GUIDE FOR

WELL TEST SYSTEMS

MARCH 2010 (Updated January 2012 – see next page)

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

Updates

January 2012 consolidation includes:

- February 2011 version plus Corrigenda/Editorials

February 2011 consolidation includes:

- March 2010 version plus Corrigenda/Editorials

Foreword

This Guide contains the technical requirements and criteria employed by ABS in the review and survey of well test systems that are being considered for Classification and for maintenance of Classification. It is applicable to well test systems that are installed on board vessels and mobile offshore drilling units.

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

ABS acknowledges that well test systems are usually installed on board when the vessel or unit is going to be engaged in well testing operations (short-term or extended well testing) and removed when the well testing campaign is finalized. The Guide has been written to account for the different scenarios during the life of the vessel or unit with adequate flexibility to cover the safety aspects during the different phases of operation as well as the preparation of the vessel or unit before the well test system is installed onboard.

The Guide has an effective date of 1 March 2010. 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 March 2010 are not applicable to a vessel or unit for which the contract for construction was signed on 28 February 2010). 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 March 2010. See also 1-1-4/3 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

GUIDE FOR

WELL TEST SYSTEMS

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SECTION 1 General

1 Application

This Guide has been developed to provide requirements for the design, construction, installation and survey of well test systems on board vessels and mobile offshore drilling 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 safety aspects related to well test systems either temporarily or permanently installed on board vessels and mobile offshore drilling units classed with ABS. The scope of the Guide is limited to surface systems and equipment and does not cover subsea components used during well testing operations.

5 Definitions

5.1 Well Test Systems

Well test systems are the facilities installed on vessels or mobile offshore drilling units (MODUs) for the purpose of evaluating the quality and/or quantity of the well fluid to determine whether the well should be completed for production or plugged and abandoned. Well test systems may include well control equipment, process pressure vessels, piping and electrical components, control systems, burners and gas flares and burner/flare booms.

5.3 Permanent Well Test Systems

Well test systems installed on board a vessel or MODU for at least 30 months are considered permanent, notwithstanding if the system is or is not in operation.

5.5 Temporary Well Test Systems

Well test systems installed on board a vessel or MODU for less than 30 months are considered temporary.

5.7 Well Test Ready

Vessels or MODUs that have been designed for well test operations, but the well test system has not been installed on board, are considered “well test ready”.

7 Class Notations

7.1 Well Test Ready

Vessels or MODUs designed to be “well test ready” that comply with Section 2 of this Guide will be assigned the notation **WT-READY**, upon Owner’s request.

7.3 Temporary Well Test Systems

Vessels or MODUs with temporary well test systems that comply with the requirements of Section 3 of this Guide will be assigned the notation **WT-TEMP**, upon Owner’s request.

Vessels or MODUs with temporary well test systems installed on board and not assigned with notation **WT-TEMP** are to comply with the minimum mandatory requirements of Subsection 3/19 of this Guide. In this case, no class notation related to well testing systems will be assigned to the vessel or MODU.

7.5 Permanent Well Test Systems

Vessels or MODUs fitted with permanent well test systems that comply with Section 4 of this Guide will be assigned the notation **Well Test Service**. This notation is mandatory.

7.7 Change of Class Notations

The installation or removal of the well test systems on board vessels and MODUs is to be notified to ABS in order to re-assess the compliance with the requirements of this Guide. The class notations will be modified as necessary to reflect the new status of the vessel or MODU, as shown in Section 1, Figure 1.

9 Plans and Data to be Submitted

Plans should generally be submitted electronically to ABS. However, hard copies will also be accepted.

