GUIDE FOR

BUILDING AND CLASSING FACILITIES ON OFFSHORE INSTALLATIONS

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

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Foreword

This Guide contains the technical requirements and criteria employed by ABS in the review and survey of hydrocarbon production facilities that are being considered for Classification and for maintenance of Classification. It is applicable to Hydrocarbon Production and Processing Systems and associated utility and safety systems located on fixed (bottom-founded) offshore structures of various types. It also applies to systems installed on floating installations such as ships shape based FPSOs, tension leg platforms, spars, semisubmersibles, etc.

There are differences in the practices adopted by the designers of fixed and floating installations. Some of these differences are due to physical limitations inherent in the construction of facilities on new or converted floating installations. Recognizing these differences, the requirements for facilities on fixed and floating installations are specified in separate chapters. Chapter 3 covers requirements for facilities on floating installations and Chapter 4 covers requirements for facilities on fixed installations.

Facilities designed, constructed, and installed in accordance with the requirements of this Guide on and ABS classed fixed or floating offshore structure, under ABS review and survey, will be classed and identified in the Record by an appropriate classification notation as defined herein.

The Guide has been written for world-wide application and as such, compliance with individual requirements may require comprehensive data, analyses and plans to be submitted to demonstrate the adequacy of the facility. ABS acknowledges that there is a wide range of documents that may be required for submittal to satisfy this Guide. It is not the intention of this Guide to impose requirements or practices in addition to those that have previously proven satisfactory in similar situations.

Design and installation requirements presented in this Guide are based on existing methodologies and attendant safety factors that are deemed to provide an adequate level of safety. Primarily, the use of such methods and limits in this Guide reflects what is considered to be the current state of practice in the design and installation of offshore facilities. The application of this Guide by ABS will not seek to inhibit the use of any technological approach that can be shown to produce an acceptable level of safety.

The Guide is applicable to the classification of facilities for which applications, or contracts for classification, are received on or after 01 May 2000. This Guide supersedes the *Guide for Building and Classing Facilities on Offshore Installations 1991*.

GUIDE FOR

BUILDING AND CLASSING FACILITIES ON OFFSHORE INSTALLATIONS

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CHAPTER 1 Scope and Conditions of Classification

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CHAPTER 1 Scope and Conditions of Classification

SECTION 1 Classification

1 Process

The term classification, as used herein, indicates that a hydrocarbon production and/or processing facility located on a floating or fixed (offshore) installation has been designed, constructed, installed and surveyed in compliance with the existing Rules, Guides or other acceptable standards.

Terms used in this Guide are defined in Chapter 2, Section 1 of this Chapter. The definitions of terms are included to assist the users of this Guide, and are based on the references commonly used by the designers.

The continuance of classification is dependent on the fulfillment of requirements for surveys after construction.

The classification process consists of:

i) The development of Rules, Guides, standards and other criteria for the design and construction of floating installations, mooring systems for floating installations, fixed installations, materials, production and processing facilities, and import and export systems;

ii) the review of the design and survey during and after construction to verify compliance with such Rules, Guides, standards or other criteria;

iii) the assignment and registration of class when such compliance has been verified, and;

iv) the issuance of a renewable Classification certificate, with annual endorsements, valid for five years.

The Rules, Guides and standards are developed by the Bureau staff and passed upon by committees made up of naval architects, ocean and marine engineers, shipbuilders, engine builders, steel makers, process engineers and by other technical, operating and scientific personnel associated with the worldwide maritime industry. Theoretical research and development, established engineering disciplines, as well as satisfactory service experience are utilized in their development and promulgation. The Bureau and its committees can act only upon such theoretical and practical considerations in developing Rules and standards.

For Classification, the system is to comply with various requirements for the hull or structure, machinery, position mooring, production and processing facilities, offloading facilities, and import and export system requirements of this Guide and all applicable Rules.

3 Certificates and Reports

3.1

Plan review and surveys during and after construction are conducted by the Bureau to verify to itself and its committees that the facility and classed elements thereof are in compliance with the Rules, Guides, standards or other criteria of the Bureau, and to the satisfaction of the attending surveyor. All reports and certificates are issued solely for the use of the Bureau, its committees, its clients, and other authorized entities.

3.3

The Bureau will release information from reports and certificates to the Port State, to assist in rectification of deficiencies during port state control intervention. Such information includes text of conditions of classification, survey due dates and certificate expiration dates. The Owner will be advised of any request and/or release of information.

3.5

The Bureau will release certain information to the vessel's hull underwriters and P&I clubs where applicable for the offshore installation for underwriting purposes. Such information includes text of overdue conditions of classification, survey due dates, and certificate expiration dates. The Owner will be advised of any request and/or release of information.

In the case of overdue conditions of classification, the Owner will be given the opportunity to verify the accuracy of the information, prior to release.

5 Representations as to Classification

Classification is a representation by the Bureau as to the structural and mechanical fitness for a particular use or service, in accordance with its Rules and standards. The Rules and Guides of the American Bureau of Shipping are not meant as a substitute the independent engineering judgement of professional designers, naval architects, marine engineers, owners, operators, masters and crew, nor as a substitute for the quality control procedures of ship and platform builders, engine builders, steel makers, suppliers, manufacturers and sellers of marine vessels, materials, system components, machinery or equipment. The Bureau, being a technical society, can only act through Surveyors or others who are believed by it to be skilled and competent.

The Bureau represents solely to the Offshore Installation Owner or client of the Bureau that when assigning class, it will use due diligence in the development of Rules, Guides and Standards, and in using normally applied testing standards, procedures and techniques as called for by the Rules, Guides, standards or other criteria of the Bureau for the purpose of assigning and maintaining class. The Bureau further represents to the Owner or other Client of the Bureau that its certificates and reports evidence compliance only with one or more of the Rules, Guides, standards or other criteria of the Bureau, in accordance with the terms of such certificate or report. Under no circumstances whatsoever are these representations to be deemed to relate to any third party.

The user of this document is responsible for ensuring compliance with all applicable laws, regulations and other governmental directives and orders related to a vessel, its machinery and equipment, or their operation. Nothing contained in any Rule, Guide, standard, certificate or report issued by the Bureau shall be deemed to relieve any other entity of its duty or responsibility to comply with all applicable laws, including those related to the environment.

7 Scope of Classification

Nothing contained in any certificate or report is to be deemed to relieve any designer, builder, owner, manufacturer, seller, supplier, repairer, operator, other entity or person of any warranty, express or implied. Any certificate or report evidences compliance only with one or more of the Rules, Guides, standards or other criteria of the American Bureau of Shipping, and is issued solely for the use of The Bureau, its committees, its clients, or other authorized entities. Nothing contained in any certificate, report, plan or document review or approval is to be deemed to be in any way a representation or statement beyond those contained in 1-1/5. The validity, applicability and interpretation of any certificate, report, plan or document review or approval are governed by the Rules and standards of the American Bureau of Shipping, who shall remain the sole judge thereof. The Bureau is not responsible for the consequences arising from the use by other parties of the Rules, Guides, standards or other criteria of the American Bureau of Shipping, without review, plan approval and survey by the Bureau.

The term "approved" is to be interpreted to mean that the plans, reports or documents have been reviewed for compliance with one or more of the Rules, Guides, standards, or other criteria of ABS.

The Rules are published with the understanding that, in the case of floating installations, responsibility for stability and trim, for reasonable handling and loading, avoidance of distributions of weight which are likely to set up abnormally severe stresses in the offshore installation, as well as shutting down operations beyond the limit specified in the design basis, does not rest upon the Committee.

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CHAPTER 1 Scope and Conditions of Classification

SECTION 2 Suspension and Cancellation of Class

1 Termination of Classification

The continuance of the Classification of the facility on any offshore installation is conditional upon the Rule requirements for periodical, damage and other surveys being duly carried out. The Committee reserves the right to reconsider, withhold, suspend, or cancel the class of any offshore facility or any part of the offshore installation for non-compliance with the Rules, for defects reported by the Surveyors which have not been rectified in accordance with their recommendations, or for nonpayment of fees which are due on account of Classification, Statutory and Cargo Gear Surveys. Suspension or cancellation of class may take effect immediately or after a specified period of time.

3 Notice of Surveys

It is the responsibility of the Owner to ensure that all surveys necessary for the maintenance of class are carried out at the proper time. The Bureau will give proper notice to an Owner of upcoming surveys. This may be done by means of a letter, a quarterly status report, or other communication. The non-receipt of such notice, however, does not absolve the Owner from his responsibility to comply with survey requirements for maintenance of class.

5 Special Notations

If the survey requirements related to maintenance of special notations are not carried out as required, the suspension or cancellation may be limited to those notations only.

7 Suspension of Class

7.1

Class will be suspended and the Certificate of Classification will become invalid, from the date of any use, operation, loading condition or other application of any vessel for which it has not been approved and which affects or may affect classification or the structural integrity, quality or fitness for a particular use or service.

7.3

Class will be suspended and the Certificate of Classification will become invalid in any of the following circumstances:

i) if recommendations issued by the Surveyor are not carried out by their due dates and no extension has been granted,

ii) if Continuous Survey items which are due or overdue at the time of Annual Survey are not completed and no extension has been granted,

iii) if the periodical surveys required for maintenance of class, other than Annual or Special Surveys, are not carried out by the due date and no Rule allowed extension has been granted, or

iv) if any damage, failure, deterioration, or repair has not been completed as recommended.

7.5

Class may be suspended, in which case the Certificate of Classification will become invalid, if proposed repairs as referred to in 1-9/1 have not been submitted to the Bureau and agreed upon prior to commencement.

7.7

Class is automatically suspended and the Certificate of Classification is invalid in any of the following circumstances:

i) if the Annual Survey is not completed by the date which is three (3) months after the due date,

ii) if the Special Survey is not completed by the due date, unless the vessel is under attendance for completion prior to resuming trading. Under exceptional circumstances, consideration may be given for an extension of the Special Survey,

provided the vessel is attended and the attending Surveyor so recommends; such an extension shall not exceed three (3) months

9 Lifting of Suspension

9.1

Class will be reinstated after suspension for overdue surveys, upon satisfactory completion of the overdue surveys. Such surveys will be credited as of the original due date.

9.3

Class will be reinstated after suspension for overdue recommendations, upon satisfactory completion of the overdue recommendation.

9.5

Class will be reinstated after suspension for overdue continuous survey items, upon satisfactory completion of the overdue items.

11 Cancellation of Class

11.1

If the circumstances leading to suspension of class are not corrected within the time specified, the offshore installation's class will be cancelled.

11.3

Class is cancelled immediately when a facility on an offshore installation proceeds to operate without having completed recommendations which were required to be dealt with before the facility is brought back into service.

11.5

When class has been suspended for a period of three (3) months due to overdue Annual, Special, or other periodical surveys required for maintenance of class; overdue Continuous Survey items; or overdue outstanding recommendations, class will be canceled. A longer suspension period may be granted for vessels which are either laid up, awaiting disposition of a casualty, or under attendance for reinstatement.

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CHAPTER 1 **Scope and Conditions of Classification**

SECTION 3 Application, System Classification Boundaries, Symbols, and Notations

1 Scope

The requirements in this Guide are applicable to hydrocarbon production and/or processing facilities and associated systems located on Floating or Fixed Installations.

Chapter 3 covers requirements for hydrocarbon production and processing facilities on Floating Installations. The ABS *Rules for Building and Classing Steel Vessels* or The ABS *MODU Rules* are applicable as referenced therein for systems for services other than for the hydrocarbon production and processing facilities.

Chapter 4 covers requirements for facilities on Fixed (Offshore) Installations.

Chapter 5 covers requirements for survey during and after construction.

Appropriate flag state and port state authorities are to be consulted for their specific requirements.

Definition of terms is included in Chapter 2, Section 1.

3 Classification Boundaries

The boundaries for classification where a hydrocarbon production and/or processing facility is installed on an offshore installation are defined to include the following major items:

For floating installations:

i) Vessel, including hull structure, equipment, and marine machinery, subject to the requirements of the *FPI Guide*.

ii) Position Mooring System, according to the requirements of the *FPI Guide*.

iii) Production Facilities, according to the requirements of this Guide.

For fixed installations:

i) Structure, subject to the requirements of the *Rules for Building and Classing Offshore Installations.*

ii) Hydrocarbon Production and/or Processing Facilities, according to the requirements of this Guide.

Classification of additional equipment and systems may be offered if requested by the owner.

5 Classification Symbols

5.1 Floating Installations

For floating installations, systems which have been designed, built, installed, and commissioned in accordance with approved plans to the satisfaction of the ABS surveyors, and which are deemed to meet the full requirements of the applicable ABS Rules and Guides, or their equivalent, where approved by the Committee, for service in specified design environmental conditions, will be classed and distinguished in the ABS *Record* by the symbols ✠**A1** followed by the appropriate notation for the system's intended service.

Floating Production, Storage and Offloading System (FPSO)
Floating Production (and Offloading) System (FPS)
Floating Storage and Offloading System (FSO)

5.3 Fixed Installations

For fixed installations, systems which have been designed, built, installed, and commissioned in accordance with approved plans to the satisfaction of the ABS surveyors, and which are deemed to meet the full requirements of the applicable ABS Rules and Guides, or their equivalent, where approved by the Committee for service in specified design environmental conditions, will be classed and distinguished in the ABS *Record* by the symbols ✠**A1** followed by the appropriate notation for the system's intended service:

Offshore Installation – Hydrocarbon Processing
Offshore Installation – Hydrocarbon Production

Note: The mark ✠ (Maltese Cross) signifies that the system was built, installed, and commissioned to the satisfaction of the ABS Surveyors.

7 Systems not Built Under Survey

Installations which have not been built under survey to ABS, but which are submitted for classification, will be subject to design review and a special classification survey. Where found satisfactory and thereafter approved by the Committee, they will be classed and distinguished in the *Record* by the symbols and special notations described above, but the mark ✠ signifying survey during construction will be omitted.

9 Conversion of Existing Vessels

Modifications of existing floating structures intended for classification as Floating Installations are required to be converted under ABS design review and survey.

11 Conversion of Existing Structures

Modifications of existing structures intended for classification as Fixed Installations are required to be converted under ABS design review and survey.

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CHAPTER 1 Scope and Conditions of Classification

SECTION 4 Rules for Classification

1 Application

These requirements are applicable to features that are permanent in nature and can be verified by plan review, calculation, physical survey or other appropriate means. Any statement in the Rules regarding other features is to be considered as guidance to the designer, builder, owner, etc.

3 ABS Referenced Rules and Guides

i)	*FPI Guide*	ABS *Guide for Building and Classing Floating Production Installations*
ii)	*Steel Vessel Rules*	ABS *Rules for Building and Classing Steel Vessels*
iii)	*MODU Rules*	ABS *Rules for Building and Classing Mobile Offshore Drilling Units*
iv)	*OI Rules*	ABS *Rules for Building and Classing Offshore Installations*

5 Alternatives

5.1 General

The Committee is at all times ready to consider alternative arrangements and designs which can be shown, through either satisfactory service experience or a systematic analysis based on sound engineering principles, to meet the overall criteria for safety and suitability for intended service established in the ABS Rules and Guides.

5.3 Regulations for Floating Installations

The committee will consider special arrangements for details of the hull, mooring system, production facility, equipment or machinery which can be shown to comply with standards recognized in the country in which the vessel is registered or built, provided they are not less effective.

5.5 National Regulations for Fixed Installations

The committee will consider special arrangements, or equipment or machinery which can be shown to comply with standards recognized in the country in which the installation is registered or built, provided they are not less effective.

7 Novel Features

Structure, machinery, equipment or systems which contain novel features of design to which the provisions of the Rules are not directly applicable, may be classed, when approved by the Committee, on the basis that the Rules insofar as applicable have been complied with, and that special consideration has been given to the novel features, based on the best information available at that time.

9 Effective Date of Change in Requirement

9.1 Effective Date

This Guide and subsequent changes to this Guide are to become effective on the date specified by the Bureau. In general, the effective date is not less than six months from the date on which the Guide is published and released for its use. However, the Bureau may bring into force the Guide or individual changes before that date if necessary or appropriate.

