approval in accordance with 2-2/Tables 1 through 4.

5.3 Equipment Layout

Equipment layout and work areas associated with the pipe laying activities are to be arranged with the following objectives:

- i) Safety of personnel and operation.
- ii) Separation of fuel and ignition source as far as practical.
- iii) Minimizing the probability of ignition.
- iv) Minimizing the consequences of fire and explosions.
- v) Preventing fire escalation and equipment damage.
- vi) Providing for adequate arrangements for escape and evacuation.
- vii) Facilitating effective emergency response.
- viii) Minimizing dropped object hazards to personnel, equipment (on facility and subsea), and structure.
- ix) Protection of critical systems and equipment from damage during operation, such as:
 - Electrical cables and cableways.
 - Exhaust ducting and air intake ducting.
 - Control and shutdown systems.
 - Fire-fighting equipment is to be arranged so that it is protected from damage during operations.
- x) Equipment arrangements are to provide access for inspection and servicing and safe means of egress from all machinery spaces.
- xi) Electrical equipment in hazardous areas is to be certified-safe type, suitable for such locations. Such equipment must be type-tested and certified by a competent independent testing laboratory for installation within hazardous areas.
- xii) Combustion equipment and combustion engines are not to be located in hazardous areas.
- xiii) Equipment arrangement drawings are to show the location of all equipment, accommodations, machinery spaces, tanks, moon pools, escape routes, evacuation equipment, air intakes, openings to closed spaces, and any fire and barrier walls.
- xiv) Additional requirements related to general arrangement and equipment layout also are to consider the applicable requirements of 4-8-3/1.11.1 of the *OSV Rules*.
- xv) The pipe laying systems and equipment arrangement drawings are to indicate the hazardous areas throughout the vessel, as defined in 4-8-4/29.3 of the *OSV Rules*.

5.5 Materials

The materials for each equipment or component are to be selected with consideration of their fitness for the intended service and in accordance with the applicable codes and standards as referenced in this Guide.

The experience of the manufacturers, designers and related performance records will be specially considered with appropriate technical justifications.

5.7 Welding and Nondestructive Examination

General requirements for welding and nondestructive examination (NDE) are to be in accordance with *ABS Rules for Materials and Welding (Part 2)* or *ABS Nondestructive Inspection of Hull Welds*, as applicable.

5.9 Design Specifications

The design specification for pipe laying systems and equipment is to consider as a minimum, but not limited to, the most adverse combination of applicable loads and is to consist of design plans, drawings, data, and calculations, to substantiate the design.

In addition to the design specifications, the manufacturing specifications are to include material specifications, WPS/PQR, NDE, and testing procedures/specifications utilized in the manufacturing, installation, and commissioning of each system, subsystem, equipment, and/or component and are to comply with the applicable section of this Guide, in addition to the codes or standards used.

5.11 Design Considerations

5.11.1 Recognized Standards

The submitted design is to be in accordance with the requirements of this Guide and recognized codes and standards acceptable to ABS (see Appendix 1 of this Guide for examples of recognized standards).

5.11.2 Alternative Basis of Design

When alternate design codes and standards are proposed, justifications can be achieved through equivalency, gap analysis or appropriate risk analysis/philosophy to demonstrate that the proposed alternate design code and standard will provide an equivalent level of safety to the recognized standards.

Designs based on manufacturers' standards may also be accepted. In such cases, complete details of the manufacturer's standard and engineering justification are to be submitted for review.

- i) The manufacturer will be required to demonstrate by way of testing or analysis that the design criteria employed results in a level of safety consistent with that of a recognized standard or code of practice.
- ii) Where strain gauge testing, fracture analysis, proof testing or similar procedures form a part of the manufacturer's design criteria, the procedure and results are to be submitted for ABS review.
- iii) Historical performance data for pipe laying systems and equipment is to be submitted for justification of designs based on manufacturers' standards.
- iv) ABS will consider the application of risk evaluations for alternative or novel features for the basis of design in accordance with the *ABS Guidance Notes on Review and Approval of Novel Concepts*, *ABS Guidance Notes on Risk Assessment Applications for the Marine and Offshore Oil and Gas Industries*, and *ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities* which provide guidance to ABS clients on how to prepare a risk evaluation to demonstrate equivalency or acceptability for a proposed pipe laying system and equipment design.

5.11.3 Corrosion/Erosion Allowance

Where pipe laying systems and equipment (including piping systems), subsystems, equipment, and/or components are subjected to a corrosive, erosive or abrasive environment, the design is to include allowances for such extra material as applicable in accordance with the requirements as specified below:

- i)* As specified by the applicable design codes and standards.
- ii)* The amount of additional material needed is to be determined based on the predicted rate of corrosion and/or erosion and the design service life of the component. Alternative allowances will be considered when supplemented with technical justifications for the life cycle of the equipment, such as:
 - a)* Previous documented service experience.
 - b)* Active corrosion protection and maintenance, such as galvanizing, anodes, etc.
 - c)* Passive corrosion protection and maintenance, such as special coating, etc.
- iii)* In the absence of requirements specified in 2-1/5.11.3i) through 2-1/5.11.3ii) above, a minimum corrosion allowance of 1.6 mm (0.0625 in.) is to be utilized.

5.11.4 Design Conditions

The pipe laying systems and equipment are to be designed to account for all applicable environmental, operational, and test loads, or combination thereof. These include, but are not limited to, the following:

- i)* Environmental Conditions, as applicable:
 - Earthquake
 - Ice
 - Current, waves
 - Wind
 - Temperature and humidity
 - Maximum design sea state or storm event
- ii)* Operational:
 - Static pressure
 - Transient pressure excursion
 - Temperature excursion
 - Tension
 - Bending
 - Vibration
 - Acceleration loads due to movement of the vessel.
 - Retrieval
 - Drifting
- iii)* Transportation
- iv)* Installation
- v)* Commissioning
- vi)* Storage and Maintenance
- vii)* Test Loads



CHAPTER 2 Pipe Laying Systems and Equipment

SECTION 2 Classification of Pipe Laying Systems and Equipment

1 Requirements for Pipe Laying Systems and Equipment

This section provides detailed procedures for ABS approval of industrial systems and equipment, and/or components, for Classification of Industrial Systems and Equipment that require design approval and survey, in accordance with 2-2/Tables 1, 2 and 3. The Table Key for the Technical Review requirements (TA, TB and TC), and the Survey Requirements (SA, SB, SC, SD and SE) is provided in 2-2/Table 4.