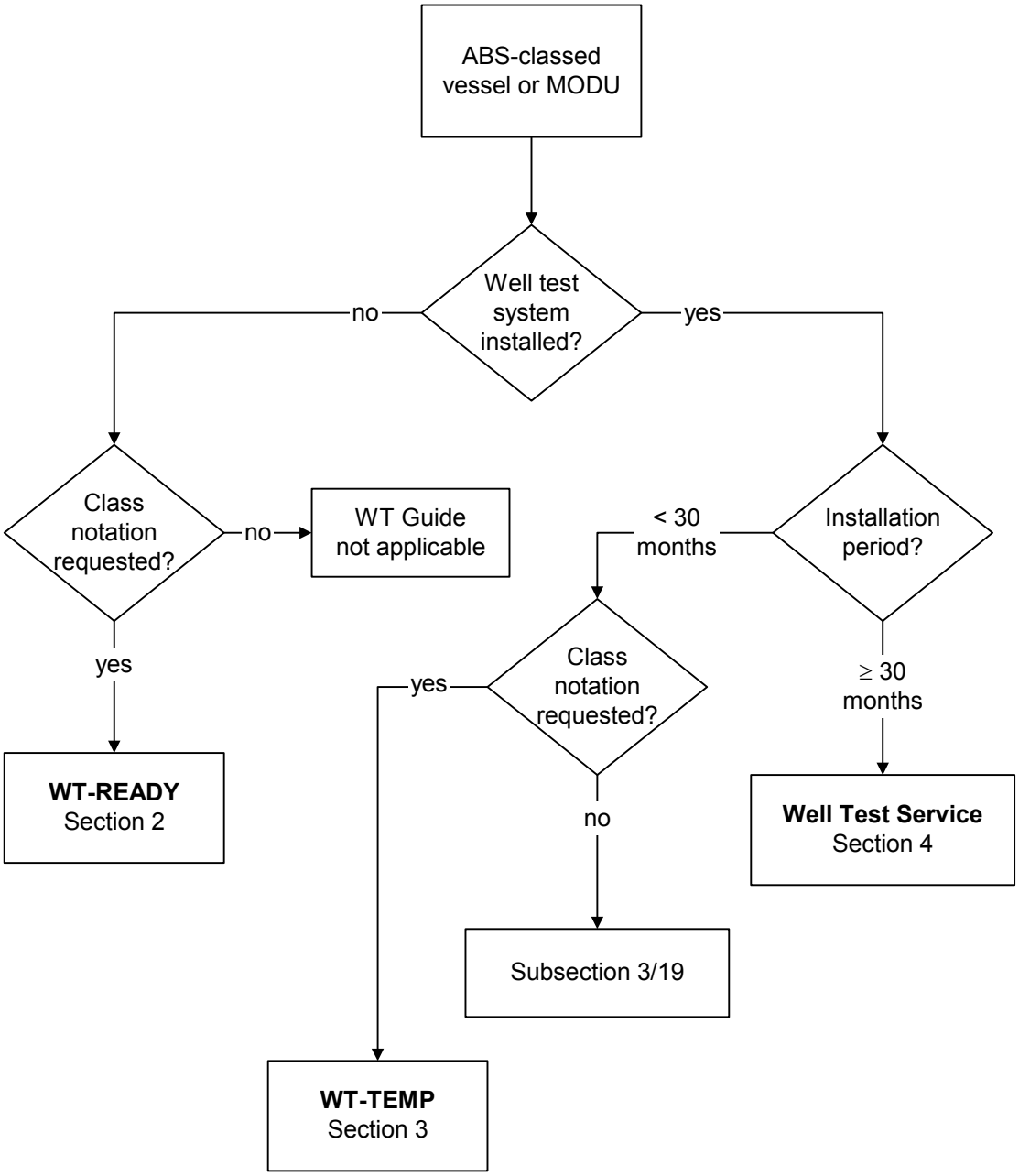
9.1 Systems

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

- Project Specification
- Process Flow Sheets
- General Arrangement Plan
- Equipment Layout Drawings
- Area Classification Drawings
- Deck Structural Drawings
- Burner/Flare Boom Structural Drawings
- Piping and Instrument Diagrams (P & ID's)
- Pressure Relief and Depressurization Systems
- Flare and Vent System
- Gas Dispersion and Radiant Heat Study
- Spill Containment and Drain Systems
- Equipment Documentation
- Piping Specification
- Electrical One-line Diagrams
- Instrumentation and Control Systems
- Firewater System
- Water Spray (Deluge) Systems for Well Test Equipment
- Foam Systems for Crude Storage Tanks
- Emergency Control Stations
- Portable and Semi-Portable Extinguishers
- Fire and Gas Detection and Alarm Systems
- Fire and Gas Cause and Effect Chart
- Arrangements for Storage Tank Venting and Inerting
- Operating Manual

For details, reference is made to Chapter 3, Section 2 of the ABS *Guide for Building and Classing Facilities on Offshore Installations (Facilities Guide)*.

FIGURE 1
Well Test System Classification



SECTION 2 Well Test Ready

1 General

The area in which the well test system will be installed is to be defined and marked on the general arrangement plan of the vessel or MODU.

For MODUs, a description of the locations where the well test systems will be installed is to be included in the Operating Manual in accordance with 1-1-5/1.15 of the ABS *Rules for Building and Classing Mobile Offshore Drilling Units (MODU Rules)*.

3 Deck Structure

The maximum deck loading for the well test system and its components is to be predetermined, either by a uniformly distributed load or by localized loads, if the footprint of the deck connections is known.

Deck structures which will support the well test system, when installed, are to be appropriately reinforced and analyzed on the basis of the maximum loading conditions in compliance with Part 3 Chapter 2 of the ABS *Rules for Building and Classing Steel Vessels Under 90 meters (295 feet) in Length (Under 90m Rules)* or Part 3 Chapter 2 of the *MODU Rules*, as applicable. The maximum deck loading used in the structural analysis is to be clearly reflected in the deck structural drawing.

For MODUs, a description of the specific locations where well testing equipment will be placed and the maximum deck loading at those locations are to be reflected in the Operating Manual (see 1-1-5/1.15 of the *MODU Rules*).

5 Crude Storage Tank Structure

Integral hull tanks or independent tanks permanently installed on board and designated for crude storage during well testing operations are to comply with the applicable structural requirements of the *Under 90m Rules*, the ABS *Rules for Building and Classing Steel Vessels (Steel Vessel Rules)* or the *MODU Rules*, dependent on the type and characteristics of the vessel or unit.

7 Burner/Flare Boom Structure

When burner/flare booms are installed on board, the boom structures are to comply with Subsection 4/7 of this Guide.

9 Components

Well test system components, tanks and features that are installed on board the vessel or MODU are to comply with Subsection 3/9 or 4/9 of this Guide, when intended for temporary or permanent well test systems, respectively.

11 Spill Containment

Spill containment is to be provided in areas which may be subject to hydrocarbon liquid or chemical spills when the well test system is installed, such as areas around process vessels, heat exchangers and storage tanks with drain or sample connections, pumps, valves, manifolds, metering and data recording units and chemical storage and dispensing areas.

Spill containment is to utilize curbing or drip edges at deck level, recessed drip pans, containment by floor gutters, firewalls or protective walls, or equivalent means to prevent spread of discharged liquids to other areas and spillover to lower levels.

Where equipment is protected by a fixed foam fire extinguishing system, a minimum of 150 mm (6 in.) coaming is to be provided.

Each containment area, as well as any other plated deck or skid area subject to rainwater or other liquid accumulation, is to be equipped with drains connected to an open drain system, and installed and located so as to prevent the accumulation of standing liquid.

Spill containment areas and open and closed drain systems that are installed on board are to comply with 3-3/13 of the *Facilities Guide*.

13 Safety Systems

Safety systems that are installed permanently on board the vessel or MODU are to comply with Subsection 3/15 or 4/15 of this Guide, when intended for temporary or permanent well test systems, respectively.

Adequate provision is to be made in the following onboard systems for the future connection and operation of the well test safety systems:

- Monitoring and alarm systems
- Gas detection system
- Water spray system

13.1 Foam Systems for Crude Storage Tanks

Deck foam systems are to be provided for all vessels or MODUs storing crude oil in integral storage tanks, in accordance with 5C-1-7/27 of the *Steel Vessel Rules*. Where process equipment is located or supported above crude storage areas such that deck foam system application might be obstructed by steel supporting members, foam applicators or fixed systems may be considered as an alternative. Deck foam system coverage in way of process equipment supports is to be no less effective than for other cargo deck areas.

When the total capacity of the crude storage tanks is not greater than 800 m^3 (28250 ft^3), a fixed dry chemical fire-extinguishing system may be installed in lieu of the deck foam system, provided that the following conditions are complied with:

i) On a deck area of 45 m^2 (484 ft^2) or less, there are two or more dry chemical extinguishers whose total capacity is not less than 135 kg (300 lbs);

ii) On a deck area of more than 45 m^2 (484 ft^2), there are three or more dry chemical extinguishers whose total capacity of extinguishing agent is not less than:

$$C = 3A \quad \text{kg}$$

$$C = 0.62A \quad \text{lbs}$$

where A is the deck area in m^2 (ft^2)

iii) The minimum rate of supply of the extinguishing agent is not less than 3 kg/min/m^2 (0.62 lbs/min/ft^2)

13.3 Fire Hoses and Nozzles

Firewater stations are to be located on the perimeter of the area designated for installation of the well test system. The stations and their arrangements are to provide at least two jets of water not emanating from the same fire station to reach any part of the well test system that may be exposed to fire. Fire hoses and nozzles are to comply with the requirements of 3-8/5.1.3 of the *Facilities Guide*.

15 Classified Areas

Classified areas related to the installation of well test systems are to be delineated in accordance with the recommended practice of API RP 500 or API RP 505 and the following:

15.1 Securing of Hatches, Companionways and Ventilators

Hatches, companionways and ventilators within 3 m (10 ft) of classified areas are to be secured gas tight for the duration of the test program.

15.3 Electrical Equipment within Classified Areas

Fixed electrical equipment within classified areas is to be suitable for the hazard or de-energized.

15.5 Valves and Ball and Socket Hammer Unions

Areas around valves and ball and socket hammer unions are to be designated as Class 1 Division 2 (Zone 2) for a distance of 1 m. (3 ft).

15.7 Fired Heaters and Diesel Driven Machinery

Fired heaters and diesel driven machinery are to have air intakes located at least 3 m (10 ft) from any classified area. Exhausts are to be equipped with spark arresting devices and are to discharge outside classified areas.