9.3 Implementation of Rule Changes

In general, until the effective date, plan approval for designs will follow prior practice, unless review under the latest Guide is specifically requested by the party signatory to the application for classification. If one or more systems are to be constructed from plans previously approved, no retroactive application of the subsequent Rule changes will be required, except as may be necessary or appropriate for all contemplated construction.

CHAPTER 1 **Scope and Conditions of Classification**

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CHAPTER 1 Scope and Conditions of Classification

SECTION 5 Recognition of Risk Based Techniques to Justify Alternatives

1 General

The requirements detailed herein provide an alternative route for an Owner to obtain and maintain ABS Class. Any departure from the requirements of this Guide may be considered by ABS on the basis of a risk assessment submitted for review. In case of such departures, ABS approval will be contingent upon a demonstration of fitness for purpose in accordance with the principles of ABS Guides and Rules, as well as recognized and generally accepted good engineering practice. Risk acceptance criteria are to be developed in line with the principles of the ABS Rules and will be subject to ABS approval. The ABS publication, *Guidance Notes for Risk and Reliability Applications to Offshore Installations,* contains an overview of risk assessment techniques and additional information.

3 Application

A risk approach may be applicable either to the installation as a whole or to individual systems, subsystems or components. The boundaries of the components and systems of the Installation to which a risk-based assessment is applied are to be logical. As appropriate, account must be given to remote hazards outside the bounds of the system under consideration. Such account is to include incidents relating to remote hazards impacting on or being influenced by the system under consideration. ABS will consider the application of risk-based techniques in the design of the Installation, Surveys during construction, and Surveys for Maintenance of Class. Portions of the Installation not included in the risk assessment are to comply with the applicable parts of the ABS Rules and Guides.

The following are the responsibility of the Owner/Operator:

i) Proposed Risk acceptance criteria

ii) Hazard identification

iii) Risk assessment

iv) Risk management

v) Compliance of the system under consideration with the applicable requirements of Flag and Coastal State

5 Submittals

As a minimum, the following documents are to be submitted to the Bureau for review and approval for Classification purpose:

i) Proposed Risk Acceptance Criteria

ii) Methodology for risk assessment

iii) Details of risk assessment

iv) Risk management measures wherever applicable

7 Risk Evaluation Methodology

The risk assessment is to consider the Installation in all anticipated operating modes. The Owner is to apply a structured and systematic risk assessment process to identify all foreseeable incidents specific to his Installation, making full consideration of the likelihood of occurrence of the incidents and their consequence. ABS review and approval of the methodology selected by the Owner is required.

While various techniques/methods may be applied, the Owner is to justify the suitability and appropriateness of the particular method(s) selected. Some typical methods include:

i) Hazard and Operability Study (HAZOP)

ii) Failure Mode and Effects Analysis (FMEA)

iii) Process Hazards Analysis (PHA)

iv) Safety Reviews

v) Checklists

vi) Experience from previous analyses

Where risk assessment techniques are used to cover only part of an Installation, the Owner is to clearly define the boundary or extent of the item(s) being considered. The extent of the boundary is to subject to review and approval by ABS.

9 Identification of Hazards

The Owner is to identify and consider all hazards that may affect his Installation or any part thereof. The Owner is to apply a systematic process to identify such situations where a combination or sequence of events could lead to an Incident, with consideration given to all foreseeable causes (initiating events).

The risk assessments are to consider, at a minimum, the following:

i) Fire and Explosion

ii) Hydrocarbon Release

iii) Blow-out

iv) Structural Failure

v) Loss of Stability

vi) Loss of Station Keeping /Mooring

vii) Loss of Electrical Power

viii) Toxicity

ix) Extreme Weather

x) Environmental Factors.

xi) Dropped Objects

xii) Ship & Helicopter Collision

11 Other Requirements

Where it is intended that risk based techniques be used as a basis for compliance with Flag and Coastal State requirements, the owner is directed to contact the Administration, either directly or through ABS, to obtain an understanding as to the extent to which the Administration is prepared to consider alternatives to such requirements. The Administration may also require that additional hazards be considered.

CHAPTER 1 Scope and Conditions of Classification

SECTION 6 Other Regulations

1 General

While this Guide covers the requirements for the classification of Facilities on Offshore Installations, the attention of Owners, designers, and builders is directed to the regulations of international, governmental, and other authorities dealing with those requirements, in addition to or over and above the classification requirements.

3 International Conventions or Codes

Where authorized by the Administration of a country signatory thereto, and upon request of the Owners of a classed Fixed or Floating Installation or one intended to be classed, The Bureau will survey for compliance with the provision of International Conventions and Codes.

5 Governmental Regulations

Where authorized by a government agency and upon request of the Owners of a classed system or one intended to be classed, the Bureau will survey and certify a new or existing Floating or Fixed Installation for compliance with particular regulations of that government on their behalf.

CHAPTER 1 Scope and Conditions of Classification

SECTION 7 IACS Audit

The International Association of Classification Societies (IACS) conducts audits of processes followed by all its member societies to assess the degree of compliance with the IACS Quality System Certification Scheme requirements. For this purpose, auditors for IACS may accompany ABS personnel at any stage of the classification or statutory work, which may necessitate the auditors having access to the fixed or floating installation, or access to the premises of the manufacturer or builder.

In such instances, prior authorization for the auditor's access will be sought by the local ABS office.

CHAPTER 1 Scope and Conditions of Classification

SECTION 8 Submission of Plans, Data, and Calculations

A generic list of plans and particulars to be submitted for facilities on floating installations is included in Chapter 3, Section 2.

A generic list of plans and particulars to be submitted for facilities on fixed installations is included in Chapter 4, Section 2.

It should be noted that due to the varying configurations of offshore production facilities, all or portions of these requirements may be applicable to a given installation.

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CHAPTER 1 Scope and Conditions of Classification

SECTION 9 Conditions for Surveys after Construction

1 Damage, Failure, and Repair

1.1 Examination and Repair

Damage, failure, deterioration or repair to the Installation or its elements, which affects classification, is to be submitted by the Owners or their representatives for examination by the Surveyor at the first opportunity. All repairs found necessary by the Surveyor are to be carried out to his satisfaction.

1.3 Repairs

Where repairs to Installation or its elements, which may affect classification, are planned in advance to be carried out, a complete repair procedure including the extent of the proposed repair and the need for Surveyor's attendance is to be submitted to and agreed upon by the surveyor reasonably in advance. Failure to notify ABS, in advance of the repairs, may result in suspension of the vessel's classification until such time as the repair is redone or evidence is submitted to satisfy the Surveyor that the repair was properly carried out.

Note: The above applies also to repairs during voyage.

The above is not intended to include maintenance and overhaul to hull or structure, machinery and equipment, in accordance with recommended manufacturer's procedures and established marine and offshore practice, which do not require ABS approval; however, any repair as a result of such maintenance and overhauls which affects or may affect classification is to be noted in the unit's log and submitted to the Surveyors as required by 1-9/1.1.

1.5 Representation

Nothing contained in this section or in a rule or regulation of any government or other administration, or the issuance of any report or certificate pursuant to this section or such a rule or regulation, is to be deemed to enlarge upon the representations expressed in 1-1/1 through 1-1/7 hereof, and the issuance and use of any such reports or certificates are to be governed in all respects by 1-1/1 through 1-1/7 hereof.

3 Notification and Availability for Survey

The Surveyors are to have access to classed facilities at all reasonable times. For the purpose of Surveyor monitoring, monitoring Surveyors also are to have access to classed facilities at all reasonable times. Such access may include attendance at the same time as the assigned Surveyor, or during a subsequent visit without the assigned Surveyor. The Owners or their representatives are to notify the Surveyors for inspection on occasions, when the floating units are on dry dock or on a slipway.

The Surveyors are to undertake all surveys on classed systems upon request, with adequate notification, of the Owners or their representatives, and are to report thereon to the Committee. Should the Surveyors find occasion during any survey to recommend repairs or further examination, notification is to be given immediately to the Owners or their representatives so that appropriate action may be taken. The Surveyors are to avail themselves for every convenient opportunity for carrying out periodical surveys in conjunction with surveys of damages and repairs in order to avoid duplication of work.

5 Attendance at Port State Request

It is recognized that port State authorities legally may have access to an Installation. In cooperation with port States, ABS Surveyors will attend on board a classed Installation when so requested by a port State, and upon concurrence by the installation’s master (or person in charge), will carry out a survey to facilitate the rectification of reported deficiencies or other discrepancies that affect or may affect classification. ABS Surveyors will also cooperate with Port States by providing inspectors with background information, if requested. Such information includes text of conditions of class, survey due dates, and certificate expiration dates.

Where appropriate, the installation’s flag state will be notified of such attendance and survey.

CHAPTER **1** **Scope and Conditions of Classification**

SECTION 10 Fees

Fees in accordance with normal ABS practice will be charged for all services rendered by ABS. Expenses incurred by ABS in connection with these services will be charged in addition to the fees. Fees and expenses will be billed to the party requesting that particular service.

CHAPTER 1 Scope and Conditions of Classification

SECTION 11 Disagreement

1 Rules and Guides

Any disagreement regarding either the proper interpretation of Rules and Guides or translation of Rules and Guides from the English language edition is to be referred to the Bureau for resolution.

3 Surveyors

In case of disagreement between the Owners or builders and the Surveyors regarding the material, workmanship, extent of repairs, or application of the Rules relating to any system classed or proposed to be classed by ABS, an appeal may be made in writing to the Committee, who will order a special survey to be held. Should the opinion of the Surveyor be confirmed, expense of this special survey is to be paid by the party appealing.

CHAPTER 1 Scope and Conditions of Classification

SECTION 12 Limitation of Liability

The combined liability of the American Bureau of Shipping, its committees, officers, employees, agents or subcontractors for any loss, claim, or damage arising from its negligent performance or nonperformance of any of its services or from breach of any implied or express warranty of workmanlike performance in connection with those services, or from any other reason, to any person, corporation, partnership, business entity, sovereign, country or nation, will be limited to the greater of a) $100,000 or b) an amount equal to ten times the sum actually paid for the services alleged to be deficient.

The limitation of liability may be increased, up to an amount twenty-five times the sum paid for services, upon receipt of Client's written request at or before the time of performance of services, and upon payment by Client of an additional fee of $10.00 for every $1,000.00 increase in the limitation.

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CHAPTER 2 Definitions

SECTION 1 General

1 "A" Class Divisions

Divisions formed by bulkheads and decks which are constructed of steel or other equivalent material, suitably stiffened, and designed to withstand and prevent the passage of smoke and flame for the duration of the one-hour standard fire test. *"A" class divisions* are to be insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 139°C above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180°C above the original temperature, within the time listed below:

class "A-60"	60 minutes
class "A-30"	30 minutes
class "A-15"	15 minutes
class "A-0"	0 minutes

This division is to remain intact with the main structure of the vessel, and is to maintain its structural integrity after one (1) hour. *Structural integrity* means that it will not fall under its own weight, nor will it crumble or break upon normal contact after exposure to the fire.

1.1 Standard Fire Test

A test in which specimens of the relevant bulkheads or decks are exposed in a test furnace to temperatures corresponding to the standard time-temperature curve and as defined by Annex 1 of Part 3 of the IMO Fire Test Procedures (FTP) Code.

1.3 Steel or Equivalent Material

For any material or combination of materials to be considered as equivalent to steel, the following four requirements will have to be met:

i) *Non combustibility*: The material is to be tested to the applicable section of the FTP Code, and approved as such.

ii) *Integrity against the passage of flame of smoke*: The material is to be tested to the IMO FTP 754 (18) standards, and approved as such.

iii) *Smoke and Toxicity*: The material is to be tested to the IMO FTP standard, and approved as such.

iv) *Structural Integrity*: Based on its area of use, whether required to be load bearing or maintaining integrity, the material is to perform similarly to steel in similar situations. (For example, if required to be "A" class, material is to remain stable after the standard fire test of one hour.)

1.5 Suitably Stiffened

Stiffened according to requirements of the IMO FTP Code. When *suitably stiffened*, a bulkhead may be considered to be "A" class without having to be tested. If, however, a bulkhead is not stiffened according to the requirement of the IMO FTP Code, the bulkhead is to be tested.

3 Abnormal Condition

A condition which occurs in a process system when an operating variable (flow, pressure, temperature, etc.) ranges outside of its normal operating limits.

5 Accommodation Spaces (Living Quarters)

Accommodation spaces are those used for public spaces, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, pantries containing no cooking appliances, and similar spaces. *Public spaces* are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

7 Administration

These are governmental organizations, such as the United States Coast Guard (USCG), UK Marine Safety Agency (UK MSA), Norwegian Maritime Directorate (NMD), etc., that provide maritime services such as the issuance of certificates and classification of ships for safety. Please note that classification societies such as ABS, DNV and Lloyds Register are not considered major governmental maritime administrations.

9 Alternative Recognized Standard

A national or international standard that addresses, at a minimum, all applicable aspects of design, material, construction, and inspection and testing, may be considered an *alternative recognized standard*, provided it is not less effective.

A manufacturer's standard with proven record that addresses, at a minimum, all applicable aspects of design, material, construction, and inspection and testing, may be considered an alternative recognized standard, provided it is not less effective.

11 Approved

Approved means approved by the Administration from an IMO recognized testing facility that is authorized to perform the applicable tests. In the absence of an Administration, or if the Administration has no specific requirements, approval from a major governmental administration that is recognized by ABS.

13 "B" Class Divisions

"B" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which are designed to withstand and prevent the passage of flame for at least the first half hour of the standard fire test. They are to have an insulation value such that the average temperature of the unexposed side will not rise more than 139°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 225°C above the original temperature, within the time listed below:

class "B-15"	15 minutes
class "B-0"	0 minutes

"B" class divisions, unless specified in the design, are not required to be load bearing or maintain their structural integrity beyond 30 minutes of exposure. The only requirement outside of the design specification is to prevent the passage of flames for 30 minutes and maintain thermal requirements as described above.

15 "C" Class Divisions

"C" class divisions are divisions constructed of approved non-combustible materials. They need meet neither requirement relative to the passage of smoke and flame, nor limitations relative to the temperature rise. The only requirement is that they do not add to the fire.

17 Catastrophic Release

Major hydrocarbon release that results from uncontrolled developments and that may lead to serious danger to personnel.

19 Classified Area

A location in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. (See API RP 500 or API RP 505 for additional details).

21 Closed Drains

Hard piped drains from process components, such as pressure vessels, piping, liquid relief valves etc., to a closed drain tank without any break to atmosphere.

23 Completed Wells

Wells fitted with Christmas trees attached to the wellhead, such that the flow of fluids into and out of the reservoir may be controlled for production purposes.

25 Control Stations

Are those spaces containing the:

i) Radio or main navigating equipment

ii) Central Process Control Rooms

iii) Dynamical positioning control system

iv) Centralized ballast control station

v) Battery Room

vi) Fire recording or fire control equipment

vii) Fire-extinguishing system serving various locations

viii) Emergency source of power

ix) CO_2 Bottle Room

x) Fire Pumps

27 Corridors

Narrow passageways, generally with rooms or compartments opening onto them. For the fire protection purposes, lobbies are considered parts of corridors.

29 Critical Equipment

Critical equipment refers to vessels, machinery, piping, alarms, interlocks, and controls determined by management to be vital in preventing the occurrence of a catastrophic release.

31 Escape Route

This is a designated path used by personnel to evade an immediate danger and ultimately leads to a temporary refuge or muster station.

33 Explosive Mixture

A vapor-air or gas-air mixture that is capable of being ignited by an ignition source that is at or above the ignition temperature of the vapor-air or gas-air mixture.

35 Fire Wall

A wall designed and constructed to remain structurally intact under the effects of fire and insulated so that the temperature on the unexposed side will remain below a specified temperature for a determined amount of time.