- i) 2-2/Tables 1, 2 and 3 are provided as a general reference listing, and are not to be considered as the complete pipe laying system, subsystem or equipment.
- ii) For pipe laying equipment or components not specifically listed, the designer and/or manufacturer is to contact the appropriate ABS Technical office for guidance on the approval process.
- iii) ABS is prepared to consider alternative design methodology and industry practice for pipe laying systems, subsystems or equipment designs, on a case-by-case basis.

**TABLE 1
Pipe Laying System Types Classification Requirements**

System Type Description	Technical Review			Survey Requirement				
	TA	TB	TC	SA	SB	SC	SD	SE
<i>S-Lay</i>								
Stinger	X	X	X	X	X		X	
Stinger Handling System	X	X	X		X	X	X	
<i>J-Lay</i>								
J-Lay Tower	X	X		X	X		X	
Lowering System	X	X		X	X		X	
Gimbal Suspension	X	X		X	X		X	
<i>Flex-Lay</i>								
Flex-Lay Tower	X	X		X	X		X	
Reel Drives	X	X		X	X		X	
Chute or Wheel	X	X		X	X		X	
<i>Reel-Lay</i>								
Vertical Pipe Reel	X	X		X	X		X	

TABLE 2
Pipe Laying Systems and Equipment Classification Requirements

System/Equipment Description	Technical Review			Survey Requirement				
	TA	TB	TC	SA	SB	SC	SD	SE
<i>Winches</i>								
Abandonment & Recovery	X	X					X	
Dead Man Anchor Winch	X	X					X	
Mooring Winches (Positioning Winches)	X	X					X	
Umbilical Spooling Winch		X						
Other Winches		X						
<i>Cranes - All Types (see ABS Lifting Appliance Guide)</i>								
<i>Firing Line Equipment</i>								
Bevel Machine		X						
Prefabrication Fire Line Rollers	X	X					X	
Line Up Rollers	X	X						
Track Conveyor	X	X					X	
Transfer Car	X	X					X	
Internal Line Up Clamp		X						
<i>Pipe Loading Systems</i>								
Deck Loader	X	X					X	
Hold Hatch Cover	X	X					X	
Pipe Elevator	X	X					X	
Tensioners	X	X					X	
Carousels	X	X					X	
Reels	X	X					X	
Hang-Off Clamps	X	X					X	
Pipe Straighteners	X	X					X	
Pipe Handling Equipment	X	X					X	
PLET Handling System	X	X					X	

TABLE 3
Standard Components Classification Requirements

Component Description	Technical Review			Survey Requirement				
	TA	TB	TC	SA	SB	SC	SD	SE
<i>Pressure Vessels & Heat Exchangers</i>								
<7 kg/cm ² (100 psi) and 93.3°C (200°F)		X						X
>7 kg/cm ² (100 psi) or 93.3°C (200°F)	X			X	X	X		
Heat Exchangers	X			X	X	X		
Fired Vessels	X			X	X	X		
<i>Meters, Strainers, Filters, and Other Fluid Conditioners</i>								
< 254 mm (10 in.) and 10.54 kg/cm ² (150 psi)			X					X
> 254 mm (10 in.) or 10.54 kg/cm ² (150 psi)	X			X	X	X		
<i>Pumps</i>								
< 7 kg/cm ² (100 psi) and 757 liters/min (200 gpm)		X						X
> 7 kg/cm ² (100 psi) or 757 liters/min (200 gpm)	X					X	X	
<i>Compressors</i>								
< 7 kg/cm ² (100 psi) and 28.3 m ³ /min (1000 scfm)		X						X
> 7 kg/cm ² (100 psi) or 28.3 m ³ /min (1000 scfm)	X					X	X	
Flowlines and Manifolds	X			X	X	X		
Packaged Process Units (Compressor, Generator, etc.)	X			X	X	X	X	
Air Compressors		X						X
<i>Engines and Turbines</i>								
< 100 kW (134 hp)		X						X
> 100 kW (134 hp)	X			X	X	X	X	
<i>Packaged Support Systems</i>								
<7 kg/cm ² (100 psi) and 93.3°C (200°F)		X						X
>7 kg/cm ² (100 psi) or 93.3°C (200°F)	X			X	X	X	X	
<i>Generators and Motors</i>								
<100 kW (134 hp)		X						X
>100 kW (134 hp)	X						X	
Hydraulic Power Units	X	X		X	X	X	X	
Distribution Transformers			X					X
Switchboard, MCC, Panel boards	X						X	X
Storage Batteries (UPS)	X							X
Control Panels Local & Other	X							X
Fire Protection and Safety	X			X	X	X	X	
Skid Structure	X				X			
Deck Equipment (Multiple Skid Structure)	X				X			

TABLE 4
Table Key for Technical Review and Survey Requirements

<i>Key</i>	<i>Description</i>
<i>Technical Review</i>	
TA	Drawings, calculations, detailed documentation, including manufacturer’s affidavit to be submitted for technical review.
TB	Technical documentation to be verified by the attending Surveyor at the shop.
TC	Technical documentation to be verified by the attending Surveyor at the point of installation.
<i>Survey Requirement</i>	
SA	ABS attendance at Vendor's shop to verify materials for compliance with drawings/specification and their traceability record, and to review welding and NDT specifications and procedures, and welder and NDT personnel qualification records.
SB	ABS attendance at Vendor's shop during critical phases of fabrication such as fit-up, alignment, and NDT examination.
SC	ABS attendance at Vendor's shop to witness and report on pressure testing, as applicable.
SD	ABS attendance at Vendor's shop to witness and report on operational tests to insure proper functioning of equipment.
SE	Exempt from ABS Shop Inspection and Testing when Vendor or manufacturer has provided acceptable documentation that component is designed, manufactured, and tested in accordance with an applicable standard or code.

Note: No Certificates or Reports can be issued prior to the completion of the Technical Review and resolution of all technical comments; therefore, ABS recommends that the construction surveys listed above not commence until the foregoing are satisfied.

3 Plans and Data to be Submitted

Plans and data are to be submitted electronically to ABS. However, hard copies will also be accepted.