15.9 Crude Storage Tanks

Delineation of classified areas for vessels and MODUs related to storage tanks for liquids with a flash point not exceeding 60°C (140°F) is to comply with 4-6-6/1.5 of the *Under 90m Rules* and Section 4-3-6 of the *MODU Rules*, respectively.

Vessels having crude storage tanks integral with the hull structure need not comply with 4-6-6/1.5 of the *Under 90m Rules* with regard to the classification of hazardous areas related to crude storage, provided they comply with the following applicable requirements:

15.9.1 Open Decks Over Crude Storage Tanks

Freely ventilated, open and gas tight deck spaces to the full breadth of the ship and 3 m (10 ft) fore and aft of cargo block to a height of 2.4 m (8 ft), or to the height of the production deck, are to be considered Class I, Division 2 areas (Zone 2).

15.9.2 Enclosed Spaces Adjacent to Crude Storage Tanks

Semi-enclosed or enclosed spaces immediately adjacent to crude oil storage tanks are to be considered Class I, Division 1 areas (Zone 1).

15.9.3 Pump Room

A continuously ventilated (20 air changes per hour) crude oil pump room is to be considered a Class I, Division 1 (Zone 1) area, provided the failure of ventilation is alarmed in a manned location.

15.9.4 Cofferdam

Spaces which are separated by a single bulkhead from crude oil storage tanks are to be considered Class I, Division 1 (Zone 1) areas.

15.9.5 Crude Storage Tank Vents

Areas of unrestricted ventilation around cargo tank vents are to be considered Class I Division 1 (Zone 1) areas with a spherical radius of 3 m (10 ft), and Class I Division 2 (Zone 2) for an additional 7 m (23 ft).

SECTION 3 Temporary Well Test Systems

1 General

Vessels or MODUs fitted with temporary well test systems are to comply with the requirements in this Section when the class notation **WT-TEMP** has been requested by the Owner.

When temporary well test systems are fitted, but the class notation **WT-TEMP** is not requested, as a minimum, the requirements of Subsection 3/19 are to be complied with.

3 Deck Structure

The area in which the well test system is installed is to be reflected in the general arrangement plan.

Deck structures which support the well test system are to be appropriately reinforced and analyzed on the basis of the maximum loading conditions in compliance with Part 3, Chapter 2 of the *Under 90m Rules* or Part 3, Chapter 2 of the *MODU Rules*, as applicable. The maximum deck loading used in the structural analysis is to be clearly reflected in the deck structural drawing.

For MODUs, a description of the specific locations where well testing equipment is placed and the maximum deck loading at those locations are to be reflected in the Operating Manual (see 1-1-5/1.15 of the *MODU Rules*).

5 Crude Storage Tank Structure

Integral hull tanks or independent tanks permanently installed on board and designated for crude storage during well testing operations are to comply with the applicable structural requirements of the *Under 90m Rules*, the *Steel Vessel Rules* or the *MODU Rules*, dependent on the type and characteristics of the vessel or unit.

7 Burner/Flare Boom Structure

The burner/flare boom structures are to comply with Subsection 4/7 of this Guide.

9 Components

9.1 Pressure Retaining Components

Design, construction, welding and testing of separators, heaters, treaters, nitrogen storage, surge and transfer tanks and other pressure retaining components are to comply with the ASME "Boiler and Pressure Vessel Code Section VIII Division 1 or Division 2" or other recognized standards.

All pressure vessels and pressure-related equipment are to be protected from overpressurization by pressure relief systems in compliance with 3-3/11.1 of the *Facilities Guide*.

At least two relief valves or the equivalent are to be provided on test separators. The relief valve vent lines are to be led outboard at least 120 pipe diameters or connected to a suitable hydrocarbon disposal facility in accordance with Subsection 3/13 of this Guide. Any vent line valves are to be interlocked to provide one open flow path for all vents at any time.

9.3 Well Control Components

Well control components such as flowheads, test trees and emergency shutdown valves (ESDV) are to be suitable for the intended pressure. Design and fabrication are to be in accordance with recognized standards such as API Spec. 6A and 14D.

9.5 Piping Components

Piping components are to be designed, fabricated and tested in accordance with Sections 5, 6 and 7 of the ABS *Guide for the Classification of Drilling Systems (CDS Guide)*.

9.7 Flexible Hoses

Flexible hoses are to be designed and constructed in accordance with 5/3.7 of the *CDS Guide*.

9.9 Pumps

Pumps are to comply with API Std. 610 or other applicable recognized standard.

9.11 Electrical Components and Installations

Electrical components are to be certified for use for their intended service. Electrical installations are to be in accordance with Chapter 3, Section 6 of the *Facilities Guide*.

11 Spill Containment

Spill containment in accordance with Subsection 2/11 of this Guide is to be provided.

13 Hydrocarbon Disposal Facilities

Hydrocarbon disposal facilities are to be designed in accordance with the principles of API STD 521. The following specific requirements are applicable.

13.1 General

Hydrocarbon disposal facilities are to be of adequate capacity and construction for the intended flow stream composition and duration of test.

As a minimum, two flare lines are to be provided at opposite sides of the vessel or unit.

13.3 Flares and Burner Booms

Flares and burner booms are to be arranged such that the incident heat (short duration) on critical surfaces does not exceed 4.73 kW/m^2 (1,500 BTU/hr/ft^2) (including solar radiation). The use of heat shields and water spray cooling system (water curtain) will be specially considered.

13.5 Burning of Atomized Crude Oil

In cases where crude oil is burned and atomization is used, atomization medium supply lines are to be provided with a non-return valve or some other approved means of preventing backflow of hydrocarbons into non-hazardous piping systems.

13.7 Gas Flare Tip Flow Rate

Gas flare tip flow rate is generally not to exceed 0.5 Mach. (see API STD 521).

15 Safety Systems

A system of automatic and manual controls together with process shutdown and operating procedures are to be provided in accordance with the principles of API RP 14C with due consideration given to the normal manning during well test operations, the accessibility of manual controls and the intermittent operation of the system. The following specific requirements are applicable.

15.1 Monitoring

Process system flow rate, pressure, level and temperature are to be automatically monitored and controlled, and the abnormal conditions are to be alarmed with visual and audible devices.

15.3 Flammable Gas Detection

Gas detection is to be provided in well test areas. Visual and audible alarms are to be set at 20% and 60% (LEL) lower explosive limit. Process safety shutdown functions are to be initiated upon high gas detection.

15.5 Hydrogen Sulfide Gas Detection

Hydrogen sulfide gas detection is to be provided. Visual and audible alarms are to be set at 10 ppm and 50 ppm H_2S. Process safety shutdown functions are to be initiated upon high gas detection.

15.7 Fire Fighting Equipment

Fire fighting equipment is to be adequate to water deluge process components with at least 10.2 liters/min/m^2 (0.25 gpm/ft^2) of component surface area. Equivalent foam or dry chemical systems may be considered.

In addition, fire hoses and nozzles in compliance with 2/13.3 of this Guide are to be provided.

15.9 Arrangement of Components

The arrangement of process components onboard is to allow for adequate access to process controls and ingress for fire extinguishing agents.