37 Fired Vessel

A vessel in which the temperature of the fluid is increased by the addition of heat supplied by a flame within the vessel. Specifically for hydrocarbon services, there are two types of fired vessels:

37.1 Direct Fired Vessel

A vessel in which the temperature of process hydrocarbon fluids is increased by the addition of heat supplied by a flame. The flame is applied directly to the fluid container. The combustion takes place in the heater.

37.3 Indirect Fired Vessel

A vessel in which the energy is transferred from an open flame or product of combustion (such as exhaust gases from turbines, engines, or boilers) to the hydrocarbon, through a heating medium, such as hot oil. The heating medium is usually non-combustible or has a high flash point. The combustion may, but does not necessarily, take place in the heater.

39 Fixed Installation

Fixed installation is a bottom-founded offshore facility permanently affixed to the sea floor. The term includes, but is not limited to, fixed platforms, guyed towers, jack-ups, converted fixed installations, etc.

41 Flammable Fluid

Any fluid, regardless of its flash point, capable of feeding a fire, is to be treated as *flammable fluid*. Aviation fuel, diesel fuel, hydraulic oil (oil based), lubricating oil, crude oil and hydrocarbon, are to be considered flammable fluids.

43 Flash Point

The minimum temperature at which a combustible liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid or within the vessel used, as determined by the test procedure and apparatus specified in NFPA 30. *Ignitable mixture* means a mixture that is within the flammable range (between the upper and lower limits) and is therefore capable of propagation of flame away from the source of ignition.

45 Floating Installation

An offshore facility designed to provide hydrocarbon processing and/or hydrocarbon storage, and offload hydrocarbons. The term *Floating Installation* is used to generically identify a buoyant facility that is site-specific. This installation is securely and substantially moored so that it cannot be moved without a special effort. The term includes, but not limited to Tension Leg Platforms (TLP), Spar Buoy, Permanently Moored Shipshape Hulls and Semisubmersibles.

47 "H" Class Divisions

"H" class divisions are those divisions formed by bulkheads and decks that are constructed of steel or other equivalent material, suitably stiffened, and are designed to withstand and prevent the passage of smoke and flame for the 120-minute duration of a hydrocarbon fire test. "H" class divisions are to be insulated so that the average temperature of the unexposed face will not increase by more than 139°C any time during the two-hour hydrocarbon fire test, nor will the temperature, at any point on the face, including any joint, rise more than 180°C above the initial temperature, within the time listed below:

class "H-120"	120 minutes
class "H-60"	60 minutes
class "H-0"	0 minutes

This division is to remain intact with the main structure of the vessel, and is to maintain its structural integrity after two (2) hours. *Structural integrity* means that it will not fall under its own weight, nor will it crumble or break upon normal contact after exposure to the fire.

47.1 Hydrocarbon Fire Test

A test in which specimens of the relevant bulkheads or decks are exposed, in a test furnace, to temperatures corresponding to the hydrocarbon fire time-temperature curve as defined by the U.K. Department of Energy/Norwegian Petroleum Directorate *Interim Hydrocarbon Fire Resistance Test for Elements of Construction for Offshore Installations*.

49 Hazardous Area

Synonymous to *Classified Area*, – See 2-1/19 "Classified Area" for definition.

51 High Integrity Pressure Protection System (HIPPS)

An efficient option to replace a mechanical safety device; an example is a pressure safety valve, with instruments, valves and logic.

53 Ignition Temperature

The minimum temperature required, at normal atmospheric pressure, to initiate the combustion of an ignitable mixture.

55 Inert Gas

A gaseous mixture, such as flue gas, containing insufficient oxygen to support the combustion of hydrocarbons.

57 Interim Class Certificate

A temporary representation as to classification. The *Interim Class Certificate* is generally issued by the Surveyor attending commissioning of the facility and verification of compliance with this Guide. Issuance of an Interim Class Certificate is subject to the terms and conditions found therein.

59 Joiner Arrangement

These are construction details showing the combination of all structural fire protection materials. For example, a detail showing the connection of the ceilings to decks, ceilings to bulkheads, bulkheads to bulkheads, bulkhead construction details, deck construction details, etc.

61 Jumper Ducts

These are openings in bulkheads (usually in the top half) used for air balance or return air.

63 Lower Explosive Limit (L.E.L.)

The lowest concentration of combustible vapors or gases, by volume in mixture with air, which can be ignited at ambient conditions.

65 Machinery Spaces of Category A

Are spaces, and trunks to such spaces, which contain:

i) Internal combustion engine(s) used for main propulsion; or

ii) Internal combustion engine(s) used for other purposes where such machinery has, in the aggregate, a total power, or combined rating of 375 kW (500 hp) or more; or

iii) Any oil-fired boiler or oil fuel unit

67 Manned Facility

A facility with permanent occupied living accommodations, or one that requires continuous presence of personnel for more than 12 hours in successive 24-hour periods.

69 Marine Support Systems

For floating installations, those functions required for maintaining the normal operations of a vessel (or MODU), such as power generation, propulsion, navigation, HVAC, water treating, etc.

These functions are neither directly nor indirectly related to the hydrocarbon production and process systems.

71 MODU Rules

The abbreviation for ABS *Rules for Building and Classing Mobile Offshore Drilling Units.*

73 Non-ducted Return

This is a means of re-circulating conditioned air back to the air handler without the use of a dedicated duct.

75 Open Drains

Gravity drains from sources which are at or near atmospheric pressure, such as open deck drains, drip pan drains, and rain gutters.

77 Operating Conditions

A set of conditions (i.e., flowrates, compositions, temperatures and pressures) chosen for normal operation of a production facility at a particular point in the life of an oil or gas field.

79 Other Machinery Spaces (vs. Machinery Spaces of Category A)

Other Machinery Spaces are all spaces (other than machinery spaces of category A) containing machinery, boilers and other fired processes, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery and similar spaces; and trunks to such spaces.

81 Pad Gas

Gas added to the vapor space of a vessel or tank to prevent an explosive or ignitable vapor-air mixture from forming.

83 Process Areas

Process Areas are areas where processing equipment is located. This includes wellhead/manifold areas.

85 Process Design Conditions

A set of conditions used to design process components and systems.

87 Process Support Systems

Process support systems are utility and auxiliary systems that complement the hydrocarbon production and process systems. A typical list of such systems is included in Chapter 3, Section 4 and Chapter 4, Section 4. These systems do not directly handle hydrocarbons.

89 Produced Fluids

Fluids coming out of completed wells, which may consist of oil, water, gas, and condensable vapor.

91 Production Facilities

For the purpose of this Guide, *production facilities* are typically the processing, safety and control systems, utility and auxiliary equipment, for producing hydrocarbon liquid and gas mixtures from completed wells or other sources. These facilities are generally inclusive from the inlet flange of the well fluid flowline above the water level to the point at which the departing pipeline enters the water. The facilities also include the safe disposal and/or collection of produced oil, gases and water.For a floating installation with the storage and offloading capability to shuttle tanker, the production facility is terminated at the inlet flange discharge into the storage tank. The storage tank and offloading piping/electrical systems arrangement are considered marine systems.

93 Sanitary and Similar Spaces

Sanitary and similar spaces are communal sanitary facilities such as showers, baths, lavatories, etc., and isolated pantries containing no cooking appliances. Sanitary facilities which serve a space and with access only from that space are to be considered a portion of the space where they are located.

95 Service Spaces (Low Risk)

Service spaces (low risk) are lockers, storerooms, and working spaces in which flammable materials are not stored, such as drying rooms and laundries.

97 Service Spaces (High Risk)

Service spaces (high risk) are lockers, storerooms, and working spaces in which flammable materials are stored, such as galleys, pantries containing cooking appliances, paint rooms and workshops other than those forming part of the machinery space.

99 Severe Environment

An environment in which regularly occurring conditions of wind, sea condition, ice, etc., would impede the orderly evacuation of an offshore facility.

101 Shut-in Condition

A condition resulting from a shutting-in of the facility (See API RP 14C) caused by the occurrence of one or more undesirable events.

103 Shut-in Tubing Pressure (SITP)

Shut-in Tubing Pressure exerted by the well due to closing of the master valve.

105 Stairways

Stairways are interior stairways, lifts and escalators (other than those wholly contained within the machinery spaces) and enclosures thereto. In this context, a stairway which is enclosed only at one level is to be regarded as part of the space from which it is not separated by a fire door. Stairways penetrating only one level are required to be enclosed in "A" class bulkheads at one level. If penetrating more than one level, the requirement is for complete enclosure at all levels.

107 Steel Vessel Rules

The abbreviation for ABS *Rules for Building and Classing Steel Vessels.*

109 Transient Condition

A temporary and short-lived condition (such as a surge) that usually does not cause an upset condition.

111 Upset Condition

A condition that occurs in a process component or system when an operating variable deviates substantially from its normal operating limits. If left unchecked, this condition will result in a threat to safety and may cause shutting-in of the process.

113 Ventilation, Adequate

Natural or artificial ventilation that is sufficient to prevent the accumulation of significant quantities of explosive mixtures in concentrations above 25% of their lower explosive limit (LEL).

115 Well Characteristics

The conditions of a well or reservoir defined by depth, temperature, shut-in pressure, flow rate, well fluid composition, etc.

117 Well Fluid Properties

The properties of a particular fluid stream defined by gas-oil ratio, flowing pressure and temperature, viscosity, density (API Gravity), composition, etc.

119 Uncontrolled Developments

Uncontrolled developments are occurrences that are likely to develop quickly, and to be outside the normal expected range of operating problems. In addition, they present only limited opportunity for preventive action, and are likely to require an emergency response.

CHAPTER 3 Floating Installations

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CHAPTER 3 Floating Installations

SECTION 1 General

1 Scope

This chapter defines the minimum criteria for ABS Class applicable to equipment and systems on floating installations. These systems include:

i) Hydrocarbon Production and Process systems

ii) Process Support Systems

iii) Process Control Systems

iv) Marine Support Systems

v) Electrical Systems

vi) Instrumentation and Control Systems

vii) Fire Protection and Personnel Safety Systems.

Terms used in this Chapter are defined in Chapter 2, Section 1.

3 Applicability

The requirements described in this chapter are applicable to facilities on floating installations of various configurations that provide hydrocarbon production and processing services. These services may include well fluid de-pressurization, phase separation, dehydration or other treatment, or just storage, metering, and off-loading of processed crude.

5 Conditions of Classification

Refer to Chapter 1, Sections 1 through 12 for information on Classification.

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CHAPTER 3 Floating Installations

SECTION 2 Plans and Particulars to be Submitted

1 Submissions

The following sections describe ABS documentation requirements for classing facilities on Floating Installations. It should be noted that due to the varying configurations of offshore production facilities, portions of these requirements may not be applicable to a given installation. See 3-2/Table 1 "Submission Requirements".

The plans and data are generally to be submitted in triplicate: one copy to be returned to those making the submission, one copy for use by the Surveyor where the facilities are being constructed or modified, and one copy to be retained in the Technical office for record.

Manufacturers' plans are to be submitted in quadruplicate if construction is to be carried out at a plant other than where the facilities are being constructed or modified.

Additional copies may be required when the mandatory attendance of the Surveyor is anticipated at more than one location.

All plan submissions originating from manufacturers are understood to be made with the cognizance of the main contracting party. A fee may be charged for the review of plans that are not covered by the contract of Classification.

3 Details

All sizes, dimensions, welding and other details, make and size of standard approved equipment are to be shown on the plans as clearly and completely as possible.

TABLE 1
Submission Requirements

ABS documentation requirements for classing facilities on Floating Installations:

I. Hydrocarbon Production and Processing Systems

1. Project Specification
2. Process Flow Sheets
3. Heat and Mass Balance
4. Equipment Layout Drawings
5. Area Classification and Ventilation Drawings
6. Piping and Instrument Diagrams (P & ID’s)
7. Safety Analysis Function Evaluation (SAFE) Charts
8. Pressure Relief and Depressurization Systems
9. Flare and Vent Systems
10. Spill Containment, Closed and Open Drain Systems
11. Process Equipment Documentation
12. Process Piping Systems
13. Sub-sea Production Systems (Optional)
14. Packaged Process Units

II. Process Support Systems

1. Piping and Instrument Diagrams (P&IDs) for each system
2. Equipment Documentation
3. Process Support Piping Specifications
4. Internal-Combustion Engines and Turbines
5. Cranes (Optional)

III. Marine Support Systems

See subsection 4-6-1/9 of the *Steel Vessels Rules* and 4/2.3 of the *MODU Rules* as applicable.

IV. Electrical Installations

1. Electrical One-line Diagrams
2. Short-Circuit Current Calculations
3. Coordination Study
4. Specifications and Data Sheets for Generators and Motors
5. Specifications and Data Sheets for Distribution Transformers
6. Details of Storage Batteries
7. Details of Emergency Power Source
8. Standard Details of Wiring Cable and Conduit Iinstallation Practices
9 Switchboard and Distribution Panel
10. Panelboard
11. Installations in Classified Areas

V. Instrumentation and Control Systems

1. General Arrangements
2. Data Sheet
3. Schematic Drawings-Electrical Systems
4. Schematic Drawings-Hydraulic and Pneumatic Systems
5. Programmable Electronic Systems

TABLE 1 (continued)
Submission Requirements

VI. Fire Protection and Personnel Safety

1. Firewater System
2. Water Spray (Deluge) Systems for Process Equipment
3. Foam Systems for Crude Storage Tanks
4. Fixed Fire Extinguishing Systems
5. Paint Lockers and Flammable Material Storerooms
6. Emergency Control Stations
7. Portable and Semi-Portable Extinguishers
8. Fire and Gas Detection and Alarm Systems
9. Fire and Gas Cause and Effect Chart
10. Structural Fire Protection (which indicates classification of all bulkheads for: quarters section, machinery spaces and processing facilities)
11. HVAC plan (including AHU location, duct layout, duct construction and bulkhead penetration details
12. Joiner detail arrangement and structural fire protection material certification
13. Guard Rails
14. Escape Routes (may be included on the fire control plan or separate plan)
15. Lifesaving Appliances and Equipment Plan (escape routes must be indicated)
16. Insulation of Hot Surfaces

Due to the varying configurations of the project, some portions of these requirements may not be applicable.

VII. Specific Arrangements

1. Arrangements for Storage Tank Venting and Inerting
2. Arrangements for Use of Produced Gas as Fuel

VIII. Start-up and Commissioning Manual

5 Hydrocarbon Production and Process Systems

To evaluate the process safety system, certain assumptions will have to be made based on information given in the Project Specification, Process Flow Sheets and Heat and Mass Balance (3-2/5.1 through 3-2/5.5). Although these documents will not be reviewed or approved by ABS, they are critical to approval of the facility, and are to be kept for reference throughout the design review process.

5.1 Project Specification

Submit project specification covering a brief description of field location, environmental conditions, well shut-in pressure, well fluid properties, production plans, oil/gas storage and transportation arrangements.

5.3 Process Flow Sheets

Submit process flow sheets identifying each process stream, process equipment component, planned addition and symbols used.

5.5 Heat and Mass Balance

Submit heat and mass balance specification, including flow rate, composition, and conditions (temperature, pressure, and vapor/liquid ratio) for each process stream under normal operating and expected extreme conditions.

5.7 Equipment Layout Drawings

Submit plans showing arrangements and locations of living quarters and control rooms, including entrances and exits; openings to these spaces; layout of machinery, process equipment, crude storage.

5.9 Area Classification and Ventilation Drawings

Submit plans showing degree and extent of all Class I, Division 1 and 2, areas and spaces; or all Class 1, Zone 0, Zone 1 and Zone 2 areas and spaces, as applicable; and the arrangements for ventilation of enclosed spaces. Include locations of ventilation inlets and outlets, with respect to the hazardous areas.

5.11 Piping and Instrument Diagrams (P & ID's)

Submit P & ID's showing size, design, and operating conditions of each major process component, piping and valve designation and size, sensing and control instrumentation, shutdown and pressure relief devices with set points, signal circuits, set points for controllers, continuity of all line pipes, and boundaries of skid units and process packages.