3.1 Industrial Equipment and Systems

The drawings or plans listed below are to be submitted and are to include material specifications, welding specifications, dimensions, and strength calculations, as applicable:

- General Arrangement/assembly drawing for each major equipment.
- Equipment Layout Drawings.
- Equipment Foundation Drawings.
- Piping and Instrument Diagrams (P&IDs).
- Equipment Documentation.
- Piping Specification.
- Electrical One-line Diagrams.
- Instrumentation and Control Systems.
- Emergency Control Stations.
- Operating Manual.

3.3 Installation Plans

General arrangement plans of the vessel or unit and project specifications are to provide the following information, as applicable: drawings showing all major equipment layouts and location arrangements, including control stations, are to be submitted.

3.3.1 General Arrangement Plan

A general arrangement plan of the installation/facility where the pipe laying system and its machinery are to be installed shall be provided.

3.3.2 Equipment Layout, Detailed Arrangements and Elevation Drawings

The following drawings showing equipment layout, detailed arrangements and elevations shall be provided:

- Location of all machinery, equipment and structures for pipe laying operation and storage onboard vessel or unit.
- Piping systems associated with the pipe laying systems.
- Control panels/stations for pipe laying system locations.
- Fire monitoring and firefighting control station locations.
- Escape and egress routes, including safety equipment and muster station locations.
- Locations of openings (air intake, exhaust, windows, doors, etc.) for all closed spaces.
- Ventilation arrangements.
- Piping Specification.
- Electrical One-line Diagrams.
- Instrumentation and Control Systems.
- Operating Manual.

3.3.3 Equipment List

An equipment list shall be provided which includes the identification number, description, and main technical specifications for all major equipment, such as cranes, winches, power units, etc.

CHAPTER 2 Pipe Laying Systems and Equipment

SECTION 3 Design Review of Pipe Laying Systems and Equipment

1 Pipe Laying Systems

Systems and equipment are to be designed, constructed and installed to applicable recognized standards. Detail drawings of the systems and equipment, and associated controls, are to be submitted for review.

1.1 S-Lay

1.1.1 Stinger

Stinger structures are to be designed in accordance with AISC or other applicable recognized standards, which must include environmental and operational loads (see 2-1/5.11.4).

Detail drawings of the stinger along with associated attachment point foundations and supporting structures, are to be submitted for review.

Stinger strength, geometry, buoyancy, mass and stiffness calculations and loads at extreme positions, static tension of the pipe and dynamic effects caused by environmental forces, are to be taken into account.

The stinger support structure is to be adequate to withstand the stinger loads listed above.

The lift-off point (last point of load contact) of the pipeline should be the next to last roller to account for any small loss of tension, thereby avoiding excessive bending at the last roller.

Stinger shall be designed such that the dynamic minimum-bend-radius limits are not exceeded during overboarding.

1.1.2 Stinger Handling System

Specifications for the handling system as well as its control system are to be provided. Handling system to be rated for the maximum load of the tensioned pipe and to take into account the static and dynamic load effects caused by environmental forces.

1.3 J-Lay

1.3.1 J-Lay Tower

Detail drawings of the foundation and supporting structure on which the pipelay towers and skid frames rest or other stowage arrangements are installed are to be submitted for review.

For strength calculations of supports, the tower's weight at extreme positions, static tension of the pipe and dynamic effects caused by environmental forces, are to be taken into account.

1.3.2 Lowering System

Specifications of the lowering system as well as its control system are to be provided. Lowering system to be rated for the maximum load of the tensioned pipe and to take into account the static and dynamic load effects caused by environmental forces.

1.3.3 Gimbal Suspension

Specifications of the Gimbal Suspension system as well as its control system are to be provided. Gimbal Suspension system to be rated for the maximum load of the tensioned pipe and to take into account the static and dynamic load effects caused by environmental forces.

1.5 Flex-Lay

1.5.1 Flex-Lay Tower

Detail drawings of the foundation and supporting structure on which the pipelay towers and skid frames rest or other stowage arrangements are installed are to be submitted for review.

For strength calculations of supports, the tower's weight at extreme positions (upright and tilted position for Flex-lay towers, upright elevation angles for pipe spooling-out, and angled for pipe spooling-on and skid fleeting locations) are to be taken into account, including associated center of gravity variations, static tension of the pipe, and dynamic effects caused by environmental forces.

1.5.2 Reel Drives

Specifications for the reel drive system as well as its control system are to be provided. Reel Drive to be rated for the maximum load and to allow for static and dynamic load effects caused by environmental forces.

1.5.3 Chute or Wheel

Specifications for the Chutes or Wheels are to be provided. Chutes or Wheels to be rated for the maximum load and to allow for static and dynamic load effects caused by environmental forces.

1.7 Reel-Lay

1.7.1 Vertical Pipe Reel

Reel support structure including the reinforcements for the hull are to be designed to adequately resist the load effects of pipes, risers or reels imposed on the supports in the severe storm, normal operating and transit conditions. Considerations should also be given to the unit in damaged conditions, where the pipe racks and reel support structure are to withstand the load effects caused by the trim and heel of the vessel.

3 Pipe Laying Equipment

3.1 Winch and Accessories

3.1.1 General

3.1.1(a) Hoisting and Holding Capabilities. The design of winches is to provide for adequate dynamic and brake holding capacity to control normal combinations of loads at the maximum operational speed of the winch. The mechanical components of the winch and associated accessories are to be capable of sustaining the maximum forces from the hoisting, rendering and braking including any dynamic effects as applicable without permanent deformation as follows:

- Operational braking capability is to be at least 150% of the maximum torque created at the maximum safe-working-load (SWL). In addition, the brake is to be capable of stopping the rotation of the drum from its maximum rotating speed.
- Brake holding capacity is to be 125% of the maximum torque created at maximum SWL.

3.1.1(b) Winch Brakes. Winches are to be provided with a power control braking means such as regenerative, dynamic, counter torque breaking, controlled lowering or a mechanically controlled braking means capable of maintaining controlled lowering speeds.

Brakes are to be applied automatically upon loss of power or when the winch lever is returned to neutral.

3.1.1(c) *Winch Supporting Structure.* Supporting structure of the winch is to be capable of sustaining the maximum brake holding capacity or the maximum hoisting capacity of the winch, whichever is greater, without permanent deformation.