15.11 Well Injection Line

Each well injection line is to be provided with a check valve located at a flowhead or test tree.

17 Classified Areas

Classified areas related to the installation of well test systems are to be delineated in accordance with Subsection 2/15 of this Guide.

19 Vessels and Units without WT-TEMP Class Notation

When the class notation **WT-TEMP** has not been requested by the Owner, vessels or MODUs fitted with temporary well test systems are to comply with the following minimum requirements:

19.1 Structures

The requirements stated in Subsections 3/3 and 3/5 of this Guide are to be complied with.

19.3 Safety Systems

The requirements stated in Subsection 3/15 of this Guide are to be complied with.

19.5 Classified Areas

Classified areas related to the installation of well test systems are to be delineated in accordance with Subsection 2/15 of this Guide. Electrical components located in classified areas are to be of a type suitable for such locations.

19.7 Mobile Offshore Drilling Units with CDS Notation

Temporary well test systems installed on board mobile offshore drilling units with **CDS** class notation are to comply with the requirements of Subsection 3/13 and any other relevant sections of the *CDS Guide*.

SECTION 4 Permanent Well Test Systems

1 General

Vessels and MODUs fitted with permanent well test systems, as defined in 1/5.3, are to comply with the *Facilities Guide* and the requirements in this Section.

3 Deck Structure

The area in which the permanent well test system is installed is to be reflected on the general arrangement plan.

Deck structures which support the well test system are to be appropriately reinforced and analyzed on the basis of the maximum loading conditions in compliance with Part 3, Chapter 2 of the *Under 90m Rules* or Part 3, Chapter 2 of the *MODU Rules*, as applicable. The maximum deck loading used in the structural analysis is to be clearly reflected in the deck structural drawing.

For MODUs, a description of the specific locations where well testing equipment is placed and the maximum deck loading at those locations are to be reflected in the Operating Manual (see 1-1-5/1.15 of the *MODU Rules*).

5 Crude Storage Tank Structure

Integral hull tanks or independent tanks permanently installed on board and designated for crude storage during well testing operations are to comply with the applicable structural requirements of the *Under 90m Rules*, the *Steel Vessel Rules* or the *MODU Rules*, dependent on the type and characteristics of the vessel or unit.

7 Burner/Flare Boom Structure

The burner/flare boom structures are to be designed and constructed in accordance with API RP 2A for secondary structures and the following:

7.1 Design Loads

The loads to be considered in the design of a boom structure include, as appropriate:

i) Dead weight of structure, piping, fittings, rigging, snow and ice, walkways, guard rails, etc.

ii) Wind Loads

iii) Thermal and impulsive loads resulting from the use of the flare

iv) Vessel motion-induced loads

The values of all design loads are to be listed in the submitted design documentation. Loads resulting from vessel motions and wind loads can be established using the procedures given in the API Spec. 4F. The derivation of loading conditions to be used in the design is to give due account of the operational requirements of the user, and should reflect both the operational and stowed modes of the boom.

For local loads of walkways and platforms associated with the boom, reference is made to 3-1-3/1.11.3 of the *MODU Rules*.

7.3 Allowable Stresses

Reference is to be made to the AISC or other recognized standard for limits on stress to preclude excessive stresses in members and connections or buckling. Permission to use a one-third increase in allowable stress must be specially approved by ABS.

9 Components

Well test system components are to comply with 3-3/3, 3-3/5, 3-3/11.1, 3-3/11.3, 3-3/17, and 3-3/23 of *Facilities Guide* and the following requirements:

9.1 Pressure Retaining Components

At least two relief valves or the equivalent are to be provided on test separators. The relief valve vent lines are to be led outboard at least 120 pipe diameters or connected to a suitable hydrocarbon disposal facility in accordance with Subsection 4/13 of this Guide. Any vent line valves are to be interlocked to provide one open flow path for all vents at any time.

9.3 Well Control Components

Well control components such as flowheads, test trees and emergency shutdown valves (ESDV) are to be suitable for the intended pressure. Design and fabrication are to be in accordance with recognized standards such as API Spec. 6A and 14D.

9.5 Piping Components

Piping components are to be designed, fabricated and tested in accordance with 3-3/19 and 3-3/21 of the *Facilities Guide* and Sections 5, 6 and 7 of the *CDS Guide*.

9.7 Flexible Hoses

Flexible hoses are to be designed and constructed in accordance with 3-3/19.7 and Appendix 2 of the *Facilities Guide* and 5/3.7 of the *CDS Guide*.

9.9 Electrical Components and Installations

Electrical components are to be certified for use for their intended service. Electrical installations are to be in accordance with Chapter 3, Section 6 of the *Facilities Guide*.

11 Spill Containment

Spill containment in accordance with Subsection 2/11 of this Guide is to be provided.

13 Hydrocarbon Disposal Facilities

Hydrocarbon disposal facilities are to comply with 3-3/11 of the *Facilities Guide* and the following requirements:

13.1 General

Hydrocarbon disposal facilities are to be of adequate capacity and construction for the intended flow stream composition and duration of test.

As a minimum, two flare lines are to be provided at opposite sides of the vessel or unit.

13.3 Burning of Atomized Crude Oil

In cases where crude oil is burned and atomization is used, atomization medium supply lines are to be provided with a non-return valve or some other approved means of preventing backflow of hydrocarbons into non-hazardous piping systems.

13.5 Gas Flare Tip Flow Rate

Gas flare tip flow rate is generally not to exceed 0.5 Mach. (see API STD 521).

15 Safety Systems

Safety systems are to comply with 3-3/7, 3-8/5.1.3, 3-8/5.1.4, 3-8/5.1.5 and 3-8/7.3 of the *Facilities Guide* and Subsection 3/15 of this Guide.

17 Classified Areas

Classified areas related to the installation of well test systems are to be delineated in accordance with 3-6/15 of the *Facilities Guide* and Subsection 2/15 of this Guide.

SECTION 5 Materials for Well Test Systems and Components

1 General

This Section addresses the considerations to be taken into account in selecting materials for well test systems and components.

3 Selection of Structural Steels

All materials are to be suitable for their intended service conditions and defined by a recognized standard.

For guidance on the selection of steel for plates, shapes and structural pipe sections, reference is to be made to recognized standards such as API RP 2A, Chapter 2 of the ABS *Rules for Materials and Welding (Part 2)* or Section 3-1-4 of the *MODU Rules*.

Toughness. Where toughness is to be considered in material selection, the toughness testing criteria in the API RP 2A and the ABS *Rules for Materials and Welding (Part 2)*, as applicable, are to be met for the principal structural components of flare/burner booms.

Bolts and Nuts. Bolts and nuts are to have corrosion characteristics comparable to the structural elements being joined and are to be manufactured and tested in accordance with recognized material standards.

5 Selection of Well Test Equipment Materials

Materials for load-bearing and pressure-containing elements of well test equipment are to be selected with due regard to toughness, corrosion resistance and weldability, and are to comply with the following specific criteria:

5.1 Toughness

Material requirements, including toughness, for well test equipment are to be in compliance with relevant API or other applicable recognized standard.