Piping Class Specification and S.A.F.E. Charts, included in 3-2/5.23 and 3-2/5.13, are preferably to be submitted in conjunction with the Piping and Instrument Diagrams.

5.13 Safety Analysis Function Evaluation (S.A.F.E.) Charts

List all process components and emergency support systems with their required devices, and the functions to be performed by each sensing device, shutdown valve, and shutdown device.

5.15 Pressure Relief and Depressurization Systems

Submit sizes, arrangements, materials, and design calculations for relief valves and depressurization systems.

5.17 Flare and Vent System

Submit sizes and arrangements, including details of flare tips, pilots, ignition system, water seals and gas purging systems, and provide design calculations for blow down rates, knockout drum sizing, flare and vent sizing, radiant heat intensities, and gas dispersion analysis including basis of analysis.

In the case of proprietary flare tips, submit validation report to supplement the radiant heat intensity values.

5.19 Spill Containment, Closed and Open Drain Systems

Submit arrangements for spill containment, details of piping connections to all process components, and slope of drains.

5.21 Process Equipment Documentation

Submit specification, data sheet, standard of construction and testing, and general arrangement plans for Christmas tree assemblies (optional), pumps, and compressors.

Submit complete design specification, including all design data such as pressure, temperature, corrosion allowances, service, external loads etc., dimensional drawings covering arrangements and details, material specification, weld details, extent of non-destructive testing, test pressure, and design calculations for verification of compliance to a recognized standard for process vessels, storage tanks, heat exchangers, fired heaters, manifolds and scraper launchers/receivers.

See 3-2/Table 2 "Major Equipment Plans/Calculations and Technical Documentation for Class Requirements".

TABLE 2
Major Equipment Plans/Calculations and Technical Documentation for Class Requirements

Column A: Drawings, calculations, detailed documentation, including manufacturer's affidavit to be submitted for technical review.

Column B: Technical documentation to be verified by the attending Surveyor at the shop.

Column C: Technical documentation to be verified by the attending Surveyor at the point of installation.

	A	B	C
HYDROCARBON PRODUCTION PROCESS SYSTEMS			
Production Vessels	X		
Storage Tanks	X		
Heat Exchangers	X		
Fired Vessels	X		
Meters, Strainers, Filters, And Other Fluid Conditioners			
< 254 mm (10 in.) and 10.54 kg/cm^2 (150 psi)		X	
> 254 mm (10 in.) or 10.54 kg/cm^2 (150 psi)	X		
Pumps			
< 7 kg/cm^2 (100 psi) and 757 liters/min (200 gpm)		X	
> 7 kg/cm^2 (100 psi) or 757 liters/min (200 gpm)	X		
Compressors			
< 7 kg/cm^2 (100 psi) and 28.3 m^3/min (1000 scfm)		X	
> 7 kg/cm^2 (100 psi) or 28.3 m^3/min (1000 scfm)	X		
Flowlines And Manifolds	X		
Scraper Launchers/Receivers	X		
Packaged Process Units	X		
Flare Systems	X		
Subsea Systems	X		
PROCESS and MARINE SUPPORT SYSTEMS			
Pressure Vessels			
<7 kg/cm^2 (100 psi) and 93.3°C (200°F)		X	
>7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X		
Heat Exchangers			
<7 kg/cm^2 (100 psi) and 93.3°C (200°F)		X	
>7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X		
Pumps			X
Air Compressors		X	

TABLE 2 (continued)
Major Equipment Plans/Calculations and Technical Documentation for Class Requirements

	A	B	C
Engines And Turbines			
< 100 kW (134 hp)		X	
> 100 kW (134 hp)	X		
Packaged Support Systems			
<7 kg/cm^2 (100 psi) and 93.3°C (200°F)		X	
>7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X		
ELECTRICAL SYSTEMS			
Generators			
<100 kW (134 hp)			X
>100 kW (134 hp)	X		
Motors			
<100 kW (134 hp)			X
>100 kW (134 hp)	X		
Distribution Transformers			X
Switchboard, MCC, Panelboards	X		
Storage Batteries	X		
INSTRUMENT AND CONTROL SYSTEMS			
Control Panels	X		
FIRE PROTECTION & SAFETY EQUIPMENT			
Fire Pumps		X	
Fire Pump Skid Package	X		
Alarm Panels		X	
Fixed Fire Extinguishing Systems Skid Package (Nozzles, Controls, Bottles, etc.)	X		
Fire and Gas Detection Systems Skid Package (Sensors, Panel, Cables, etc.)	X		
COMPONENT SKID STRUCTURE For modules that require design review, see 3-3/23.3 and 3-2/5.27.	X		

5.23 Process Piping Specifications

Submit line list with design conditions, pipe and fitting material lists, specifications, sizes, pressure ratings, and calculations for pipe wall thickness.

5.25 Subsea Production Systems (Optional)

Provide stress calculations for structural components, P & ID's, S.A.F.E. Charts, equipment specifications and data sheets, control schematics, assembly drawings, and installation and operation procedures.

5.27 Packaged Process Units

Packaged process units include, but are not limited to, the following: dehydration, sweetening, stabilizing, vapor recovery, and gas compression for fuel or re-injection.

Documentation requirements for packaged process units include:

i) Skid arrangements

ii) P & ID's

iii) S.A.F.E. charts

iv) Process equipment and piping system documentation

v) Electrical one-line diagrams

vi) Specifications and data sheets.

vii) Structural design calculations for skid units in dry condition with a center of gravity height of more than 1.5 m (5 ft.), or a maximum operating weight in excess of 10 MT (metric tons) or 22.05 Kips.

7 Process Support Systems

As defined in Chapter 2, Section 1 of this Guide, process support systems are utility and auxiliary systems that complement the hydrocarbon production and process systems. These systems do not handle hydrocarbons, but serve and support solely the hydrocarbon production and process operations, or the drilling operations, as applicable. A typical list of process support systems includes, but is not limited to, the following:

i) Utility/Instrument Air System

ii) Fuel/Instrument Gas System

iii) Purging System

iv) Use of Produced Gas as Fuel

v) Fuel Oil System

vi) Hydraulic System

vii) Chemical Injection System

viii) Material Handling System (Cranes) (Optional)

ix) Platform Drilling Systems

x) Heating & Cooling Systems

7.1 Piping and Instrument Diagrams (P & ID's)

Submit Piping and Instrument Diagrams (P & ID's) for each system, details as per 3-2/5.11.

7.3 Equipment Documentation

Submit specifications, data sheets, and drawings for each equipment component such as pressure vessels, heat exchangers, pumps and compressors. Details as per 3-2/5.21.

7.5 Piping Specifications

Submit specifications, materials, sizes, and pressure ratings for all pipes, valves and fittings, and calculations for pipe wall thickness.

7.7 Internal-Combustion Engines and Turbines

Submit specifications for internal-combustion engines and turbines, including types, horsepower, revolutions per minute, shutdown arrangements, and manufacturer's affidavit verifying compliance with recognized standards.

7.5 Cranes (Optional)

Submit specifications for cranes, including structural design calculations, load rating chart, and test certificates for wire rope.

9 Marine Support Systems

Submissions are to be as required by the applicable parts of the *Steel Vessel Rules* or *MODU Rules*. See 2-1/69 for "Marine Support Systems" definition.

Marine support systems include, but are not limited to, the following:

i) Boilers and Pressure Vessels

ii) Turbines and Gears

iii) Internal-Combustion Engines

iv) Pumps and Piping Systems (i.e. Fuel Oil, Lube Oil, Fresh Water, Ballast Control, Cargo, Inert Gas, etc.)

v) Propellers and Propulsion Shafting

vi) Steering Gears

11 Electrical Systems

11.1 Electrical One-Line Diagrams

Indicate the ratings of generators, transformers, motors, and other loads; rated load current of each branch circuit; type and size and temperature rating of cables; rating or settings of circuit breakers, fuses, and switches; interrupting capacity of switchgear, motor control centers, and distribution panels.

11.3 Short-circuit Current Calculations

To establish that the protective devices have sufficient short-circuit breaking and making capacities, data is to be submitted giving the maximum calculated short-circuit current in symmetrical r.m.s. and asymmetrical peak values available at the main bus bars, along with the maximum allowable breaking and making capacities of the protective device. Similar calculations are to be made at other points in the distribution system where necessary, to determine the adequacy of the interrupting capacities of protective devices.

11.5 Coordination Study

A protective device coordination study is to be submitted. This protective device coordination study is to consist of an organized time-current study of all protective devices in series. The study is to be from the utilization equipment to the source for all circuit protection devices having different settings or time-current characteristics.

Where an over-current relay is provided in series and is adjacent to the circuit protection device, the operating and time-current characteristics of the relay are to be considered for coordination.

11.7 Specifications and Data Sheets for Generators and Motors

For generators and motors of 100 kW (134 hp) and over, submit drawings showing assembly, seating arrangements, terminal arrangements, shafts, coupling, coupling bolts, stator and rotor details together with data for complete rating, class of insulation, designed ambient temperature, temperature rise, weights and speeds for rotating parts.

For generators and motors under 100 kW (134 hp), submit nameplate data along with degree of enclosure.

11.9 Specifications and Data Sheets for Distribution Transformers

Submit nameplate data along with degree of enclosure, and standard to which manufactured. Test reports in accordance with the standard of construction are to be made available upon request.

11.11 Details of Storage Batteries

Submit arrangement, ventilation, corrosion protection, types and capacities, conductors and charging facilities, over-current and reverse current protection.

11.13 Details of Emergency Power Source

Submit location, arrangement, and services required to maintain the integrity of the facility in the event of primary power loss.

11.15 Standard Details of Wiring Cable and Conduit Installation Practices

A booklet on the standard wiring practices and details is to be submitted. The booklet is to include such items as cable supports, earthing details, bulkhead and deck penetrations, cable joints and sealing, cable splicing, watertight and explosion-proof connections to equipment, earthing and bonding connections, etc.

11.17 Switchboard, Distribution Boards and Motor Control Centers

i) A front outline of the switchboard, including overall dimensions, front view indicating instrumentation, circuit breakers, switches, drip-shields, hand-rail and securing supporting details.

ii) Complete list of materials, including manufacturer's name, model number, rating, size, type, testing laboratory's listing number (if any), or indication of construction standard for components such as: switchboard enclosure, circuit breakers, all types of fuses, power and control wiring, bus bars, connectors and terminals and power switches.

iii) Bracing arrangements and calculations to determine that bus bars and short runs of power cables are adequately braced to withstand the mechanical forces that the switchboard may be subjected to under fault conditions.

iv) A complete wiring schematic, including type of wiring, size, and setting of protective devices.

v) One line schematic of the bus bars, indicating rating for each of the horizontal and vertical buses, the exact connection of circuit breakers to the bus bars, setting of the power circuit breakers and loads ampacities and power cable sizes, if available.

vi) Actual bus bar arrangement of the horizontal, vertical, and ground buses, including bus bar material, size and rating, separation distances between bus bars, and between bus bars and bare metal parts.

vii) Grounding details

viii) If applicable, details of metal barriers provided to isolate bus bars, wiring, and associated components.

11.19 Panelboard

The information as requested in 3-2/11.17i), ii), v) and vii), as applicable.

11.21 Installations in Classified Areas

List of electrical equipment installed in classified areas, together with documentation issued by an independent testing laboratory certifying suitability of same for intended services.

13 Instrumentation and Control Systems

13.1 General Arrangements

Submit layout plans for local controllers, central controllers, displays, printers, and other instrumentation and control devices.

13.3 Instrumentation List

Submit a list of instrumentation and control equipment, including a list of monitoring, control, and alarm set points and ranges.

13.5 Schematic Drawings – Electrical Systems

Include types and sizes of electrical cables and wiring, voltage rating, service voltage and current, overload and short-circuit protection for the following systems:

i) Process control panels

ii) Emergency shutdown (ESD) panels

iii) Intrinsically safe systems

iv) Fire and gas detection and alarm panels

v) Fire alarm circuits

vi) Emergency generator or fire pump drive starting circuit

13.7 Schematic Drawings – Hydraulic and Pneumatic Systems

Submit system description of hydraulic and pneumatic control systems, including pipe sizes and materials, pressure ratings, and relief valve settings.

13.9 Programmable Electronic Systems

Submit the control philosophy, schematic alarm, monitoring and control arrangements, and redundancy arrangements. Provide failure modes of the system components. See also 3.3.15 and 6.4.1.4 of API RP 14J.

15 Fire Protection and Personnel Safety

15.1 Firewater System

Submit plans indicating pump and piping arrangements, location of isolation valves, locations of firewater stations, details of fire pumps including pump drivers, pump capacity and pressure, and hydraulic calculations for sizing of fire pump capacity and fire main.

15.3 Deluge Systems (Water Spray for Process Equipment)

Submit plans showing the arrangement for firewater piping and spraying nozzles, as well as detailed hydraulic calculations.

15.5 Foam Systems (for Crude Storage Tanks)

Indicate the arrangement for firewater supply, foam supply and delivery, type of foam and expansion ratio, as well as capacity calculations for areas protected.

15.7 Fixed Fire Extinguishing Systems

Submit plans showing the arrangement for piping, spraying nozzles, and storage of the extinguishing medium, and details of control and alarm for release of the extinguishing medium, as well as capacity calculations and discharge time calculations for areas protected.

15.9 Paint Lockers and Flammable Material Storerooms

Submit plans and calculations showing details of fixed fire extinguishing systems for the paint lockers and flammable material storerooms.

15.11 Fire Control and Life Saving Equipment Plan

Submit a fire control and life saving equipment plan for the process area. For a floating installation, additional requirements for a fire control and life saving equipment plan may also be found in *Steel Vessel Rules* or *MODU Rules*, as applicable. A fire control plan and life saving equipment plan for a process area is to include the following:

15.11.1 Portable and Semi-Portable Extinguishers

The plan is to show types, quantities and locations of portable and semi-portable extinguishers for the production facility.

15.11.2 Fixed Fire Detection, Alarm and Extinguishing Systems

The plan is to show locations, controls, protected spaces/areas and types of extinguishing system.

15.11.3 Emergency Control Stations

The plan is to show location and equipment.

15.11.4 Lifesaving Appliances and Equipment

The plan is to show type, capacity, quantity and location.

15.11.5 Structural Fire Protection

The plan is to show arrangements, locations, and types of firewalls for buildings and bulkheads installed in or adjacent to the process area.

15.11.6 Guard Rails and Escape Routes

The plan is to show arrangement of protective guardrails, toe plates, and means of escape from normally manned spaces.

15.13 Fire and Gas Detection and Alarm Systems

Indicate the locations and details of power supplies, sensors, annunciation and indicating equipment, set points of alarm systems, and data sheets for detectors.

15.15 Fire and Gas Cause and Effect Chart

Relate all fire and gas sensors to shutdowns, operation of fixed systems and fire control plans.

15.17 Insulation of Hot Surfaces

Submit details of insulation and shielding provided for personnel safety and fire protection.

17 Arrangements for Storage Tank Venting and Inerting

Submit piping and control arrangements for storage tank venting and inerting systems.

19 Arrangements for Use of Produced Gas as Fuel

Submit piping and control arrangements for use of produced gas as fuel, showing details of double wall or ducting arrangements for the pipe runs in way of the safe space.

21 Start-up and Commissioning Manual

The manual outlined in 5-1/7 is to be submitted for review as early as possible, prior to the commissioning of the installation.

23 Maintenance of Class Modifications

Details of modifications to machinery, piping, process equipment, etc., which may affect classification, are to be submitted for approval.

Typically, these may include the following:

i) Equipment changes and modifications, including changes in alarms, instrumentation, and control schemes

ii) Facility throughput changes, and changes in feed and product compositions

iii) Changes in operating conditions, including pressures, temperatures, flow rates, or process conditions different from those in the original process or mechanical design

iv) Changes in relief requirements due to factors such as increased process throughput, operation at higher temperatures or pressures, increased size of equipment, or addition of equipment

v) Changes to process support systems, such as changes to chemical injection, gas dehydration, etc.