Doubler plates are not allowed between the winch foundation and the deck plating; a thicker insert plate is to be applied, if necessary.

Stresses in the structure supporting the winch are not to exceed:

$$\text{Normal stress} = 0.75Y$$

$$\text{Shear stress} = 0.45Y$$

where: Y is the specified minimum tensile yield strength or yield point.

3.1.2 Abandonment and Recovery System (A&R)

3.1.2(a) *General.* An Abandonment and Recovery (A&R) system is to be provided to lay the pipe down on completion of operation or the onset of harsh weather and for recovering the pipe after such an event. The system may consist of a hydraulic or electric motor driven traction winch, storage winch, and sheaves.

3.1.2(b) *A&R System Capacity.* The A&R system is to be designed to provide adequate dynamic and brake holding capacity to control combined loads of the expected maximum tension generated by flooding the heaviest pipe and environmental forces such as waves, currents and tides, etc., exerting on the vessel as well as the laid-off pipes.

3.1.2(c) *Braking.* The A&R system is to be provided with a power control braking means such as regenerative, dynamic, counter torque breaking, controlled lowering or a mechanically controlled braking means capable of maintaining controlled lowering speeds. Brakes are to be applied automatically upon loss of power or when the control lever is returned to neutral.

3.1.2(d) *Supporting Structures.* Detail drawings of the foundation and supporting structure on which the A&R winch is installed are to be submitted. The foundations and supporting structures of the A&R winch and accessories are to be designed for the design static and dynamic loading conditions, using the allowable stresses below:

$$\text{Normal Stress} = 0.7Y$$

$$\text{Shear Stress} = 0.4Y$$

$$\text{Equivalent stress} = 0.8Y$$

where: Y is the specified minimum tensile yield strength or yield point.

3.3 Cranes

Cranes of pedestal mounted rotating, heavy lift, gantry, shear leg or “A” frame types, installed onboard the vessel and intended for lifting operations are to be certified by ABS in accordance with Chapter 2 of the *ABS Guide for Certification of Lifting Appliances*.

3.3.1 Subsea Lifting

Subsea lifting is normally the operation of a lifting appliance handling a load which will be lowered through the splash zone and: either held at an intermediate level, released on the seabed, or retrieved back through the splash zone onto the vessel. Lifting appliances must first be certified by ABS for in air lifting according to the *ABS Guide for Certification of Lifting Appliances* and/or other recognized standards. They may then be eligible for subsea lifting provided these subsea lifts are engineered on a case-by-case basis by a responsible party associated with subsea lifting for the appropriate environmental conditions. This will result in some degree of de-rating the lifting appliance from its ABS certified in air capacity. In principle, ABS does not approve these subsea lifts, as the degree of variance precludes a general rule for this type of operation. The detail requirements for the cranes used for subsea lifting can be found in Appendix 5-9-A2 of the *ABS Rules for Building and Classing Offshore Support Vessels (OSV Rules)*. In this appendix, ABS provides a recommended sequence to be followed for de-rating lifting appliances from the in-air lifting mode to the subsea lifting mode.

3.3.2 Cargo Gear

Cargo gear installed onboard the vessel and intended for loading and unloading of the vessel are to be certified by ABS in accordance with Chapter 3 of the *ABS Guide for Certification of Lifting Appliances*. Cargo Gear includes masts, stays, booms, winches, cranes, standing and running gear forming part of the shipboard cargo gear used in connection with the loading and unloading of a vessel. Slings, pallets, spreaders and similar loose gear, as well as vangs, preventers and the tackle and structures associated therewith, are not included in the certification of cargo gear unless their details were specifically approved.

3.3.3 Shipboard Elevators

Shipboard Elevator for personnel and passengers on vessels may be certified by ABS in accordance with Chapter 5 of the *ABS Guide for Certification of Lifting Appliances*. Personnel and passenger elevators certified in accordance with the requirements of this Guide may be used to transport vessel's stores and equipment.

3.5 Firing Line Equipment

3.5.1 General

All firing line equipment, of which typical examples are listed below, are to be suitably rated for the maximum size and schedule of pipe to be handled, as well as designed for service in the marine environment.

- i) Bevel Machine.
- ii) Prefabrication Firing Line Rollers.
- iii) Line-Up Rollers.
- iv) Track Conveyor.
- v) Transfer Car.
- vi) Internal Line Up Clamp.

3.5.2 Arrangement

Firing line welding, NDT and field-joint coating stations are to be suitably located to perform within their design parameters. All hot work to be located away from all sources of flammable and combustible materials.

Firing line rollers and tracks are to be suitably spaced to support and properly align the pipe for the entire length of the firing line to allow for controlled movement. Rollers and tracks are to be designed such that they do not damage any anodes or pipe coatings.

Firing line is to be provided with appropriate drip pans and drains to direct residual coatings and solvents to appropriate catch or drain systems.

3.7 Pipe Loading Systems

3.7.1 General

All pipe loading equipment, of which typical examples are listed below, are to be suitably rated for the maximum size and schedule of pipe to be handled, as well as designed for service in the marine environment.

3.7.2 Arrangement

Pipe loading systems shall be suitably located to perform within the design parameters.

3.7.2(a) *Deck Loader*. See 2-3/3.17 as applicable.

3.7.2(b) *Pipe Elevator*. See 2-3/3.17 as applicable.

3.7.2(c) *Hold Hatch Cover*. Where weathertight hold hatch covers are steel, the maximum allowable stress and deflection under the design loads must comply with 3-2-15/7 of the *OSV Rules*.

3.9 Tensioners

Reliable tensioners are to be provided for keeping the tension in the pipeline while it is being lowered onto the seabed.

The tensioner is to be designed to provide adequate dynamic and brake holding capacity to control combined loads of the tension generated by the paid-out pipeline, motions and environmental forces such as waves, currents and tides, etc. The required type of tensioner depends on pipe specifics and configuration of the pipe lay system.

The tensioners are to be provided with power-controlled system operable at a remote control station to control and monitor the paid out length with feedback to the lay speed setting or vessel's station keeping system.

The foundations and supporting structures of the tensioner and accessories are to be designed for the load effects of pipe tensioner capacity defined above.