Charpy V-notch impact testing is to be performed at 0°C (32°F) or the design service temperature, whichever is lower. The absorbed energy requirement is as follows:

Yield Strength (YS)			*Impact Energy (Longitudinal)*		
N/mm^2	*(kgf/mm^2)*	*(ksi)*	*J*	*(kgf-m)*	*(ft-lbf)*
Lower than 270	(Lower than 27.5)	(Lower than 39)	27	(2.8)	(20)
270-420	(27.5-43)	(39-61)	YS/10	(YS/10)	(YS/1.95)
Higher than 420	(Higher than 43)	Higher than 61)	42	(4.3)	(31)

Other toughness tests and criteria may be submitted for consideration, as alternatives to the above.

5.3 Corrosion – Hydrogen Sulfide

Materials used in well control equipment and systems that will be exposed to well bore fluids are to be selected within appropriate limits of chemical composition, heat treatment and hardness to resist sulfide stress cracking. For this purpose, selection of material is to be guided by National Association of Corrosion Engineers (NACE) Standard MR0175/ISO 15156: Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment.

5.5 Corrosion – Marine Atmosphere

External and internal steel surfaces exposed to salt water/salt air environment are to be suitably coated or cathodically protected. Where the corrosion rate can be reliably predicted, a calculated corrosion allowance may be used. In the absence of a reliable corrosion rate, 0.125 mm (0.005 in.) is to be applied on each surface.

5.7 Stress

To determine the suitability of a material to withstand design stresses, the ultimate tensile strength, yield strength, elongation and reduction of area are to be specified.

7 Fabrication Considerations

7.1 Welding

Generally, weldments subject to hydrogen sulfide service are not to exceed a hardness of 22 Rockwell C in weld metal or heat affected zone (see NACE MR0175/ISO 15156). All welding is to comply with Section 6 of this Guide.

7.3 Forming

In general, for steel components, forming at temperatures around 205°C (400°F) is to be avoided. Where degradation of properties is unavoidable, complete post forming heat treatment may be required.

Suitable supporting data is to be provided to indicate compliance with the specified properties. For materials with specified toughness properties that are to be formed beyond 3% strain* on the outer fiber, data are to be provided indicating that the toughness properties meet the minimum requirements after forming. After straining, specimens used in toughness tests are to be subjected to an artificial aging treatment of 288°C (550°F) for one hour.

* For details, see 2-4-1/3.13 of the ABS *Rules for Materials and Welding (Part 2)*.

9 Primary Product Form

9.1 General

Wrought and cast products are to be procured in accordance with written specifications that, in addition to property requirements, specify the frequency, location, orientation and types of test specimens. Specific nondestructive examination requirements may be required for some product forms. See 6/11.3 of this Guide.

9.3 Rolled Products

Plates, shapes and bars may be supplied in the as-rolled, thermo-mechanically processed, normalized, or quenched and tempered condition, depending on the intended application.

9.5 Forgings

Forged products are to be supplied in a fully worked condition and demonstrate a wrought microstructure and internal soundness. A forging reduction ratio of not less than 3:1 will be considered as meeting this requirement. Where a net change in the cross section does not occur during a portion of the forging operation, the hot working ratio representing that portion will be evaluated as a complement to the forging reduction ratio.

9.7 Castings

In general, cast products are to be supplied in a heat-treated condition. Samples for testing are to be taken from integrally cast coupons or appropriately designed separately cast coupons. These coupons are to be subjected to the same heat treatment as the casting.

11 Sealing Materials

11.1 Elastomeric Sealants

Materials used for sealing are to be suitable for the intended operating pressures and temperatures. Age-sensitive materials for critical components are to have a defined storage life and be identified in storage as to month and year of manufacture.

11.3 Ring Joint Gaskets

Ring joint gaskets are to be of soft iron, low carbon steel or stainless steel, as required by the design standard. Gaskets that are coated with a protective coating material such as fluorocarbon or rubber for shipment and storage are to have the coatings removed prior to installation.

13 Materials and Traceability

13.1 Materials

All materials used for pressure-retaining and major load-bearing parts are to be furnished with documentation that states the process of manufacture and heat treatment, together with chemical analysis and tests that were applied according to recognized standards. Test coupons are required for each heat treatment for verification of mechanical properties to the manufacturer's written specification and/or industry standards.

13.3 Traceability

Traceability through the manufacturing process shall be documented on major load-bearing and pressure-retaining parts. The manufacturers are responsible for maintaining this documentation on file and upon request are to provide this information to ABS.

The traceability documentation shall include:

i) Certified Materials Test Report

- Chemical and mechanical properties for each heat
- Heat treatment temperatures and time at temperature
- Charpy impact values and temperatures
- Hardness test readings (as applicable to NACE MR0175/ISO 15156)

ii) Manufacturing Processes

- Welding records with all approved qualifications
- Post weld heat treatment
- NDT results
- Hardness test results (as applied to NACE MR0175/ISO 15156)
- Dimensional check results
- Hydrostatic pressure tests

SECTION 6 Welding and Nondestructive Examination

1 General

All welds in the pressure boundary of pressure-retaining components and piping systems and welds in load-carrying mechanical and structural components are to be made using approved welding procedures by qualified welders and are to be inspected utilizing approved procedures by qualified technicians.

Critical sections of primary components are to be examined for surface and volumetric flaws to the extent specified in the design, but not to a lesser extent than that specified in this Section.

The Surveyor is to be satisfied that all welders and welding operators to be employed in the construction of equipment are properly qualified and experienced in the work proposed. The Surveyor is also to be satisfied as to the employment of a sufficient number of skilled supervisors for thorough supervision and control of all welding operations. Inspection of welds employing methods outlined in this section is to be carried out to the satisfaction of the Surveyor.

3 Specifications

As applicable, Welding Procedure Specification (WPS) and Nondestructive Examination (NDE) procedures are to be submitted for review as part of the design. Where high-tensile strength or special alloy materials are used, the corresponding Procedure Qualification Record (PQR) for the WPS is also required to be submitted for review.

3.1 Welding Procedure Specification

A written Welding Procedure Specification (WPS) is to be prepared in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, or ANSI/AWS D1.1 Structural Welding Code, or equivalent, depending on the component. The WPS is to describe in detail all essential and nonessential variables to the welding process(es) employed in the procedure.

Welding procedure specifications are to be qualified and the Procedure Qualification Record (PQR) documenting the following data is to be made available to the attending Surveyors:

i) Maximum hardness values (for well bore fluid service)

ii) Minimum and average toughness values for weld heat affected zone and weld metal (absorbed energy or lateral expansion, both by Charpy method, where the base metal is required to be impact tested in accordance with Sections 3 or 6 of this Guide.)

iii) Minimum tensile strength

iv) Results from other tests required by the applicable code or standard

Where welding equipment and consumables have never been used at the manufacturer's facility, are not compatible or are outside of the essential variable limits defined in the existing WPS or if specifically requested by the attending Surveyor, the WPS is to be qualified by welding qualification procedures in the presence of the Surveyor. The qualification process may require the submittal of relative WPS and supporting PQRs to the Engineering office for review and agreement.

3.3 NDE Procedures

NDE procedures are to be specified and the parameters of test specification (method), extent of examination and acceptance criteria are to be submitted for review and be available to the attending Surveyor.