CHAPTER 3 **Environmental Loading and Design Basis**

SECTION 3 **Hydrocarbon Production and Process Systems**

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CHAPTER 3 Floating Installations

SECTION 3 Hydrocarbon Production and Process Systems

1 General

1.1 Scope

This section defines the minimum criteria applicable to equipment and systems for handling and processing produced fluids from completed wells. These requirements address process components such as process vessels, heat exchangers, fired vessels (heaters), compressors and pumps, as well as the associated piping, process control, and process safety systems. The documentation requirements for design review are given in Chapter 3, Section 2.

1.3 Process Safety Criterion

The process safety overall criterion is that hydrocarbon production and processing systems be designed to minimize the risk of hazards to personnel, property and environment. Implementation of this criterion to production systems and associated facilities design is intended to:

i) Prevent an abnormal condition from causing an upset condition

ii) Prevent an upset condition from causing a release of hydrocarbons

iii) Safely collect and dispose of hydrocarbon gasses and vapors released

iv) Prevent formation of explosive mixtures

v) Prevent ignition of flammable liquids or gases and vapors released

vi) Limit exposure of personnel to fire hazards

1.5 Governmental Regulations

The designer is directed to governmental regulations or guidance notes, which may be in excess of these provisions, depending on the size, type, location, and intended services of the floating installation.

3 Process Design

3.1 Design Basis

Production process design is to be based on production plans, expected well fluid properties, required pipeline or product custody transfer specifications, and other considerations. The floating processing drainage, production water discharge and displacement water discharge are to be in accordance with National/Regional Regulations. The Administration and the Coastal State are to be consulted, if necessary.

3.3 Process Design Conditions

Process design conditions specified for equipment and systems are to include provision for handling short term and transient conditions, such as pipeline-riser slugging, cyclic pump operation, or pressure spikes, and to meet the required product specifications.

Due consideration is to be given to the well fluid properties, such as presence of hydrogen sulfide (H_2S), carbon dioxide (CO_2), etc., for selection of materials.

NACE MR0175 "Sulfide Stress Cracking Resistant Metallic Material for Oilfield Equipment" (latest edition) is to be used for design, procurement, and fabrication of equipment and equipment components that may be exposed to hydrogen sulfide under conditions conducive to Sulfide Stress Cracking, as defined by that NACE Standard.

API RP 55 "Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide," or other recognized standards, may be used as reference for the system design if the system is intended to handle H_2S.

Each process component or piping element is to be designed for the maximum extremes of pressure, temperature, and corrosive properties of the fluid, which it can encounter in service.

3.5 Process Flow Sheets

Process flow sheets are to indicate all process components with associated piping systems, and define operating conditions for each component. Each flow stream is to be labeled by composition, flowrate, phase, pressure, and temperature.

5 Facility Layout

5.1 General Arrangement

Machinery and equipment are to be arranged in groups or areas in accordance with API RP14J. Equipment items that could become fuel sources in the event of a fire are to be separated from potential ignition sources by space separation, firewalls or protective walls. See 3-3/Table 1 for typical fuel and ignition sources.

In case of a fire onboard a subject unit, the means of escape is to permit the safe evacuation of all occupants to a safe area, even when the structure they occupy can be considered lost in a conflagration.

With safety spacing, protective firewalls and equipment groupings, a possible fire from a classified location is not to impede the safe exit of personnel from the danger source to the lifeboat embarkation zone or any place of refuge.

5.3 Accommodation Spaces (Living Quarters)

Accommodation spaces or living quarters are to be located outside of hazardous areas and may not be located above or below crude oil storage tanks or process areas. "H-60" ratings are required for the bulkheads of permanent living quarters, temporary living quarters and normally manned modules that face areas such as wellheads, oil storage tanks, fired vessels (heaters), crude oil processing vessels, and other similar hazards. If such bulkhead is more than 33 m (100 ft) from this source, then this can be relaxed to an "H-0" rating. As will be explained in Chapter 3, Section 8, "A-60" and "A" rated bulkheads, respectively, may be utilized provided that a risk or fire load analysis was done and reviewed by this office, indicating that these bulkheads are acceptable.

TABLE 1
Fuel and Ignition Sources

Fuel Sources

- Wellheads and Manifolds
- Separators and Scrubbers
- Coalesces
- Gas Compressors
- Liquid Hydrocarbon Pumps
- Heat Exchangers
- Hydrocarbon Storage Tanks
- Gas Metering Equipment
- Oil Treaters (unfired vessels)
- Process Piping
- Risers and Pipelines
- Vents
- Pig Launchers and Receivers
- Drains
- Portable Fuel Tanks
- Chemical Storage Tanks
- Laboratory Gas Bottles
- Sample Pots

Ignition Sources

- Fired Vessels
- Combustion Engines & Gas Turbines
- Living Quarters
- Flares
- Welding Machines
- Grinding Machines
- Cutting Machinery or Torches
- Static Electricity
- Electrical Equipment
- Waste Heat Recovery Equipment
- Mobile phones
- Lightning
- Spark Producing Hand Tools
- Portable Computers
- Cameras
- Non-Intrinsically Safe Flashlights

5.5 Wellhead Areas

Wellhead areas are to be separated or protected from sources of ignition and mechanical damage. A-0 firewalls around wellheads are to be used to provide protection from potential uncontrolled flow from wellheads with shut-in pressures exceeding 42 kg/cm^2 (600 psig).

5.7 Storage Tanks and Slop Tanks

Supported storage tanks for crude oil or other flammable liquids are to be located as far as possible from wellheads. In addition, they are to be located far from potential ignition sources such as gas and diesel engines, fired vessels, and buildings designated as unclassified areas, or areas used as workshops, or welding locations.

For crude storage tanks, slop tanks, and low flash point flammable liquid storage tanks (flash point of 60°C (140°F) or less), such as methanol storage tanks built as hull or integral tanks, are to be separated from machinery spaces, service spaces, and other similar source of ignition spaces by cofferdams of at least 0.76 m (30 in.) wide. Pump rooms, ballast tanks and fuel oil tanks may be considered cofferdams for this purpose.

5.9 Fired Vessels

Fired vessels, such as glycol reboilers, hot oil heaters, etc., are considered ignition sources. They are to be installed away from wellheads and other unfired hydrocarbon processing and storage equipment. Occasionally, it may not be possible to observe the above requirement, particularly when the space of the process area is limited, causing fired vessels to be located in the unfired process areas. In this case, the fired vessel is to be surrounded on all sides, except on the outboard side of the unit mounted on the perimeter of a platform or FPSO, by a minimum of A-0 rated firewall.

For equipment such as the direct fired (crude oil) treater that is considered both a fuel and ignition source, a minimum of A-0 rated firewall is to be provided as described above, regardless of where the unit is installed (Fired or Unfired Process Areas).

5.11 Structural Considerations for Process Deck

Structure that supports production facilities or forms an integral part of the equipment is to be designed to a recognized standard. Plans and calculations are to be provided for verification. Process liquid weights and dynamic loads due to vessel motions are to be considered. If the vessel hull girder deflection has significant effects on the structure, this is to be taken into account in the design.

7 Piping and Instrumentation Design

7.1 Process Control System

Essential process parameters (such as flow rate, pressure, temperature and liquid level) are to be automatically monitored and controlled, and the abnormal conditions are to be alarmed with visual and audible devices.

The process control system used to maintain process variables within normal operating ranges is to be capable of accommodating a reasonable range of abnormal or transient conditions without creating an upset condition.

7.3 Safety System

A safety system is to be provided in accordance with the recommended practices of API RP14C. Essential elements of the system are to include:

7.3.1 Safety Sensing and Self-acting Devices

The safety system is to provide two levels of protection (primary and secondary), with sensing and self-acting devices, which are functionally different types of devices. They are to be in addition to process control devices used to maintain normal process parameters. The safety system is to sense process variables. It reacts to a condition outside acceptable limits by automatically activating an alarm and initiating the necessary protective response.

Pressure vessels, for example, are generally fitted with pressure control valves to protect against overpressure. Nevertheless, they are to be fitted with a safety system device such as Pressure Safety High (PSH) (primary) and a Pressure Safety Valve (PSV) (secondary).

Loss of any single control or safety system component is not to cause an unsafe condition. [Example: If a production separator liquid outlet control valve sticks open, an Level Safety Low (LSL) can protect against gas blow-by.)]

Where High Integrity Process Protection Systems (HIPPS) are used, these systems will be subject to special consideration. Use of these systems will only be considered up to the inlet of the low pressure shutoff valve upstream of the first stage separator/heater.

7.3.2 Fire Detection

A fusible plug system, or other means of automatically detecting fire, is to provide a shutdown signal for production facilities, as per 3-8/7.1 and API RPI4C, Appendix C.

7.3.3 Gas Detection

Combustible and hydrogen sulfide gas detectors are to be provided, as per 3-8/7.3, to initiate alarms and shutdowns.

7.3.4 Process Emergency Shutdowns (ESD)

An emergency shutdown (ESD) system with manual stations is to be provided, per 3-3/9 and Appendix C of API RP14C, to shut down the flow of hydrocarbon from all wells and pipelines, and to terminate all production and injection activities of the facility.

The emergency shutdown system is to be automatically activated by:

i) the detection of an abnormal operating condition by flowline pressure sensors and sensors on any downstream component through which the pipeline fluids flow;

ii) the detection of fire in the wellhead and process areas;

iii) the detection of combustible gas at a 60% level of the lower explosive limit;

iv) the detection of hydrogen sulfide (H_2S) gas at a level of 50 ppm.

Emergency Shutdown (ESD) valves for flowlines and pipelines are to be located as far away from the facility as practical. (See 3-8/5.11 and 4-8/5.9, as applicable).

7.3.5 Safety Analysis

Safety Analysis Tables (SAT) and Safety Analysis Checklists (SAC) provided in API RPI4C are to be used to verify that the safety devices provided to protect each process component and piping segment are adequate. Safety Analysis Function Evaluation (SAFE) Charts are to be prepared to show the integration of all safety devices and self-protected equipment into a complete facility safety system.

9 Emergency Shutdown (ESD) Stations

Emergency shutdown stations are to be provided for manual activation of the Process Safety Shutdown system for shutdown of all wells and process systems. These manual activation stations are to be protected against accidental activation, and conveniently located at the primary evacuation points (i.e., boat landing, helicopter deck, etc.) and the emergency control stations (see 3-8/5.11 and 4-8/5.9, as applicable). For a design guidance, the following additional locations may be considered appropriate for emergency shutdown stations:

i) Exit stairway at each deck level

ii) Main exits of living quarters

iii) Main exits of production (process) facility deck

11 Pressure Relieving and Hydrocarbon Disposal Systems

11.1 Pressure Relief Systems

11.1.1 Pressure Relief Valves

Pressure relief valves are to be installed as per API RP 14C to protect all vessels and pressure-rated equipment from overpressurization. Pressure relief valves are to be sized and installed in accordance with API RP 520 and Appendix M of Section VIII, Division 1 of the ASME Code.

If block valves are installed in the relieving lines, means are to be provided to ensure that pressure relief valves are not isolated from the protected equipment.

The practice of locking open block valves to eliminate the need for higher design pressures or additional relief protection is allowed if:

i) closure of the valve would not result in the pressure rising more than 1.5 times the design pressure of the equipment or component under consideration, or

ii) can be otherwise demonstrated that the proposed installation is safe and would not, in any circumstance, either planned or unplanned, inadvertent or intentional, result in a risk to personnel or facilities.

See also 3-7/17.5 of this Guide for reference on block valve locking devices.

11.1.2 Gas Service

Pressure relief valves in hydrocarbon gas service are to discharge to one or more closed relief headers for atmospheric discharge at either a flare or vent. Such flare or vent discharges are to meet the requirements of 3-3/11.5.

Pressure relief headers are to be sized to handle the maximum anticipated discharges that could occur at any time. Relief header sizing is to be sufficient so that excessive back-pressure does not develop, which may prevent any pressure relief valve from relieving at its design rate.

Where necessary, separate high and low pressure relief headers are to be employed to meet this requirement.

11.1.3 Liquid Service

Pressure relief valves in liquid hydrocarbon service are to discharge to a lower pressure system such as a tank, pump suction, sump vessel, or closed drain system. Discharges to drip pans or other open drains are to be limited to small volume thermal releases.

11.1.4 Rupture Discs

Use of rupture discs is limited to the following:

i) In gas or gas/liquid service, rupture discs may be utilized only as backup to pressure relief valves, which are themselves sized for the maximum relieving conditions.

ii) In liquid service, rupture discs may be utilized only as backup to pressure relief valves which themselves are sized for the maximum relieving condition. They may be installed as primary relief devices for non-flammable, non-hazardous liquids at relieving pressures no greater than 10.5 kg/cm^2 (150 psig).

iii) In applications where use of other relieving devices is not practical, requests for such exceptions will be considered.

11.1.5 Vapor Depressurizing

An emergency vapor depressurizing system is to be provided for all equipment processing light hydrocarbon with operating pressures of 17.5 kg/cm^2 (250 psig) and above, as recommended in Section 3.19 of API RP 521. To gain rapid control of a situation in which the source of a fire is the leakage of flammable fluids from the equipment to be depressurized, the equipment is to be depressurized to 7 kg/cm^2 (100 psig).

In cases where the equipment is handling high pressure and large inventories of hydrocarbon, and depressurizing to 100 psig is impractical, it is acceptable to depressurize to 50% of the equipment design pressure if such depressurization is achieved within 15 minutes. This is provided the equipment has been designed with ample margin of safety to prevent the vessel from failing due to overheating. Calculations, showing the maximum allowable temperature of the equipment would not exceed the equipment rated temperature, are to be submitted for verification. See Appendix A of API RP 521 for information on the effect of heat input to uninsulated steel vessels.

11.3 Pressure/Vacuum Venting System

All atmospheric and low pressure storage tanks and similar components, such as flotation cells and atmospheric corrugated plate interception (CPI) separators, are to be provided with pressure and vacuum relief protection where required.

This is in accordance with the sizing criteria of API Std. 2000. Vent lines are to be routed to an atmospheric vent header, or to individual vents. Such vent discharges are to meet the requirements of 3-3/11.5.4.

11.5 Flares and Vents

11.5.1 Location

Flares and vents for hydrocarbon gas disposal are to be located with respect to prevailing winds. This is to limit exposure of personnel, equipment and helicopter traffic to vented gas, flare exhaust, or flame radiation.

11.5.2 Atmospheric Conditions

Reasonable worst-case atmospheric conditions are to be used for radiation and gas dispersion calculations. Hence, flame radiation calculations are normally to assume a strong wind (32.2 km per hour (20 miles per hour), or worst-case scenario based on the project specification) distorting the flame pattern toward the facilities. Dispersion calculations are normally to assume still air and low vent velocity as a worst-case condition.

11.5.3 Heat Radiation from Elevated Flares

The calculated radiant heat intensity from flaring (including solar radiation), at any deck level or location where normal maintenance or operating activity could take place, is not to exceed API RP 521 recommendations.

The flare evaluation or analysis may be based on API RP 521 method or other recognized industrial method. However, if an industrial method is selected, a validation study of the model is to be made available in support of the modeling results:

i) at the design continuous flaring rate: 1.58 kW/m^2 (500 BTU/hr/ft^2)

ii) at the design short duration (several minutes) maximum flaring rate: 4.73 kW/m^2 (1,500 BTU/hr/ft^2).

<u>NOTE</u>: These radiation levels (500 and 1500 BTU/hr/ft^2) are only applicable to personnel, and not equipment. Higher radiation levels may be considered on deck areas if these areas are off-limit to personnel during normal or emergency operations, respectively.

11.5.4 Atmospheric Discharge

For hydrocarbon vapor disposal by atmospheric dispersion from a vent stack, the vent outlet is to be of sufficient height or distance from the facilities to accomplish the following:

i) The calculated radiant heat intensity (including solar radiation) in case of accidental ignition is not to exceed 4.73 kW/m^2 (1500 BTU/hr/ft^2) at the maximum venting rate, at any deck level or location where normal maintenance or operating activity could take place.

ii) The following concentration of hazardous vapors, calculated per API RP 521 or other industrial model, is not to be exceeded at any deck level where normal maintenance or operating activity could take place, based on the reasonable worst-case conditions (e.g., still air and low vent velocity).