Tensioner, tensioner brakes and pipe anchor support shall be fail-safe and rated to hold the heaviest pipe (including flooded) load case.

3.11 Carousels, Reels, Pipe Racks and Support Structure

Pipe reels and carousels are to be designed, constructed and installed so as to satisfy the requirements of a recognized standard in the severe storm, normal operating and transit conditions.

Pipe racks and reel support structure including the reinforcements for the hull are to be designed to adequately resist the load effects of pipes, risers or reels imposed on the supports in the severe storm, normal operating and transit conditions. Considerations should also be given to the unit in damaged conditions, where the pipe racks and reel support structure are to withstand the additional load effects caused by the trim and heel of the vessel.

3.13 Hang-Off Clamps

Hang-off clamps are to be provided to hold the pipe when it is not suspended by tensioners or alternative means to hold the pipe such as A&R systems. Means are to be provided to maintain the holding power in case of electrical power blackout.

3.15 Pipe Straighteners

The straightener system straightens plastically deformed pipes coming from the reel before they enter the tensioner. The straightener consists of two tracks where a reverse bend is performed to straighten the pipe and guide the pipe into the tensioner.

The straightener is to be designed to handle the specified pipe diameters and wall thicknesses.

The foundations and supporting structures of the straightener system are to be designed for the pipe maximum plastic moments and the load effects of the pipe reel and straightener.

3.17 Pipe Handling Equipment

Typical components of the pipe handling equipment include deck loaders, pipe elevators, hold hatch covers, pipe racks, cranes, winches, and wire ropes, or any other handling devices used to aid in the transfer of pipe to/from storage areas.

- i) The vessel may be equipped with hydraulic, pneumatic or mechanical equipment capable of lifting, transporting, or suspending the pipe.
- ii) Adequate safety areas are to be designated for all pipe handling activities in order to provide for safety of personnel and equipment.
- iii) All storage racks are to be designed to prevent pipe from unintended release from the rack.
- v) Foundations and storage racks are to be designed to withstand the maximum anticipated load of the racked pipe.
- vi) Major mechanical load-bearing components are to be in accordance with 2-2/5 of the *ABS Guide for the Certification of Lifting Appliances*.
- vii) Cranes are to be in accordance with 2-2/3.3.

- viii) Winches are to be in accordance with 2-3/3.1.
- ix) The control systems are to be in accordance with 2-3/5.5.
- x) Hydraulic and pneumatic cylinders are to be in accordance with 2-3/5.1.
- xi) Electrical systems are to be in accordance with 2-3/5.3.

3.19 PLET Handling System

The Pipeline End Termination handling system facilitates the fitting of a PLET onto the pipeline.

Typical components of the PLET handling system include the PLET manipulator, skid unit, PLET pallets, PLET supports, and skid rails (deck and moonpool hatches). Applicable requirements for the PLET Handling system are found in 2-2/Table 2 and 2-3/3.17.

5 Standard Components

5.1 Hydraulic and Pneumatic Systems

5.1.1 Plans Submission

Piping and instrument diagrams (P&ID) are to be submitted for all facility systems and subsystems, accompanied by lists of material giving size, wall thickness, maximum working pressure and material of all pipes/tubes, and the type, size, pressure rating and material of valves and fittings.

5.1.2 General

The arrangements for Class I and II hydraulic piping systems are to be in accordance with the requirements of 4-6-7/3 and 4-6-7/5 of the *ABS Rules for Building and Classing Steel Vessels (Steel Vessel Rules)*. Piping is to meet the requirements of 4-6-1/7.1, 4-6-2/3 and 4-6-2/5 of the *Steel Vessel Rules*, except that mill tests need not be witnessed by the Surveyor if at an ABS approved facility. In such cases, mill certificates are to be provided. If the facility is not ABS approved, then attendance by an ABS surveyor is required, in order to verify and document the standards being applied.

5.1.3 Standard Components

A manufacturer's certificate or catalog data is required for all pressure containing components (ball valves, gate valves, check valves, fittings, instruments, control valves, strainers, filters, etc.) stating compliance with an applicable recognized industrial code and maximum allowable working pressure and corresponding temperature. This information is not required for standard components such as fittings, flanges, and flanged gate, globe and check valves meeting applicable ASME/ANSI requirements such as B16.5, B16.9, B16.11, B16.34, and B16.47.

5.1.4 Hoses

Where hoses are a part of the installation, the following shall be submitted: Burst test data and confirmation that all hoses for oil service are fireproof per 3-3/11.7 of the *Facilities Rules*, which states that hoses carrying flammable fluids are to be fire-resistant rated for maximum working pressure and temperature and reinforced with wire braid or other suitable material. Burst pressure of the hose is not to be less than four times the relief valve setting or system design pressure. Flexible hoses are to meet the requirements of 4-6-2/5.7 of the *Steel Vessel Rules*.

5.1.5 Engineered Items

For other than standard components (i.e., engineered items), such as coolers, heat exchangers and compressors, detailed dimensional drawings (including nozzle installation schedules and strength calculations shall be submitted. The maximum allowable working pressure (MAWP) is not to be less than the relief valve setting.

5.1.5(a) Accumulators. Accumulators are to meet the requirements of Section 4-4-1 and Appendix 4-4-1A1 of the *Steel Vessel Rules*.

Each accumulator, which may be isolated, is to be protected by suitable relief valves. Where a gas charging system is used, a relief valve is to be provided on the gas side of the accumulator.

5.1.5(b) *Fluid Power Cylinders.* Fluid power cylinders are to meet the requirements of 4-6-7/3.5.5 of the *Steel Vessel Rules*.

5.1.5(c) *Segregation of High Pressure Hydraulic Units.* Hydraulic units with maximum working pressures above 15.5 bar (15.8 kgf/cm², 225 psi) installed within machinery spaces are to be placed in a separate room or rooms, or shielded as necessary to prevent any oil or oil mist that may escape under pressure from coming into contact with surfaces with temperatures in excess of 220°C (428°F), electrical equipment or other sources of ignition. For the purposes of this requirement, a hydraulic unit includes the power pack and all components of the hydraulic piping system.