5 Welder/Welding Operator Qualification

Welders and welding operators are to be qualified by qualification tests conducted and evaluated in accordance with the applicable code for each welding process and for each position used in production welding. Welder/welding operator qualification records are to be made available to the Surveyor.

7 Qualification of Nondestructive Technicians

The manufacturers are to certify that personnel performing and evaluating the nondestructive examinations have been qualified and certified in accordance with their employer's written practice. American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A or equivalent is to be used as a guideline for employers to establish their written practice for qualification and certification of their personnel. Certification documents of NDE technicians are to be made available to the Surveyor.

9 Post Weld Heat Treatment

Accurate records of all heat treatments during fabrication, including rates of heating and cooling, hold time and soaking temperature are to be made available to the Surveyor. Alternative methods of stress relief will be subject to special consideration by ABS where post-weld heat treatment is not a requirement of the applicable construction code.

11 Nondestructive Examination

All weldments and other critical sections covered under Subsection 6/1 of this Guide are to be subjected to 100% visual examination and nondestructive examination for surface and volumetric defects in accordance with this Guide or the relevant code. Examinations are to be carried out after any postweld heat treatment.

11.1 Extent of Examination for Materials and Welds

i) All highly stressed areas of forgings and castings of primary components used in well control are to be examined for flaws by methods capable of detecting and sizing significant internal defects. Methods to detect surface flaws are also to be used in special applications. Substantiation is to be provided for areas exempted from examination in the terms of stress levels, quality control procedures at the foundry, forming or casting procedures, or documented historical data.

ii) Repair welds are to be subject to 100% surface NDE.

iii) All welds of structural members considered special are to be inspected 100% by the ultrasonic or radiographic method. Twenty percent of all welds of structural members considered primary are to be inspected by the ultrasonic or radiographic method. Welds of structural members considered to be secondary are to be inspected by the ultrasonic or radiographic method on a random basis. In locations where ultrasonic test results are not considered reliable, the use of magnetic-particle or dye-penetrant inspection as a supplement to ultrasonic inspection is to be conducted.

iv) Welds of major load-carrying or pressure-retaining components are to be examined by nondestructive methods capable of detecting and sizing significant surface and internal defects.

11.3 Methods and Acceptance Criteria

The methods for performing the nondestructive examination and the acceptance standards to be used for each type of examination, in general, are to be in accordance with the following, as applicable:

11.3.1 Magnetic Particle Examination

i) *Methods* – ASME Boiler and Pressure Vessel Code Section V Article 7: "Magnetic Particle Examination." ASTM E709: "Standard Recommended Practice for Magnetic Particle Examination."

ii) *Acceptance Criteria* – Section VIII, Appendix 4, ASME Boiler and Pressure Vessel Code.

11.3.2 Liquid Penetrant Examination

i) *Methods* – ASME Boiler and Pressure Vessel Code Section V Article 6: "Liquid Penetrant Examination." ASTM E165: "Standard Practice for Liquid Penetrant Inspection."

ii) *Acceptance Criteria* – ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Appendix 8, "Methods for Liquid Penetrant Examination (PT)." ANSI/AWS D1.1 "Structural Welding Code" 9.25 "Quality of Welds."

11.3.3 Radiographic Examination

i) *Methods – A*SME Boiler and Pressure Vessel Code Section V Article 2: "Radiographic Examination." ASTM E94: "Standard Practice for Radiographic Testing." ASTM E446: "Standard Reference Radiographs for Steel Castings up to 2 in. in Thickness." ASTM E186: "Standard Reference Radiographs for Heavy Walled (2 to 4.5 in.) (51 to 114 mm) Steel Castings." ASTM E280: "Standard Reference Radiographs for (4.5 to 12 in.) (114 to 305 mm) Steel Castings."

ii) *Acceptance Criteria* – ASME Boiler and Pressure Vessel Code, Section VIII, Appendix 4, "Rounded Indications Charts Acceptance Standard for Radiographically Determined Rounded Indications in Welds." ANSI/AWS D1.1 "Structural Welding Code" 9.25 "Quality of Welds."

11.3.4 Ultrasonic Examination

i) *Methods* – ASME Boiler and Pressure Vessel Code Section V, Nondestructive Testing, Article 5: "UT Examination Methods for Materials and Fabrication." ASTM A388: "Recommended Practice for Ultrasonic Examination of Heavy Steel Forgings." ASTM E428: "Standard Recommended Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Inspection." ASTM A609: "Specification for Ultrasonic Examination for Carbon and Low-Alloy Steel Castings."

ii) *Acceptance Criteria* – ASME Boiler and Pressure Vessel Code, Section VIII, Appendix 12, "Ultrasonic Examination of Welds (UT)." ANSI/AWS D1.1 Section 6, Part C, "Ultrasonic Testing of Groove Welds." API RP-2X "Ultrasonic Examination of Offshore Structural Fabrication and Guidelines for Qualification of Ultrasonic Technicians."

11.3.5 Hardness Testing

i) *Methods* – ASTM 10: "Standard Test Methods for Brinell Hardness of Metallic Materials." ASTM E18: "Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials." ASTM E92: "Standard Test Method for Vickers Hardness of Metallic Materials."

ii) *Acceptance Criteria* – NACE MR0175/ISO 15156: "Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment."

13 Record Retention

The manufacturer shall maintain the following records after completion, and these records are to be made available to the Surveyor upon request:

i) Weld Procedure Specification

ii) Procedure Qualification Records

iii) Welder/welding operator performance test records, including the date and test results and identification of work assigned to each welder

iv) A record providing traceability and capable of identifying the welders who have carried out welding on a particular part

v) Qualification records for all personnel performing nondestructive examinations and evaluating results of examination

vi) Nondestructive Examination records, including radiographs (the manufacturer is to provide a suitable viewer to properly illuminate radiographs)

SECTION 7 Surveys at Vendor's Plant, During Installation and Commissioning

1 General

This Section pertains to surveys of well test system components at the vendor's plant of manufacture and their installation onboard the vessels or MODUs prior to commencement of well test operations.

This Section applies to vessels and MODUs with **WT-TEMP** and **Well Test Service** notations, except when indicated otherwise.

3 Surveys at Manufacture and During Assembly

When the Surveyor's attendance at the shop of the manufacturer and at the assembly site is required by the applicable ABS Rules or this Guide, the manufactured/assembled system components will be verified to be satisfactorily in compliance with a recognized standard such as the American Petroleum Institute (API) and as stated in the manufacturer's submitted affidavit.