H_2S:	10 ppm
Combustible Vapors:	20% LEL

iii) The vent outlet is to be at least 8 m (25 ft) above any immediately adjacent process vessel or hydrocarbon processing equipment, and at least 3 m (10 ft) above the top of any vessel or equipment within an 8 m (25 ft) radius of the vent.

iv) When a short vent stack is used in lieu of a vent boom arrangement as normally found on the FPSO, the vent outlet is to be provided with devices to prevent the passage of flame into the system. The pressure drop of the flame arrestor is to be considered in the vent diameter sizing calculations.

When a dispersion model based on a modeling method other than API RP 521 is used, a validation study of the model is to be made available for verification.

11.5.5 Fire Extinguishing Systems for Atmospheric Vent

When a venting system is selected for disposal of hydrocarbon vapors, a vent snuffing system is to be provided to extinguish vented gases, should they ignite.

11.5.6 Liquid Droplet Scrubbers

Flare scrubber or vent scrubber vessels are to be provided and sized to separate liquid droplets greater than 450 micrometers in diameter from the maximum calculated gas relieving rate of the system, as per API RP 521 Section 5.4.2.1. Piping between the scrubber and flare or vent is to be self-draining back to the scrubber. If a piping low point is unavoidable, it is to be equipped with an automatic drain, e.g., a loop seal type, with connection to the open drain system.

11.5.7 Ground Flares

Ground flares may be used in place of the high stack flare. Ground flares are to be provided with automatic controls which will divert the flow of flare gas to a vent stack upon detection of flame failure, unless gas dispersion calculations show that the vapor concentrations do not exceed those specified in 3-3/11.5.4ii) under flame-out conditions. Draining connections are to be provided, to remove accumulated condensate or water to the open drain system.

11.5.8 Flashback Protection

Burn-back and flashback protection for flares is to be provided by sufficient purge gas rate maintained from a reliable source, or by a seal drum to prevent air intrusion. The purge gas source is to have sufficient gas supply for continuous purging during production shutdown, or for a complete purging of the flare system before re-ignition of the flare. The sizing of a seal drum is to be in accordance with API RP 521, Section 5.4.2.2**.**

11.5.9 Flare Ignition

The flare system is to be provided with means for purging sufficiently (below 5 percent of oxygen content) before ignition to prevent explosion inside the flare system.

13 Spill Containment, Open and Closed Drain Systems

13.1 Spill Containment

13.1.1 General

Spill containment is to be provided in areas subject to hydrocarbon liquid or chemical spills, such as areas around process vessels and storage tanks with drain or sample connections, pumps, compressors, engines, glycol systems, oil metering units, and chemical storage and dispensing areas.

13.1.2 Containment

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. A minimum of 150 mm (6 in.) coaming is to be provided.

A spill containment with less than 150 mm (6 in) coaming arrangement is subject to special consideration. Calculations showing sufficient spillage containment for the skid are to be submitted for verification.

13.3 Open Drain Piping

13.3.1 General

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.

13.3.2 Line Sizing and Arrangement

Open drain piping is to be self-draining with a slope of not less than 1:100. Lines are to be sized for gravity drainage without backup or overflow, based on a full drainage rate from any single source, with consideration given to the maximum rainfall condition.

13.3.3 Cleanouts

Cleanouts or flushing connections are to be provided for removal of sediment or solids from open drains subject to potential blockage.

13.3.4 Disposal

Open drains are to be piped individually or collected in one or more piping systems, which are to convey the fluids, by gravity or pumping, to oily water treatment or final disposal location.

13.5 Sealing of Open Drains

13.5.1 General

Piping drain traps, floor drains with integral drain seal, submerged open-ended pipes, or other means of utilizing liquid head, are to be provided to prevent vapor release from the sump or drain vessel to atmosphere.

13.5.2 Drain Seals

Except as permitted by 3-13/13.5.4 below, where flammable liquids (diesel fuel, tube oil, glycol, crude oil, etc.) could be present in an open drain system, a seal is to be provided at each open drain location. This is to prevent flammable vapors evolving from the liquids in the drain system from being released to atmosphere. Each such seal is to have a minimum effective water seal height of 3.8 cm (1.5 in.).

13.5.3 Pressure Seals

Where an open drain system is subject to an applied pressure, such as pad gas on the sump or drain vessel which receives the open drainage, a liquid seal is to be provided on each drain header or drain line connected to the source of pressure.

Minimum effective liquid seal height (unless increased by provisions of 3-3/13.5.4 below) is to be 150 mm (6 in), or 80 mm (3 in) over the pad gas pressure, whichever is greater.

Where such sealing is accomplished by submerging the open end of each line feeding the sump or drain vessel, the minimum operating liquid level in the vessel is to be maintained, and minimum seal height is to be increased proportionally for submergence in liquids of specific gravity less than 1.0.

13.5.4 Hot and Dry Climates

For installations located in hot, dry climates, it is recognized that water seals on open drain systems exposed to ambient conditions are of limited use, since the seals quickly evaporate and are rarely replenished by rainfall. For such installations, the following provisions apply:

i) Individual local drain seals per 3-3/13.5.2 above are not required.

ii) Drain header seals per 3-3/13.5.3 above are to be provided on each open drain line or header connected to a hydrocarbon containing sump or drain vessel. Where pad gas or other imposed pressure is present, the minimum effective seal height is to be increased by 50 mm (2 in).

13.5.5 Protection Against Freezing

In areas where drain seals are subject to freezing, means are to be provided to prevent the drain seal from freezing.

13.7 Segregation of Open Drain Systems

Drains from classified and unclassified areas are to be separate. When this requirement cannot be met, drains from classified and unclassified areas or between different zone areas are to be connected or led to a drain tank in a hazardous area. The following requirements are applicable:

i) Non-hazardous area drain header is to be equipped with a stop check valve at the safe area bulkhead, together with a loop seal with a leg length of at least 762 mm (30 in) installed before the inlet to the drain tank. The loop seal is to be so installed as to prevent freezing. Where drainage arrangement is such that the drain header from the classified areas are physically located lower than the unclassified areas, and there is no possibility of back flow into the safe areas, the check valve may not be needed.

ii) Drain outlets within the tank are to discharge against the tank side.

iii) Vent outlets from the subject drain tank are to be led to the main deck, be equipped with a flame screen, and treated as zone 1 and/or 2, as applicable.

When pumping systems are used to remove liquids from hazardous areas or from drain tanks mentioned above, branch suctions from safe and hazardous areas are to be arranged so that such areas cannot be pumped simultaneously.

13.9 Closed Drain Systems

13.9.1 General

Drains or liquid relief from process vessels, piping or other sources that could exceed atmospheric pressure are to be hard piped without an atmospheric break to a drain vessel.

The drain vessel is to be provided with pressure relief valve(s), which are to be sized to handle the maximum flow of gas or liquid that could occur under blocked outlet condition.

13.9.2. Connection to Open Drain System

Drains or liquid relief from vessels containing non-toxic, non-flammable liquids, may be connected to an unclassified open drain piping system if the open drain system is sized to accommodate these additional drains.

13.11 Overboard Discharges from the Production Treatment Plan

Although the overboard discharge from the production treatment plan onboard is not subject to MARPOL 73/78 (Annex I Regulations for the Prevention of Pollution by Oil), the discharge is to conform to the National/Regional Regulations.

In accordance with MARPOL 73/78, only discharges from machinery space, not from the offshore processing drainage, production water, or from displacement, are subject to the MARPOL regulations. See Appendix 6, Unified Interpretations of Annex I of MARPOL 73/78 for reference.

15 Protection from Ignition by Static Charge

For specific requirements on protection from ignition due to static electric discharge, refer to 3-6/29 of this Guide.

17 Major Equipment Requirements

This section provides requirements for equipment components that are typically utilized in floating facilities. Conformance to standards or codes different from those listed will be considered where applicable.

17.1 Process Vessels

17.1.1 General

Pressure vessels are to be designed, constructed, and tested in accordance with the ASME “Boiler and Pressure Vessel Code Section VIII Division 1 or Division 2”.

Consideration will be given to arrangements and details of pressure vessels which can be shown to comply with other recognized national Codes or Standards, provided they are no less effective than the ASME Code.

All process vessels are to be suitably supported and properly secured.

17.1.2 Materials

Low melting point or brittle materials such as cast iron, aluminum, brass, copper, or fiberglass, are not to be utilized in pressure retaining parts of vessels containing flammable or toxic fluids.

17.1.3 Thermal Considerations

Supports and insulation of vessels subject to change in temperature are to be designed to accommodate the resulting thermal movement.

17.1.4 Design Load

The design is also to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces, such as wind, are within the limits allowed by the Code.

17.3 Process Heat Exchangers

17.3.1 General

Process heat exchangers with a design pressure in excess of 1.05 kg/cm^2 (15 psig) and handling flammable fluids are subject to the requirements of 3-3/17.1 and the following applicable requirements:

17.3.2 Shell and Tube Heat Exchangers

Process heat exchangers of tubular design are to conform to applicable sections of ASME Section VIII, Division 1 or 2, TEMA Standards or API Standard 660.

17.3.3 Plate and Frame Exchangers

Plate and frame exchangers may be employed for handling flammable liquid, with the following restrictions:

i) Safety or protective devices are to be provided as required in accordance with Section A.10 of the Appendix A of API RP 14C.

ii) Each exchanger is to be provided with an exchanger enclosure, protective wall, shield or similar barrier, capable of containing spray in case of gasket leakage during operation.

iii) Each exchanger is to be provided with spill containment and drain capable of handling a liquid release of at least 10% of the maximum flammable stream flowrate.

17.3.4. Air Cooled Heat Exchangers

Air-cooled heat exchangers are to comply with API Std. 661.

17.3.5 Design Load

The design is to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces such as wind, are within the limits allowed by the Code.

17.5 Process Electric Heater

17.5.1 General

Process electric heater shells with a shell operating pressure greater than 1.05 kg/cm^2 (15 psig) are to be designed and constructed in accordance with ASME Boiler and Pressure Vessel Code.

17.5.2 Over Temperature Protection

Process electric heaters in hydrocarbon service are to be provided with heater element skin high temperature alarms.

17.5.3 Overpressure Protection

Where the vessel, tank or piping segment containing an electric heater can be isolated, a relief valve is to be provided for overpressure protection. It is to be sized for a blocked-in condition with the heater operating at full power.

17.5.4 Low Level, Low Flow or High Temperature Protection

Process electric heaters in liquid service are to be protected by low level, low flow, or high liquid temperature sensor to shut off electrical input.

17.5.5 Design Load

The design is to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces, such as wind, are within the limits allowed by the Code.

17.7 Fired Vessels (Heaters)

17.7.1 General

All fire-tube type fired vessels, with a shell operating pressure greater than 1.05 kg/cm^2 (15 psig), are to be designed in accordance with Section I of ASME Boiler and Pressure Vessel Code. Fired vessel (heater) shells, (heater) coils or other components designed in accordance with ASME Code, are to conform to all applicable requirements of 3-3/17.1.

17.7.2 Indirect Fired Vessels (Heaters)

Indirect fired water bath heaters with working pressures lower than 1.05 kg/cm^2 (15 psig) are to be designed and fabricated in accordance with API Spec. 12K. Similar types of indirect fired vessels (heaters), such as steam bath heaters, are to comply with API Spec. 12K in all respects, except those, that must differ because of the inherent operating principle of the heater.

17.7.3 Direct Fired Vessels (Heaters)

Direct fired vertical or horizontal emulsion treaters are to be designed and constructed in accordance with API Spec. 12L.

17.7.4 Ignition Control

Where burner ignition or light-off is part of an automatic sequence, the following control functions are to be provided:

i) Automatic timed purge interval prior to admitting pilot fuel. Purge may be by fan if so equipped, or by time delay to allow natural draft purge.

ii) Firing limit on a trial for ignition (15 seconds maximum) on each attempted pilot light-off.

iii) Confirmation of pilot lighting prior to admitting main burner fuel.

17.7.5 Manual Light-off

Each burner designed for manual light-off of the pilot is to be designed to allow an operator to light the pilot from a location which limits his exposure to flame flashback, should it occur. Burners are to be equipped with a sight-glass suitable for verifying pilot light-off and for viewing of main flame.

17.7.6 Combustion

Combustion air intakes for fired vessels are to be located in, or ducted from, a safe area.

17.7.7 Fired Vessel (Heater) Arrangement

Any fired vessel (heater) installed within a firewall is to be arranged with means of shutdown from outside the firewall enclosure.

17.7.8 Design Load

The design is to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces, such as wind, are within the limits allowed by the Code.

17.9 Atmospheric Storage Tanks

17.9.1 General

Atmospheric and low pressure storage tanks for flammable liquids are to be designed and fabricated in accordance with one of the following standards, as applicable:

i) Part 3 Section 5.9 of ABS *MODU Rules* for Semi, Tension Leg Platform (TLP), Deep Draft Caisson Vessel (DDCV) or Spar type FPS and FOI

ii) Section 3-2-10 of ABS *Steel Vessel Rules* for ship shape FSO and FPSO

iii) Part 3 Section 4 of *Offshore Installation Rules* for fixed installations

17.9.2 Overflows

Any storage tank larger than 20 barrels (2,312 liters) and operating at or near atmospheric pressure is to be equipped with one or more overflow connections, sized sufficiently to remove all incoming fluid in excess of the design operating level.

17.11 Compressors

Natural gas compressors are to comply with applicable API Standards such as API Std. 617 for centrifugal compressors, API Std. 618 for reciprocating compressors, and API 619 for rotary type positive displacement compressors. Compressors rated for less than 7 kg/cm^2 (100 psig) and 28.3 m^3/min (1000 scfm) can be accepted on the basis of manufacturer's certification data and test reports.

A fusible plug fire detection system complying with 3-8/7 and 4-8/7 as applicable, and directly activating the emergency shutdown system, is to be installed in the compressor package. The emergency shutdown system is to be interlocked to shutdown the compressor.

17.13 Pumps

Centrifugal pumps intended for hydrocarbon service are to comply with API Std, 610. Centrifugal pumps having stuffing box pressures in excess of 14 kg/cm^2 (200 psig) are to be provided with either single-balanced mechanical seals with means to collect and contain seal leakage, or tandem-balanced mechanical seals with alarm, to indicate primary seal failure.

Pumps rated for 7 kg/cm^2 (100 psig) and 757 liters/min (200 gpm) or less may be accepted for hydrocarbon service, on the basis of a manufacturer's certificate of compliance with the requirement of API 610.

Pumps rated above 7 kg/cm^2 (100 psig) and 757 liters/min (200 gpm) are to meet the following requirements:

i) The manufacturer is to supply a Certificate of Conformance to API 610 to the ABS Technical Office.

ii) The manufacturer is to furnish, in accordance with Section 6.1.5 of API 610, a statement indicating any system or components not in strict accordance with the requirements, detailing and explaining every deviation to the ABS Technical Office. (This is to include alternative designs or systems that are guaranteed for specific duties).

iii) Survey guidelines are to be in accordance with 5-1/Table 1 of this Guide.

iv) For all API 610 pumps, regardless of size, the Manufacturer's Certification of Conformance is also to include documentation on the seal arrangement of the pump.

17.15 Flowlines and Manifolds

Flowlines and manifolds transporting gas and liquid in two-phase flow are to be designed and sized in accordance with API RP 14E. Flowline valves are to be in accordance with Section 10.5 of API Spec. 6A.

Flow lines are to be fitted with a remotely operated shutoff valve at the first flange (as close as possible) on the loading manifold connecting the flexible lines that lead to the installation. These remote operated valves are to close upon actuation of the ESD System.

Boarding valves or first shutdown valves on board the installation are to be fire safe and tested to API Spec 6FA.