5.3 Electrical Systems and Equipment

5.3.1 General

A block diagram is to be submitted for each major piece of equipment indicating the electrical components and any interconnecting cables. One-line diagrams are to be submitted for each skid indicating the power supply arrangements for the motors and any other electrical components. A bill of materials for significant electrical components is to be submitted for each major piece of equipment, indicating all the electrical components, such as motors, pressure switches, cable glands, etc.

Electrical systems and equipment are to comply with the ABS *MODU Rules* and with API RP 14F or API RP 14FZ.

- i) Compliance with industry standards, such as the following, will be specially considered:
- API RP 500.
 - API RP 505.
 - API RP 2003.
 - IEC 61892.
 - IEEE C37.06.1.
 - IEEE C37.20.6.
 - IEEE Std. 45.
 - IEEE Std. 142.
 - IEEE Std. 242.
 - NFPA 70.
 - NFPA 496.
- ii) ABS may consider other industry standards and practices for electrical equipment, on a case-by-case basis, with justifications through novel features and/or comparative analyses to be provided to demonstrate equivalent level of safety to the recognized standards as listed in this Guide, performed in accordance with 1-1-4/5 and 1-1-4/7 of the *ABS Rules for Conditions of Classification (Part 1)*.
- iii) All electrical components are to be designed to meet safe operating conditions by accounting for maximum and minimum temperatures and vibrations expected during service.

5.3.2 Rotating Machinery

All electrical machinery (rotating) is to comply with the following requirements:

- i) All rotating machines (if any) 100 kW (135 hp) and above are to be of an ABS-approved design in accordance with the ABS *OSV Rules*, tested in the presence of and inspected by the Surveyor at the plant of the manufacturer.
- ii) For machines of less than 100 kW (135 hp), the tests may be carried out by the manufacturer whose certificate of tests (test reports) may be acceptable and is to be included in the manufacturer's affidavit of compliance.

5.5 Control Systems

5.5.1 General

Control system is an assembly of devices interconnected or otherwise coordinated to convey the command or order. Control system can be hydraulic, pneumatic, electric, electro-hydraulic, acoustic, etc., or combination thereof.

- i)* A general description of the operation of the system is to be provided. This is to include the control system configuration, general arrangements for the vessel and the layout of the machinery with essential auxiliaries, specifications of main equipment with information of manufacturer's name, type, rating and number of the equipment. The following is to be provided:
 - a)* Schematic diagrams showing connections between all main components (units, equipment) of the system, human machine interfaces (HMI) and interfaces with other systems.
 - b)* Operational descriptions for the following items:
 - Starting of machinery
 - Control transfer
 - Critical speeds
 - Essential auxiliary machinery automatic starting arrangement if fitted
 - c)* Safety systems descriptions may include a list of all monitored parameters with settings for implemented protective actions (e.g., automatic shutdown and automatic slowdown), schematic diagrams showing the connections between the safety devices, control and display units, alarm devices, human machine interface (HMI) and power supply arrangement, as appropriate.
 - d)* Schematic diagrams showing the connections between the sensing devices, control and display units, alarm devices, human machine interfaces (HMI) and power supply arrangement, and description of monitoring systems including a list of monitoring points, displays and alarms including preset parameters for the machinery and all essential auxiliary machinery and systems at each control station.
- ii)* The control system (hydraulic, pneumatic, electric, electro-hydraulic, acoustic, etc.) is to be designed such that no single control-system component failure will lead to either a failure of the controlled system or to a loss of control. Shutdown of the system or equipment being controlled may be permitted, provided such shutdown does not lead to an unsafe situation.
- iii)* Transfer between control stations, where applicable, is to comply with the following requirements:
 - a)* When control of the system or equipment is possible from more than one control location, control is to be possible only from one control location at a time.
 - b)* Clear method to transfer control between stations is to be provided.
 - c)* At each control location, there is to be an indicator showing which location is in control.
- iv)* Visual and audible alarms are to be provided to indicate an alarm condition of a monitored parameter.
- v)* Control panels are to be clearly labeled.

- vi) Logic Circuit Features:
 - a) When logic circuits are used for sequential startup or for operating individual components, indicators are to be provided at the control console to show the successful completion of the sequence of operations by the logic circuit, and start-up and operation of the component. If some particular step is not carried out during the sequence, the start-up process is to stop at this point.
 - b) Manual override is to be fitted in vital functions to permit control in the case of failure of a logic circuit.
- vii) Electrical control systems are to comply with 4-9-2/3.1 (except 4-9-2/9.1 and 4-9-2/3.1.5) of the *Steel Vessel Rules*.
- viii) Computer-based systems are to comply with the requirements of 4-9-3/5(except 4-9-3/5.1.7 and 4-9-3/5.1.8) of the *Steel Vessel Rules*. Computer-based systems are to be designed such that any of the system's components will not cause unsafe operation of the system or equipment being controlled. Detailed FMEA, FMECA or similar analysis is to be conducted for the computer-based systems covering all components to determine compliance with the design principles.
- ix) Safety Integrity: When computer-based systems have safety-related control functions and the associated failure modes identified in the FMEA/FMECA result in an undesirable situation, special consideration may be given in order to avoid such conditions, provided the appropriate level of safety integrity has been provided. The appropriate level is to be determined by the application of a recognized industry standard, such as the IEC 61508 Series or the ANSI/ISA 84 Series.

5.7 Safety Systems – Equipment

- i) Means are to be provided to indicate the cause of the safety action.
- ii) Alarms are to be given at each control location, including any local manual control positions when the system performs a safety action.
- iii) Pipe laying systems or equipment shut down by a safety action is to be designed not to restart automatically.
- iv) Shutdowns are to be executed in a predetermined logical manner, as specified in the “shutdown logic” and/or “shutdown cause and effect charts”, and are to execute actions to:
 - Limit the severity of the incident
 - Protect personnel
 - Limit environmental impact
- v) Shutdown systems are not to result in adverse cascading effects.
- vi) Shutdown systems are to be designed such that when a shutdown is activated, any ongoing operations can be terminated without leading to an unsafe situation.