Unless the facility/vendor has ABS Product Quality Assurance Certificate, ABS Surveyor's attendance is required, typically for the following purposes:

i) To confirm that the facilities to manufacture, fabricate or repair well test system components have and maintain an effective quality control program effectively covering design, procurement, manufacturing and testing, as applicable, and meeting the requirements of a recognized standard applied to their product

ii) To qualify or verify welder's qualifications to the extent deemed necessary by the attending ABS Surveyor

iii) To qualify or verify welding procedure specifications and corresponding weld procedure qualification records to the extent deemed necessary by the attending ABS Surveyor

iv) To verify material certificates/documentation

v) To survey fit-up prior to major weldments

vi) To survey final weldments

vii) To witness, as far as deemed necessary, nondestructive examination tests of welds and to review records of nondestructive examinations

viii) To review records of post-weld heat treatment, in particular for piping subjected to pressurized sour service and subject to NACE MR0175/ISO 15156 requirements

ix) To verify dimensions are the same as shown on approved drawings

x) To check dimensional tolerances and alignment of mating surfaces

xi) To witness prototype testing of well test equipment subject to such testing in accordance with the applicable API requirements. For well test equipment of an existing design, documentation of prototype testing is to be made available to the Surveyor for consideration.

xii) To witness pressure and/or proof-load testing of equipment components and as a unit, as applicable and as called for in the fabrication procedures

xiii) To witness final testing and functional testing of subassemblies and completed units, as called for in the fabrication procedures

xiv) To verify purged and pressurized systems, motor controllers, SCR banks, consoles and instrumentation and control panels are in compliance with approved drawings

xv) To carry out other inspections as agreed upon during prefabrication meeting.

The Materials Test Report (MTR) of the following components is to be made available to the attending Surveyor during the manufacturing process:

i) Materials of main pressure-retaining parts of valves, including safety valves that have flanged or screwed ends or other specialty fittings

ii) All screwed fittings and bolts for fastening

iii) All other piping, valves and fittings with a design temperature not less than 180°C (356°F) or a design pressure not less than 20 bar (20.4 kgf/cm^2, 290 psig). The above components include, but shall not be limited to, the main pressure-retaining parts of valves with welded ends or components joined by welding if used at temperatures equal to or above 180°C (356°F) or at pressures equal to or above 20 bar (20.4 kgf/cm^2, 290 psig).

3.1 Module Fabrication

Where equipment and components are assembled as skid mounted units or modules, the Surveyor is to inspect the fit-up, piping and electrical connections, and to witness pressure and function tests of the completed assembly in accordance with approved plans.

5 Onboard Surveys During Installation

5.1 Operation Procedures

Operation procedures are to detail the well test plan. Manning requirements, equipment operations and emergency procedures are to encompass component testing, well test startup and shutdown, fire fighting procedures and emergency evacuation.

5.3 Installation and Testing

Installation and testing of well test equipment is to be witnessed by an ABS Surveyor for the initial installation of the test equipment. Subsequent installation of an identical arrangement may be witnessed to the extent deemed necessary by the attending Surveyor.

5.5 Surveys

Surveys onboard will verify that the production test plan and procedures are being observed. ABS Surveyor's attendance is required for the following surveys to be carried out during installation and testing:

i) Arrangements of equipment and piping are to be inspected visually to determine accessibility of controls.

ii) Piping systems and pressure-containing components are to be inspected visually and a hydrostatic test performed, as required by the *MODU Rules* or applicable API Codes.

iii) All pressure relief and safety valves are to be tested.

iv) Electrical equipment is to be inspected for condition, suitability for operation and effectiveness of controls.

v) Control system and shutdowns are to be tested to the satisfaction of the Surveyor.

vi) All wiring and electrical connections are to be checked for continuity and proper workmanship in accordance with the *MODU Rules*.

vii) Monitoring and alarm systems are to be tested to determine if the flow rate, pressure, level and temperature transducers are in proper working order.

viii) Fire fighting equipment is to be inspected for condition and arrangements are to be surveyed to determine accessibility of all well test areas for fire fighting purposes.

ix) The completed burner assembly is to be pressure tested from the flexible hose connection flange to the burner head. The adequacy of the boom's slewing and topping gear is to be demonstrated by testing after the boom's installation onboard the vessel or unit. The details of the test procedure are to be agreed upon with ABS and witnessed by a Surveyor.

For vessels and MODUs where a temporary well test system is installed, but class notation **WT-TEMP** has not been requested, ABS Surveyor's attendance is required for surveys as per 7/5.5i), iii), iv), v), vii), and viii), as a minimum.

5.7 Module Hook-up

Survey during hook up is to be carried out per approved procedures, and to include the following where applicable:

5.7.1

All piping hook up is to be verified for compliance with approved drawings and procedures. All welds are to be visually inspected, and non-destructive testing (NDT) carried out as required. Upon completion of hook up, the affected sections are to be proven tight by hydrostatically testing to 1.5 times the design working pressure.

5.7.2

All electrical hook up is to be verified for compliance with the approved drawings and procedures. Proper support for all cables and proper sealing of cable entries to equipment are to be verified. Upon completion of all hook up, the affected sections of the equipment and cabling are to be insulation tested and proven in order. All grounding is also to be verified in order.

5.7.3

All instrumentation hook up is to be verified for compliance with the approved drawings and procedures. All tubing supports are to be verified. Upon completion, all systems are to be functionally tested and proven in order.

5.7.4

All mechanical equipment hook up is to be verified for compliance with the approved drawings and procedures, including the grounding of the equipment. Upon completion, all equipment is to be functionally tested and proven in order.

7 Commissioning Surveys of the Well Test Systems

Commissioning of well test systems is to be verified by an attending ABS Surveyor and is to be in accordance with ABS agreed test procedures. Commissioning surveys are to at least include verification of the following items by the attending Surveyor during the well test system trials:

i) Proper hook-up and testing of the well test system equipment and components is completed prior to commissioning. This is to include all tests outlined in Subsection 7/5 of this Guide.

ii) Necessary safety precautions are taken during commissioning, which are to include checks of operational readiness of the fire and gas detection system, fire extinguishing system, ESD systems, unobstructed escape routes, etc.

iii) Necessary communication procedures are established prior to commissioning.

iv) Necessary emergency procedures are readily available to deal with any contingencies such as spillage, fire, and other hazards. Drills prior to commencement of commissioning may be carried out to the satisfaction of the attending Surveyor to confirm readiness of these procedures.

v) Readiness of all utility support systems, including main and auxiliary sources for the well test system, prior to commissioning. Random start-up and testing of the utility support systems to the extent deemed necessary by the attending Surveyor.

vi) Proper operation of the hazardous area access and ventilation system whilst the drilling system is running, including random simulation of associated alarms and shutdowns.

vii) System's capability to control the flow of the well effluent in a stabilized manner, without undue control upsets.

viii) Satisfactory functioning of the well test system installed onboard and covered under this Guide, while simulating actual operations to the extent possible and practicable, and to the satisfaction of the attending Surveyor:

9 Start-up and Commissioning Manual

The start-up and commissioning manual is to include, at a minimum, the procedures listed in 7/9.1 and 7/9.3.

9.1 Functional Testing Procedures

During commissioning, the following systems are to be functionally tested in accordance with approved procedures.