17.17 Scraper Launchers/Receivers

Closures and barrels for scraper launchers/receivers are to be designed and constructed in accordance with ASME Code, Section VIII, Division 1, or other equivalent recognized standard/code. Branch connections are to be in accordance with ASME B31.3, B31.4 and B31.8, as applicable.

Block valves are to be provided for isolation of process elements subject to pressure, to enable their safe removal when required. Means are to be provided to relieve pressure and to confirm the scraper launchers/receivers are not pressurized before opening the "quick opening closure".

17.19 Wellheads and Subsea Equipment

Christmas tree assemblies and subsea equipment are not part of the classification boundaries for a normal production facility. However, the equipment may be classed if desired by the owner. The following requirements are applicable:

17.19.1 Wellheads

Christmas tree assemblies including tubing head adapters, valves, tees, crosses, and chokes, are to comply with API Spec. 6A. Wellhead surface safety valves (SSV) and underwater safety valves (USV) are to comply with ISO 10418.

17.19.2 Subsea Equipment and Production Systems

Subsea production systems include, but are not limited to, template, wet or dry tree assemblies, well manifold, subsea production equipment, riser base or pipeline end manifold, riser, control pods and umbilicals, chokes and subsea safety valves. The design of each component is to be in accordance with a recognized standard such as API Series 17 for subsea production systems. The design is to take into consideration the mechanical loads due to buoyancy, pressure (internal and external), thermal expansion and contraction, and pre-stressing, and environmental loads due to wave current, ice, and earthquake.

Subsea completion wells are to be designed for automatic shutdown upon detecting flow pressure outside a preset level, or upon receiving ESD signals from the topside facilities.

Subsea control system and equipment are to be designed and constructed per requirements of APO Series 14 and 17 Specification, where applicable.

Where well fluid is not received on the installation directly from the well, means are to be provided to detect the actuation of ESD system, which will enable all subsea valves to shut-in.

17.21 Flare and Vent Structures

Flare and vent booms and ground flare structures are to be designed and constructed in accordance with API RP 2A for secondary structures.

19 Process Piping Systems

19.1 General

Process piping design, selection of valves, fittings and flanges, are to be in accordance with API RP 14E or other recognized standards.

19.3 Thermal Relief

Sections of piping systems that can be isolated with block valves, while they may be filled with cold liquid or liquid at near ambient temperature, are to be provided with thermal relief valves. This is to protect the piping from overpressure caused by solar heating or exposure to fire.

19.5 Isolation Valves

Block valves are to be provided for isolation of process elements subject to pressure to enable their safe removal when required. Means are to be provided to relieve pressure from the blocked piping segment before removal of the control element.

19.7 Flexible Hoses

Hose assemblies may be installed between two points where flexibility is required, if they will not be subject to twisting under normal operating conditions. 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.

To be considered fire resistant, hoses for flammable fluid service are to pass an industrially recognized fire test such as one listed in Section 10.5.1 of API Spec 16C "Specification for Choke and Kill Systems" (1300°F/704°C – Pressurized full water to normal working pressure for minimum 5 minutes).

For flexible hoses in hydraulic control system requirements, see Sections 4 and 5 of Chapters 3 and 4, as applicable.

Burst pressure of the hose is not to be less than three (3) times the relief valve setting. For details, see Appendix 2.

21 Plastic Pipe Installations

All non-metallic piping materials used in the piping systems for conveying hydrocarbon fluid must meet Level 1 fire endurance test, as referenced in Appendix 1 of this Guide, except as modified herein.

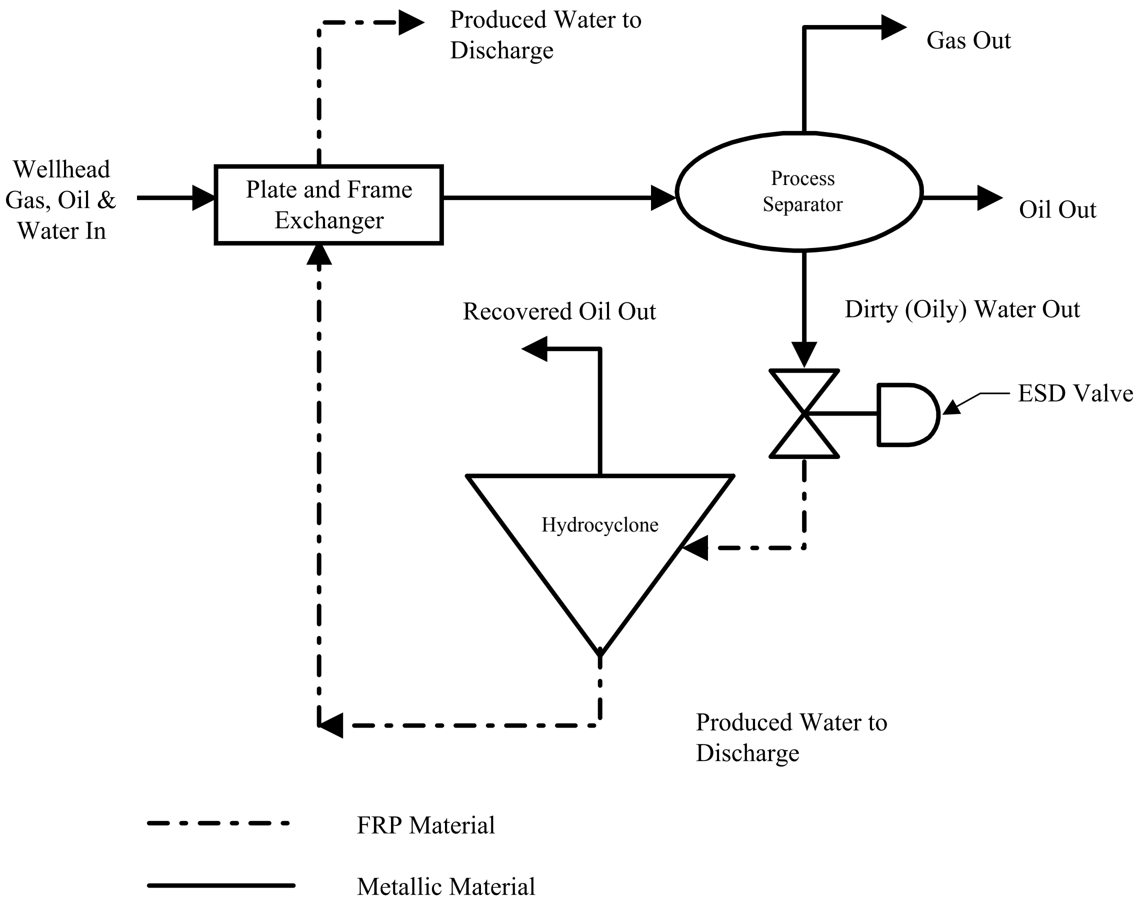
For a produced water piping system, a plastic pipe which passes a Level 3 fire endurance test or any equivalent fire endurance standard (such as the testing specified in Section 10.5.1 of API Spec 16C) may be considered, provided the following conditions are met:

i) A metallic isolation valve (ESD Valve), arranged to close in the event of a fire, is to be connected by metallic piping to hydrocarbon containing vessels, where the failure of the plastic piping would result in the uncontrolled release of hydrocarbons. Non-metallic piping materials may only be used beyond the ESD valve. See 3-3/Figure 1 for reference.

ii) Fire detection, fire fighting and shutdown systems are provided.

See 3-3/Figure 1 for typical detailed arrangement.

FIGURE 1
Typical FRP/GRP Arrangement in a Process Piping Layout



23 Packaged Process Units

23.1 General

Packaged process units are considered subsystems of the total production process systems. Subsystems are to comply with 3-3/7, 3-3/11, 3-3/13, 3-3/15, 3-3/19 and 3-3/21 for process system requirements and 3-3/17 for major equipment requirements. The electrical installation and instrumentation and control systems are to comply with Chapter 3, Sections 6 and 7. Fire protection systems are to comply with Chapter 3, Section 8 of this Guide.

23.3 Skid Structures

The skid structure is to be sufficiently rigid to support the mounted equipment and piping and, as required, to permit lifting during shipment without damage to the equipment or piping. Structural design calculations for skid units with a center of gravity height of more than 1.5 m (5 ft.), or a maximum operating weight in excess of 10 MT (metric tons) or 22.05 Kips, calculated in dry conditions, are to be submitted for review.

23.5 Drip Pans

Drip pans are to be provided to contain liquid spills and leaks from skid mounted equipment and piping, and to drain the liquid with adequate slope of 1 cm per meter ($^1/_8$ inch per foot) into open drain systems. A minimum 150 mm (6 in) coaming around the entire perimeter of a skid is to be provided. Skid beams that extend above the drip pan may be considered as meeting the coaming requirement, provided that the drip pan is seal-welded to the skid beams. A spill containment with less than 150 mm (6 in) coaming arrangement is subject to special consideration. Calculations showing sufficient spillage containment for the skid are to be submitted for verification.

CHAPTER 3 **Floating Installations**

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CHAPTER 3 Floating Installations

SECTION 4 Process Support Systems

1 General

This section presents criteria for the design and installation of process support systems on floating installations. General arrangement of these systems is to comply with API RP 14J, or other applicable standard. The documentation requirements for design review are given in Chapter 3, Section 2.

Process support systems are utility and auxiliary systems that complement the hydrocarbon production and process systems. Process support systems include, but are not limited to, the following:

i) Utility/Instrument Air System

ii) Fuel/Instrument Gas System

iii) Use of Produced Gas as Fuel

iv) Purging System

v) Fuel Oil System

vi) Hydraulic System

vii) Lubricating Oil System

viii) Chemical Injection System

ix) Heating and Cooling System

3 Component Requirements

The component requirements listed below are intended for the components of process support systems not covered in Chapter 3, Section 3.

3.1 Pressure Vessels

Pressure vessels are to be designed, constructed, and tested in accordance with the ASME "Boiler and Pressure Vessel Code Section VIII Division 1 or Division 2".

The design is also to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces, such as wind, are within the limits allowed by the Code.

Consideration will be given to arrangements and details of pressure vessels that can be shown to comply with other recognized national Codes or Standards, provided they are no less effective.

3.3 Heat Exchangers

Heat exchangers are to be designed, constructed, and tested in accordance with the ASME "Boiler and Pressure Vessel Code Section VIII Division 1 or 2", TEMA Standards, API Std. 660, or API Std. 661, as applicable.

The design is also to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces, such as wind, are within the limits allowed by the Code.

Consideration will be given to arrangements and details of heat exchangers, that can be shown to comply with other recognized national Codes or Standards, provided they are no less effective.

3.5 Pumps

All pumps for process support service are to comply with a recognized industrial standard such as ANSI, UL, ASME, etc., and may be accepted on the basis of manufacturer's affidavit of compliance with a recognized industrial standard.

3.7 Compressors

Compressors, such as those used with air or refrigeration systems, are to be designed to a recognized industrial standard, and may be accepted on the basis of manufacturer's affidavit of compliance with a recognized industrial standard.

3.9 Prime Movers (Internal Combustion Engines and Turbines)

3.9.1 General

Engines and turbines are to be designed and constructed in accordance with a recognized industry standard or code of practice, and be suitable for the full range of possible operating conditions, including angles of heel and trim, and accelerations due to floating structure roll, pitch and yaw. Additionally, prime movers for emergency services on floating structures are to be shown suitable for extended periods of operation at the maximum angles of heel, trim, pitch, and roll. Gas turbines are to comply with API Standard 616, as applicable. Manufacturer's affidavit verifying compliance with recognized standards are to be submitted. For engines and turbines of less than 100 kW (134 hp), manufacturer's affidavit may be presented and accepted by the attending Surveyor.

3.9.2 Installation

The installation of internal combustion engines and gas turbines is to be approved by ABS, and is to comply with a recognized standard such as NFPA Std. No. 37, as applicable.

3.9.3 Engines in Classified Areas

Combustion engines are not to be installed in Class 1, Division 1 areas, unless they are installed in an enclosure of fire resistive construction with adequate ventilation from a non-classified area. Spark ignition engines may not be installed in Class 1, Division 2 areas, except when natural gas fuel is utilized, in accordance with the provisions of NFPA Standard 37. See 3-6/15 for hazardous areas.

3.9.4 Exhaust Manifolds

Exhaust manifolds and piping are to be shielded for ignition prevention and personnel protection. Explosion relief valves or other appropriate protection against explosion are to be provided in the exhaust and scavenge manifolds. The explosion relief valves are to be of the return-seating type. The arrangement and location of the valves is to minimize the dangers from emission of flame. Exhaust piping from internal combustion engines and turbines is to be equipped with spark arresters, and discharge into non-hazardous areas. See 3-6/15 for hazardous areas.

3.9.5 Air Intakes

Air intakes to internal combustion engines and gas turbines are to be not less than 3 m (10 ft) from hazardous areas. An explosion relief valve or other appropriate protection against explosion is to be provided in the air inlet manifold.

3.9.6 Starting Air

Means are to be provided to exclude gas from starting air if the engine is air-started. Starting air branch pipes to each cylinder are also to be provided with flame arresters.

3.9.7 Protection of Crankcase and Piston Underside Space

3.9.7(a) Ventilation and Monitoring For a trunk piston type engine, ventilation is to be provided for the crankcase to prevent accumulation of gas. Arrangements are to be made so that any blow-by gas may readily reach the vent. The crankcase vent is to be led to a safe location in the atmosphere through a flame arrester. The crankcase is also to be protected by an oil mist detector and gas detecting or equivalent equipment. For a cross-head type engine, the crankcase is to be protected by an oil mist detector or bearing temperature detector. Gas detection or equivalent equipment is to be provided for the piston underside space.

3.9.7(b) Explosion Relief Valves Where explosion relief valves are fitted, the valves are to be sized based on the expected detonation pressure resulting from the ignition of fuel oil, fuel gas, and lubricating oil vapors. Since the detonation pressure depends on the length of flame travel, it may be necessary to increase the relief areas, or provide more than one relief valve for each crankthrow.

3.9.7(c) Warning Notice To caution against opening a hot crankcase, suitable warning notices are to be fitted, preferably on a crankcase door on each side of the engine, or on the engine/turbine control stand. The notices are to specify a period of time for cooling after shutdown, (based on the size of the engine, but not less than 10 minutes in any case) before safely opening the door. Additionally, the notices are to include a caution that the crankcase is not to be opened until adequate precautions have been taken to insure that no gas remains trapped in the crankcase. The notice is also to warn against restarting an overheating engine/turbine until the cause of overheating has been remedied.

3.9.8 Regulators

When the gas pressure on the upstream side of a regulator exceeds 350 mm (14 in) of H_2O, a relief valve is to be installed on the downstream side. This relief valve is to discharge to a safe location in the atmosphere through a flame arrester. The capacity of the relief valve is to be adequate in venting the volume of gas that would pass through the regulator if that device should fail.

3.11 Cranes (Optional)

Cranes and hoists are to comply with the guidelines of API RP 2D, API Spec. 2C, or ABS *Guide for Certification of Cranes*, when requested by the Owner.

5 System Requirements

Process support piping design, selection of valves, fittings, and flanges are to be in accordance with API RP 14E, or other recognized standards such as ASME B31.3.

For plastic piping, the requirements of Appendix 1 are applicable.

5.1 Utility/Instrument Air System

5.1.1 Arrangement

Utility and instrument air may be supplied by a single air compressor or by a separate compressor for each service. When using a single compressor for both services, controls are to be provided to give priority to instrument air requirements.

5.1.2 Air Quality

Instrument air is to be oil-free and dried to prevent liquids and dirt from entering pneumatic instruments.

5.1.3 Piping

Air compressor suctions are to be at least 3 m (10 ft) from hazardous areas. Air outlets from compressors are to be fitted with non-return valves and discharged into air receivers/scrubbers for oil and water removal. Instrument piping is to be installed to minimize low points, and provisions are to be included in the piping to allow removal of condensation. Crossovers where air and combustible fluids could be intermixed are not permitted anywhere in the system.