CHAPTER 3 Surveys

CONTENTS

SECTION 1	General	25
1	General	25
SECTION 2	Survey of Industrial Systems and Equipment During Manufacture	26
1	General	26
3	Documentation	26
5	Survey Requirements	26
7	Marking	26
9	Type Approval	27
SECTION 3	Installation, Commissioning and Survey After Construction	28
1	General	28
3	Installation Survey	28
5	Survey After Construction	29
5.1	Annual Surveys	29
5.3	Special Survey (Every 5 Years)	29



CHAPTER 3 Surveys

SECTION 1 General

1 General

This Chapter outlines the survey requirements during the manufacture, installation, commissioning, and after construction of approved equipment onboard a vessel or unit.

Section 2 of this Chapter pertains to surveys of industrial systems and equipment and/or components at the vendor's manufacturing plant and their installation onboard the vessel or unit for system build-up and completion for final trials prior to commencement of operations.

Section 3 of this Chapter pertains to the survey requirements for installation, commissioning and survey after construction of approved industrial systems and equipment onboard a vessel or unit.



CHAPTER 3 Surveys

SECTION 2 Survey of Industrial Systems and Equipment During Manufacture

1 General

This Section outlines the survey requirements to be complied with at the equipment manufacturer.

See also 2-2/Tables 1 through 4 for detailed survey requirements for ABS approval of industrial systems and equipment, and/or components that require design approval and survey.

3 Documentation

The following documents are to be made available to the Surveyor, as applicable:

- Approved plans and review letters including any revisions addressing electrical, piping and structural aspects of the design of equipment and any amendments noted during the technical review are addressed during the fabrication.
- Welding procedures, welder qualification tests and material certification/traceability.
- Nondestructive Testing (NDT) methods to be used and qualifications of NDT operators, including yard personnel and subcontractors.
- Extent of NDT examination applied to the project including acceptance criteria.
- Certificates for items or equipment for materials, electrical components, etc.

5 Survey Requirements

Alarms and any other safety devices are to be tested and confirmed to be in operating condition. Alarm interfaces are to be examined.

The attending Surveyor is to confirm that the as-built equipment is in compliance with the approved plans. The onsite surveys are to be completed in accordance with the applicable ABS Rules.

7 Marking

For identification purposes, each equipment item is to be permanently marked by the manufacturer with the following information:

- Manufacturer's name and address.
- Manufacturer's serial number.
- Reference to the ABS approval letter (Type Approval Number).
- Equipment weight.
- Electrical load of the equipment.

9 Type Approval

If Type Approved components are used in a system or equipment, then a valid proof of certification or the specific service, through the Type Approval Program, is to be provided to the attending surveyor at the time of manufacture.

CHAPTER 3 Surveys

SECTION 3 Installation, Commissioning and Survey After Construction

1 General

This section outlines the survey requirements for installation, commissioning and survey after construction of approved equipment onboard a vessel or unit.

3 Installation Survey

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)* Location of equipment in relationship to any hazardous areas.
- ii)* Equipment orientation on the vessel or unit, equipment structural arrangements, supporting foundations, securing details and protective coating.
- iii)* Visual and/or NDT examination of assembled and installed equipment, attachment onboard, including underdeck support.
- iv)* Hook-up and integrity of equipment piping, electrical, machinery, ventilation system, including WT penetrations and integration with associated ship systems.
- v)* Piping system visual examination, NDT and pressure test per applicable Rules or codes.
- vi)* Testing of pressure relief and safety valves for hydraulic/ pneumatic systems onboard.
- vii)* Visual examination of electrical equipment, wiring connections, cable routing, earthing, cable penetrations, distribution panels to include testing of electrical systems and insulation tests.
- viii)* Lighting systems examination and test.
- ix)* Ventilation systems examination, ducting arrangements and penetrations, damper arrangements, operational tests.
- x)* Control systems, safety devices, and shutdowns to be tested to the satisfaction of the attending Surveyor.
- xi)* Fire/Safety Measures such as Fire Control Plan, EEBDs, Lifesaving Appliances, as applicable, Crew Protection, General Alarm/PA, Fire Detection, Portable Extinguishers, Escape Arrangements, Main and Emergency lighting, and any required Emergency Shutdowns.
- xii)* Load test of winches, Abandon & Recovery (A&R) winch, recovery davit, stinger, lifting appliances related to pipe laying operations.
- xiii)* Compliance with any special requirements from the flag Administration.
- xiv)* Commissioning of all pipe laying systems.
- xv)* Commissioning of communication equipment related to pipelaying operations.
- xvi)* All pipe laying systems and equipment to be checked for proper operation during pipe lay.

5 Survey After Construction

5.1 Annual Surveys

At each Annual Survey, equipment are to be examined for continued use based on the criteria for Initial Survey with particular emphasis on proper maintenance, coating conditions of critical pipe laying equipment and structures, and confirmation that no unauthorized modifications have been carried out. Additionally, underdeck structures shall be examined in way of major foundations of reels, winches and tensioners for deformation or any damage.

In addition to the above surveys, the following to be carried out in the presence of an ABS surveyor, as applicable:

- i) Examination of stinger structure and hull connection weld points.
- ii) Verify hydraulic oil cooling system condition and satisfactory operation.
- iii) Examination of all hydraulic power units, hoses, piping for any damage, corrosion or leakages.
- iv) Satisfactory operational test of all emergency stops, controls and remote controls.
- v) Review of calibration record, operations manual and logbooks, and insulation resistance log.
- vi) Examination and testing of all winches, tensioners, pipe elevators, deck cranes, track conveyors, pipe loaders and reel drives, including respective limit switches.
- vii) Examination and testing of fire/safety alarms, detectors and ventilator dampers.
- viii) Testing of all means of communication.
- ix) Examination of all piping systems.
- x) Functional tests of equipment integrated or associated with ship's systems.
- xi) Examination and testing of pipe laying electrical systems and related equipment.
- ix) Satisfactory operational test of all pipe laying equipment alarms.

5.3 Special Survey (Every 5 Years)

At each Special Survey, equipment is to be examined for continued use based on the criteria for Initial Survey with particular emphasis on proper maintenance, coating conditions of critical pipe laying equipment and structures, and confirmation that no unauthorized modifications have been carried out. Additionally, underdeck structures shall be examined in way of major foundations of reels, winches and tensioners for deformation or any damage with gauging of suspect areas as identified by the surveyor.