9.1.1 Piping and Equipment

i) Pressure/Leak Test

ii) Purging

9.1.2 Utility Systems

i) Power Generation (Main & Emergency)

ii) Process Support Facilities

9.1.3 Fire Fighting Systems

i) Fire Pumps

ii) Fixed Fire Fighting Systems

9.1.4 Detection and Alarm

i) Fire Detection

ii) Gas Detection

iii) Fire and Gas Panel

iv) ESD Systems

9.1.5 Process Systems

i) Flare (pilot, ignition, snuffing and flare operational tests)

ii) Instrumentation and Control (wellhead control and process control system)

iii) Safety Shutdown Valves

iv) Process Components

9.3 Start-up Procedure

A step-by-step procedure is to be followed for the displacement of air or other fluid from the well test system prior to start-up. The Surveyor is to be permitted access to suitable vantage points to verify that the start-up procedures are satisfactorily accomplished.

SECTION 8 Surveys After Construction and Maintenance of Class

1 General

The provisions of this Section are requirements for the maintenance of certification of the well test systems. These requirements are in addition to the provisions noted in other ABS Rules such as Part 6 of the *MODU Rules*.

When ABS is authorized to perform surveys on behalf of a governmental authority, or when requested by the Owner, items as specified by the governmental authority or Owner will be surveyed. Reports indicating the results of such surveys will be issued.

This Section applies to vessels and MODUs with **WT-TEMP** and **Well Test Service** notations, except when indicated otherwise.

3 Surveys Onshore and Issuance of Maintenance Release Notes

During operation of the vessel or MODU when parts of the well test system components are returned ashore for maintenance, repair or modification purposes, it is the responsibility of the Owner to inform Surveyors of the scope of work at the shore facility/plant. Surveyors are to attend the facility/plant for all required function, load and/or pressure testing carried out on the well test system components prior to their release back offshore to the vessel or MODU. Tests conducted should follow guidelines outlined in API or equivalent.

Upon satisfactory completion of tests and visual examination, a "Maintenance Release Note" (MRN) shall be issued by the attending Surveyor, subject to satisfactory installation of the component on the vessel or MODU and examination of the component during the forthcoming Annual Survey. All MRNs are to be maintained onboard the vessel or drilling unit as part of the Owner's maintenance record and for verification by the attending Surveyor during classification surveys of the unit.

5 Surveys of Well Test Systems

5.1 Survey Intervals and Maintenance Manuals/Records

For well test systems installed onboard for periods longer than 12 months, an Annual Survey of the well test systems is to be carried out by a Surveyor within three months either way of each annual anniversary date of the initial installation survey.

For permanent well test systems installed onboard for periods longer than 5 years, Special Periodical Survey of the system is to be carried out within five years of the initial installation survey and at five-year intervals thereafter.

Required surveys are to be completed within three (3) months of their due dates, unless extended by agreement with ABS. Any part of the well test system may be offered for survey prior to the due date when so desired, in which case, the survey will be credited as of that date.

Maintenance records are to be kept and made available for review by the attending Surveyor. The maintenance records will be reviewed to establish the scope and content of the required Annual and Special Periodical Surveys that are to be carried out by a Surveyor. During the service life of the well test system components, maintenance records are to be updated on a continuing basis. The Owner is to inform ABS of any changes to the maintenance procedures and their frequencies as may be caused, for example, by changes or additions to the original well test equipment. The Surveyor may determine during the periodic survey if the changes are sufficient to warrant review by the ABS Engineering staff.

5.3 Annual Surveys

At each Annual Survey, the Surveyor is to verify the effectiveness of various systems and components by visual examination and testing, as appropriate. As a minimum, the following is to be carried out to the satisfaction of the attending Surveyor:

i) Review of Owner's maintenance manual and relevant logs/records to confirm that a suitable maintenance program has been followed, periodical testing requirements have been carried out and that any repairs, reconditioning or renewals of well test equipment, pressure vessels or electrical systems/equipment were carried out according to the applicable standards and the requirements of this Guide.

ii) Review of ABS-issued MRNs since initial or last Annual Survey, and examination of these components to extent deemed necessary by the attending Surveyor.

iii) Exposed surfaces of the structural components, burner booms, platforms and equipment foundations shall be examined and placed in satisfactory condition, as found necessary. The inspection of the structural members will include the following:

- The general condition of the structure, especially bent, missing or abraded parts and lost corrosion protection coatings.
- Tightness of bolts.

iv) General external examination so far as accessible of the well test system for damage, excess corrosion, fracturing or malfunctions.

v) External examination of pressure vessels and their appurtenances, including safety devices, foundations, controls, relieving gear, piping systems, flexible hoses, insulation and gauges.

vi) Examination of safety shutdown devices.

vii) General examination of all electrical and instrumentation systems, including protective devices and cable supports.

5.5 Special Periodical Surveys

The Special Periodical Survey is to include all items listed under the Annual Survey, and, in addition, the following is to be carried out to the satisfaction of the attending Surveyor:

i) Review of Owner's maintenance records to verify periodical testing requirements have been carried out and that any repairs, reconditioning or renewals of well test equipment, pressure vessels and electrical systems/equipment were carried out according to the applicable standards and the requirements of this Guide.

ii) Internal examination and/or thickness gauging of pressure vessels and pressure-retaining components, testing of relief valves and pressure piping systems, as considered necessary by the Surveyor.

iii) Hydrostatic testing of pressure vessels and other pressure-retaining components related to the well test system to their maximum allowable working pressure (MAWP).

iv) Hydrostatic testing of well test system piping systems and flexible hoses to their MAWP.

v) Examination and check of insulation resistance of motors that are part of the well test system.

vi) Checking and weighing the contents of fixed fire protection systems, including the capability and stability of storage foam liquids. Blowing through and verifying that piping for fixed fire extinguishing systems is not choked.

vii) Operational check of process control equipment.

5.7 Continuous Survey Program

A continuous inspection program may be arranged with ABS whereby all required surveys are carried out on a continuing basis within a five-year cycle.

5.9 Survey Based on Preventative Maintenance Techniques

A properly conducted preventative maintenance/condition-monitoring plan may be credited as satisfying the requirements of Special Continuous Survey. This plan must be in accordance with Appendix 7-A-14 "Guide for Survey Based on Preventative Maintenance Techniques" of the ABS *Rules for Survey After Construction (Part 7)*.

5.11 Surveys Using Risk-based Techniques

A properly conducted Risk-based Inspection plan or Reliability-centered Maintenance Plan may be credited as satisfying requirements of Special Continuous Survey. The plan must be in accordance with the ABS *Guide for Surveys Using Risk-based Inspection for the Offshore Industry* or ABS *Guide for Surveys Based on Reliability-Centered Maintenance*.

7 Modifications, Damage and Repairs

When it is intended to carry out any modifications to the machinery, piping, equipment, etc., which may affect classification, the details of such modifications are to be submitted for approval and the work is to be carried out to the satisfaction of the Surveyor.

If a well test system suffers any damage to its components, ABS is to be notified and the damage examined by a Surveyor. Details of intended repairs are to be submitted for approval, and the work is to be carried out to the satisfaction of the attending Surveyor.

Where component parts suffer a premature or unexpected failure, and are subsequently repaired or replaced without Surveyor attendance, details of the failure, including the damaged parts where practicable, are to be retained onboard for examination by the Surveyor during the next scheduled survey/visit. Alternatively, the component(s) may be taken ashore for examination and testing, as required. If failures are deemed to be a result of inadequate or inappropriate maintenance, the maintenance manual is to be amended and resubmitted for approval.