In addition to the applicable requirements noted in 3-3/5.1 above for Annual Surveys, the following is to be carried out in the presence of an ABS surveyor:

- i) Examination of stinger structure and hull connection weld points, supplemented by NDT of the connection welds.
- ii) Examination of all pipelay winches corrosion, damages.
- iii) Examination of all reels, deck cranes and tensioners.
- iv) Verify hydraulic oil cooling system condition and satisfactory operation.
- v) Examination of all hydraulic power units including oil samples for analysis, and examination of hoses, piping for any damage, corrosion or leakages.
- vi) Examination of pipe laying equipment wiring, wireways, junction boxes and electrical panels for damage, corrosion or loose connections.
- vii) Examination and testing of insulation resistance of motors and cables related to pipe laying systems and equipment.
- viii) Calibration of essential safety alarms, detectors and equipment.

- ix)* Satisfactory operational test of all emergency stops, controls and remote controls.
- x)* Satisfactory operational test of all pipe laying equipment alarms.
- xi)* Operational tests of relief valves and verification of set pressure.
- xii)* Satisfactory load testing to 110% of rated load for all reels, pipe elevators, and tensioners.



APPENDIX 1 References

1 Application of Codes and Standards

Use of national or international standards or codes other than those listed herein in the design and construction of the equipment and components is subject to prior approval and acceptance by ABS. The standards or codes being applied are to be adhered to in their entirety.

American Bureau of Shipping (ABS):

Barge Rules	Rules for Building and Classing Steel Barges
MODU Rules	Rules for Building and Classing Mobile Offshore Drilling Units
MOU Guide	Guide for Building and Classing Mobile Offshore Units
Offshore RCM Guide	Guide for Automatic or Remote Control and Monitoring for Auxiliary Machinery and Systems (other than Propulsion) on Offshore Installations
OSV Rules	Rules for Building and Classing Offshore Support Vessels
Risk Guidance Notes	Guidance Notes on Risk Assessment Application for the Marine and Offshore Oil and Gas Industries
Risk Guide	Guide for Risk Evaluations for the Classification of Marine-Related Facilities
Steel Vessel Rules	Rules for Building and Classing Steel Vessels

American Institute of Steel Construction (AISC):

AISC Steel Code	Manual of Steel Construction – ASD, latest edition
-----------------	--

American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):

ANSI/ASME B31.1	Code for Pressure Piping, Power Piping
ANSI/ASME B31.3	Chemical Plant and Petroleum Refinery Piping
ANSI/ASME B31.4	Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohol
ANSI/ASME B31.8	Gas Transmission and Distribution Piping Systems

American Petroleum Institute (API):

API RP 14F	Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms
API RP 14FZ	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1 and Zone 2 Locations
API Bull 2U	Bulletin on Stability Design of Cylindrical Shells, Third Edition 2004

API Bull 2V	Bulletin on Design of Flat Plate Structures, Third Edition 2004
API Spec 9A	Specification for Wire Rope Twenty-fifth Edition 2004
API RP 9B	Recommended Practice on Application, Care, and Use of Wire Rope for Oil Field Service Twelfth Edition – 2005
API Spec 2C	Specification for Offshore Pedestal Mounted Cranes
API RP 17B/ISO 13628-11	Recommended Practice for Flexible Pipe, Fourth Edition 2008
API RP 500	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I Division 1 and Division 2, Second Edition – 1997 (ANSI/API RP 500-1998)
API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2, First Edition – 1997
API Std 521/ISO 23251	Pressure-Relieving And Depressuring Systems Fifth Edition 2007
API Spec 17J	Specification for Unbonded Flexible Pipe
API RP 2003	Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents

American Society of Mechanical Engineers (ASME):

Boiler Code	Boiler and Pressure Vessel Code, Section VIII, latest edition
-------------	---

British Standards Institution (BSI):

BS 1113	Design and Manufacture of Water Tube Steam Generating Plant (including Superheaters, Reheaters and Steel Tube Economizers)
BS 2790	Specifications for the Design and Manufacture of Shell Boilers of Welded Construction
BS 5500	Specification for Unfired Fusion Welded Pressure Vessels

European Committee for Standardization (CEN):

EN 287	Qualification test of welders – Fusion welding – 2004
--------	---

Health and Safety Executive (HSE):

HSE Guidance Notes	Offshore Installations: Guidance on DESIGN CONSTRUCTION AND CERTIFICATION, Fourth Edition, 1991, as amended
--------------------	---

Institute of Electrical and Electrical Engineers (IEEE)/American National Standards Institute (ANSI):

IEEE/ANSI C37.06.1	Guide for High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis Designated "Definite Purpose for Fast Transient Recovery Voltage Rise Times"
IEEE/ANSI C37.20.6	Standard for 4.76 kV to 38 kV Rated Ground and Test Devices Used in Enclosures
IEEE Std. 45	Recommended Practice for Electric Installations on Shipboard
IEEE Std. 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE Std. 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

International Electrotechnical Commission (IEC):

IEC 61892 Mobile and fixed offshore units, electrical installations

International Organization for Standardization (ISO):

ISO 15614-1 Specification and qualification of welding procedures for metallic materials –
Welding procedure test – Part 1: Arc and gas welding of steels and arc welding
of nickel and nickel alloys – 2004

ISO 9712 Non-destructive testing – Qualification and certification of NDT personnel – 2012

ISO 11666 Non-destructive testing of welds – Ultrasonic testing – Acceptance levels – 2010

ISO 23278 Non-destructive testing of welds – Magnetic particle testing of welds – Acceptance
levels – 2010

ISO 5817 Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam
welding excluded) – Quality levels for imperfections – 2006

Japanese Industrial Standards (JIS):

JIS B8270 Pressure Vessels (General Standards), et al

National Fire Protection Association (NFPA):

NFPA 70 National Electrical Code

NFPA 496 Standard for Purged and Pressurized Enclosures for Electrical Equipment

Oil Companies International Marine Forum (OCIMF):

Guidelines for Handling, Storage, Inspection, and Testing of Hoses in the Field

Tubular Exchanger Manufacturers Association (TEMA):

Standards of Tubular Exchanger Manufacturers Association

Underwriters Laboratories (UL):

UL 57 Electric Lighting Fixtures

UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

UL 595 Marine-Type Electric Lighting Fixtures

UL 1570 Fluorescent Lighting Fixtures

UL 1571 Incandescent Lighting Fixtures

UL 1572 High Intensity Discharge Lighting Fixtures