5.3 Fuel/Instrument Gas System

Gas used for fuel or instrument systems is to be passed through a gas scrubber to remove entrained liquid. The instrument gas may also have to be dried to meet requirements of the specific equipment that will use the gas. Gas containing hydrogen sulfide is not to be used as instrument gas. Where gas is used for instrument systems, the area classification in way of these instruments is to be in accordance with API RP 500 or 505.

5.5 Segregation of Piping Systems

Piping systems carrying non-hazardous fluids are to be segregated from piping systems that may contain hazardous fluids. Cross connection of the piping systems may be made where means are provided for avoiding possible contamination of the non-hazardous fluid system by the hazardous medium.

5.7 Use of Produced Gas as Fuel

Enclosed spaces located on the production deck having boilers, inert gas generators, and combustion engines using produced gas as fuel, are to have ventilation systems providing at least 30 air changes per hour. These spaces are to be fitted with gas detection systems to alarm at 20% L.E.L., and to activate automatic shutdown of the gas supply at 60% L.E.L. The automatic shutdown valve is to be located outside the space.

This valve is also to be activated upon loss of the required ventilation in the enclosed space, and upon detection of abnormal pressure in the gas supply line.

For produced gas containing hydrogen sulfide, provisions are to be made for gas sweetening, unless the equipment manufacturer has certified the equipment's suitability for sour gas application, and the equipment is located in a freely ventilated, open space.

To bring fuel gas containing H_2S to equipment located in an enclosed machinery space, the sour gas must be sweetened. Additionally, the machinery space is to be equipped with H_2S gas detectors. The detectors are to be set to alarm at 10 ppm, and to activate the shutdown valve at 50 ppm.

Burner control systems are to be in accordance with NFPA 8501.

5.9 Purging System for Process Equipment

5.9.1 Purging

Process equipment and systems are to be purged prior to initial startup. They are also to be purged when being put back into service after shutdown, if there is a possibility of oxygen entering the system during shutdown. Facilities not equipped for storage of liquid hydrocarbon may only require temporary inert gas storage containers. (For facilities equipped for storage, refer to 3-5/5.3 for floating installations, and 4-4/7 for fixed installations.

5.9.2 Oxygen Content and Monitor

The oxygen content of the inert gas used is not to exceed five percent (5%) by volume. Oxygen monitoring equipment is to be provided to monitor oxygen levels in the inert gas supply.

5.9.3 Isolating Valves

Shutoff valves are to be fitted at the inlet and outlet of the final pressure regulator in a stored purging gas system.

5.11 Fuel Oil System

This section of the Guide is applicable to all fuel oil systems located on the production deck that supply fuel to the process equipment. For fuel oil systems serving marine support functions such as the fuel oil system for the vessel/unit service generator or for the helicopter deck refueling facility, see *Steel Vessel Rules* or *MODU Rules* for applicable requirements.

5.11.1 Pumping Arrangements

Fuel oil pumping arrangements are to be completely separate from other pumping systems, and are not to be connected to other piping systems.

5.11.2 Pump Controls

Fuel oil transfer pumps, fuel oil unit pumps, and other similar fuel pumps are to be fitted with local and remote controls so they may be stopped in case of an emergency. Remote controls are to be located in a space not affected by fire at the pump locations.

5.11.3 Containment

A containment at least 150 mm (6 in) high is to be provided at unloading and/or offloading stations, pump areas, and overflow/vent line locations, and arranged to direct a possible leak or spill to the open drain system.

5.11.4 Valves on Oil Tanks

Where pipelines emanate from oil tanks at such a level that they will be subjected to a static head of oil from the tank, they are to be fitted with a positive closing valve located at the tank. Gray cast iron valves are not to be used as shutoff valves for fuel oil tanks.

Arrangements are to be provided for closing the tank's valve locally and from a space not affected by fire at the fuel oil tank location. This requirement may be omitted if the tank capacity is less than 132 US gallons (500 liters).

5.11.5 Non-metallic Expansion Joints and Hoses

Non-metallic expansion joints and hoses for use in fuel oil systems are only allowed at machinery connections, provided they are in an easily accessible position, and pass the API Spec 16C (item 10.5.1) fire test. See Appendix 2 of this Guide for API Spec 16C fire test requirements. Non-metallic expansion joints and hoses are not allowed for connecting runs of pipes for expansion and deflection purposes in fuel oil systems.

5.13 Hydraulic System

This section of the Guide is applicable to all hydraulic oil systems located on the production deck that supply hydraulic fluid to control systems of process related equipment. For hydraulic systems that are serving both industrial support and marine support functions, see 3-5/5.1 of this Guide.

High flash point hydraulic fluids are to be used, unless a specific system design requires the use of low flash point fluids. When low flash point fluids are used, precautions are to be taken to minimize fire hazard, by insulating nearby hot surfaces that could ignite a low flash point fluid. See 3-8/17.5 or 4-8/17.5, as applicable.

Non-metallic hoses used for oil based hydraulic fluid in all hydraulic control systems, except BOP control system, must pass API Spec 16C fire test or equivalent. See Appendix 2 of this Guide for API Spec 16C fire test requirements. Additionally, gray cast iron material is not allowed for supply valves on oil based hydraulic storage tank.

5.15 Lubricating Oil System

5.15.1 Interconnection

The lubricating oil piping is to be entirely separated from other piping systems.

5.15.2 Valves on Lubricating Oil Storage Tanks

Normally opened valves on lubricating oil storage tanks are to comply with the same requirements as those for fuel oil tanks given in 3-4/5.11.4.

5.15.3 Turbines

5.15.3(a) Automatic Shut-off Turbines are to be provided with a means of automatically shutting off the steam or gas turbine fuel supply upon failure of the lubricating oil system.

5.15.3(b) Indicators Indicators are to be fitted to allow monitoring of the pressure and temperature of the water inlet and oil outlet of the oil coolers. Pressure systems are to be fitted with low-pressure alarm. Sump and gravity tanks are to be provided with suitable gauges for determining the level of oil within the tank.

5.15.3(c) Strainers and Filters For auxiliary turbines, a magnetic strainer and fine mesh filter (strainer) are to be provided in the lubricating oil piping to the turbine. Strainers are to be so arranged as to prevent, in the event of leakage, spraying oil onto heated surfaces.

5.15.4 Internal Combustion Engines

5.15.4(a) Lubricating Oil Pumps The lubricating oil pump is to be of sufficient capacity for the maximum output of the engine.

5.15.4(b) Filters Lubrication oil filter is to be provided and so arranged as to prevent, in case of leakage, spraying oil onto heated surfaces.

5.15.4(c) Low Oil Pressure Alarm An alarm device with audible and visual signals for failure of the lubricating oil system is to be fitted.

5.17 Chemical Injection System

5.17.1 Materials

The chemical storage tank, pumps, and piping are to be suitable for the chemicals being handled. Affidavit from tank manufacturers confirming the tank material is compatible with the chemical being stored is to be provided. Fiberglass reinforced polyester independent tanks may be considered for non-flammable chemicals only. For metallic tanks containing flammable or combustible fluids, scantling plans and calculations are to be submitted for review.

Atmospheric and low pressure metallic storage tanks for flammable liquids are to be designed and fabricated in accordance with Part 3 Section 5.9 of the *MODU Rules*, Section 3-2-10 of *Steel Vessel Rules* or Part 3, Section 4 of *Offshore Installation Rules*, as applicable.

Design and construction of non-metallic tanks for non-flammable liquids are to be in accordance with industry-recognized standards, such as ASME Boilers and Pressure Vessels Code Section X, API 12P (FRP) or applicable ASTM Standards.

Alternatively, all tanks may be accepted based on the manufacturer's affidavit of compliance with an applicable standard.

5.17.2 Arrangement and Components

For multi-chemical systems, a separate tank or tank compartment is to be provided for each chemical used. Chemical storage tanks are to be provided with atmospheric vents and level glasses. Flame arrester is to be provided to flammable or combustible tank vent. The discharge of each pump is to be provided with a pressure relief device to return the chemical to the pump suction or chemical tank. Injection lines are to be fitted with non-return valves, and means are to be provided to automatically shutdown the injection pump in the event of process shutdowns.

5.19 Heating and Cooling Systems

The medium used for heating or cooling any hydrocarbon system is to be contained solely within the classified area, unless the return line of the heating or cooling system to a non-classified area is provided with means to detect any hydrocarbon contamination.

5.21 Sodium Hypochlorite Solution Storage

The sodium hypochlorite solution injected into the seawater system to combat the growth of marine organisms and algae that could foul filters and pipelines is considered highly corrosive. Stainless steel or GRP storage tank may be considered. The solution also produces hydrogen gas; therefore, the storage tanks are to be located in a well-ventilated open deck area.

5.23 Control of Static Electricity

Refer to 3-6/29.

7 Drilling Systems

See the *Rules for Building and Classing Mobile Offshore Drilling Units* for applicable requirements for the drilling, workover, and completion systems.

CHAPTER 3 **Floating Installations**

SECTION 5 **Marine Support Systems**

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CHAPTER 3 Floating Installations

SECTION 5 Marine Support Systems

1 General

Marine support systems are to be in accordance with the requirements of the *Rules for Building and Classing Steel Vessels* or *Rules for Building and Classing Mobile Offshore Drilling Units*, except as modified herein and in Chapter 3, Sections 6, 7 and 8.

Marine support systems and components include, but are not limited to the following:

i) Boilers and Pressure Vessels

ii) Turbines and Gears

iii) Internal-Combustion Engines

iv) Pumps and Piping Systems

v) (i.e. Fuel Oil, Lube Oil, Fresh Water, Ballast Control, Cargo, Inert Gas, etc.)

vi) Propellers and Propulsion Shafting

vii) Steering Gears

3 Components Requirements

3.1 Pressure Vessels

Pressure vessels are to be in accordance with the requirements of the *Rules for Building and Classing Steel Vessels*.

Where applicable, the design is also to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces are within the limits allowed by the Code.

Consideration will be given to arrangements and details of pressure vessels that can be shown to comply with other recognized national Codes or Standards, provided they are no less effective.

3.3 Heat Exchangers

Heat exchangers are to be in accordance with the requirements of the *Rules for Building and Classing Steel Vessels*.

Where applicable, the design is also to ensure that stresses due to external nozzle loads and moments, stresses due to acceleration forces arising out of the motion of the floating installation, and stresses due to any other applicable external forces are within the limits allowed by the Code.

Consideration will be given to arrangements and details of heat exchangers that can be shown to comply with other recognized national Codes or Standards, provided they are no less effective.

5 System Requirements

5.1 Pipe System Interconnections

If a system is serving both marine support and industrial functions (i.e., hydraulic power to ballast control valves, process shutdown valves, etc…), the design criteria of the system are to meet the *Steel Vessel Rules* or *MODU Rules*, as applicable. If portions of the system serve only industrial functions and can be isolated from the part serving marine functions, the less severe industrial criteria can be applied to that part of the system up to, but not including, the isolating valve. For industrial systems design criteria, see 3-3/19.1 and 3-4/1, as applicable.

5.3 Oil Storage Tank Purging and Blanketing Systems

On facilities equipped for storage of liquid hydrocarbons, a permanently installed inert gas system is to be provided for tank purging and blanketing. The inert gas system is to be designed and constructed in accordance with subsection 5-1-7/25 of the *Steel Vessel Rules*, except as modified below. Either inert gas or produced gas is to be used to maintain crude oil storage tanks with a positive pressure in relation to the surrounding atmosphere, and with an oxygen content not exceeding five percent (5%) by volume in the inert gas supply main to the storage tanks. The system is to capable of maintaining the atmosphere in any part of any storage tank with an oxygen content not exceeding eight percent (8%) by volume. The storage tanks are to be previously purged with inert gas when produced gas is used for tank blanketing.

5.5 Oil Storage Tanks Venting System

Where pressure/vacuum relief valves are fitted on crude oil storage tanks, pressure relief lines are to be connected to the low-pressure (less than 2.5 psig) flare header, or vented to a safe location. The oil storage tanks venting system is to be designed and constructed in accordance with subsection 5-1-7/11 of *Steel Vessel Rules*.

5.7 Use of Produced Gas as Fuel

Enclosed spaces above decks having boilers, inert gas generators, and combustion engines using produced gas as fuel, are to have ventilation systems providing at least 30 air changes per hour. These spaces are to be fitted with gas detection systems to alarm at 20% L.E.L., and to activate automatic shutdown of the gas supply at 60% L.E.L. The automatic shutdown valve is to be located outside the space. This valve is also to be activated upon loss of the required ventilation in the enclosed space, and upon detection of abnormal pressure in the gas supply line.

For produced gas containing hydrogen sulfide (H_2S), provisions are to be made for gas sweetening, unless the equipment manufacturer has certified the suitability of the equipment for sour gas application, and the equipment is located in a freely ventilated open space. To bring fuel gas containing H_2S to the equipment located in an enclosed machinery space, the sour gas must be sweetened. Additionally, the machinery space is to be equipped with H_2S gas detectors. The detectors are to be set to alarm at 10 ppm (part per million), and to activate the shutdown valve at 50 ppm.

Use of produced gas as fuel for boilers, inert gas generators, and combustion engines located within machinery spaces under decks, is to comply with the 5-8-16 of *Steel Vessel Rules*. For floating installations with no **Disconnectable ✠ AMS** notation, the dual fuel requirements listed in 5-8-16/5 "Special requirements for main boilers" and 5-8-16/9 (General) of the *Steel Vessel Rules* are not applicable.

Burner control systems are to be in accordance with 4-4-1/11 of the *Steel Vessel Rules*.

5.9 Flammable Liquid Storage Facility Arrangement

The storage of flammable liquids having a flash point of 60°C (140°F) or less, such as methanol, in integral hull tanks requires, in many respects, the application of "Tanker" requirements. Subsection 5-1-7 of the *Steel Vessel Rules* is applicable for pumping, piping, venting and electrical arrangements. With regard to the general arrangement and tank locations, cofferdams may be required to prevent hazardous area delineation in adjacent spaces, and the pumping/piping are to be arranged independently from all other systems. Transfer pumps and piping (including fill, discharge, vent and sounding piping) are not to be located in, or pass through, the machinery spaces.

See 3-8/5.5 of this Guide for fire protection requirements.

CHAPTER 3 **Floating Installations**

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CHAPTER 3 Floating Installations

SECTION 6 Electrical Systems

1 Applicability

Electrical systems used solely for hydrocarbon processing on floating installations are to meet the requirements of this Guide. Where electrical systems or equipment are used to supply services other than Oil or Gas Production, the equipment is also to comply with the relevant ABS Class Rules for the hull structure.

3 General

Electrical installations are to comply with this section and with API RP 14F. Consideration will be given to the use of other recognized national or international standards, such as IEC, provided they are no less effective, and the entire system is designed to such standards. For installations classified by class and zone, the requirements of API RP14FZ (when approved) may be used in lieu of API 14F. Where sections of API RP 14F are called out in the following text, the intent is solely to help identify relevant clauses; the designer is not relieved from full compliance with all the recommended practices contained with API RP 14F. The references to IEC standards, are intended solely as minimum requirements when standards other that API RP 14F are applied.

5 Design Considerations

5.1 Equipment and Enclosures

Electrical equipment and enclosures subject to the offshore environment are to be provided with a degree of protection suitable to the environment or hazard in which they are located, in accordance with API RP 14F Section 6.11 and 7.2.4, or other recognized standard.

5.3 Selection of Materials

Materials of construction are to be selected that are suitable for their intended purpose and location.

5.5 Equipment Grounding (Earthing) Arrangements

5.5.1 Permanent Electrical Equipment

All electrical equipment with metallic enclosures, whose arrangement and method of installation does not assure positive grounding to the metal hull or equivalent conducting body, is to be permanently grounded through a separate conductor. In addition, it is to be protected against damage. Where separate grounding conductors are required, they are to be in accordance with paragraph 6.10.3 of API 14F. Systems designed to other recognized standards are to comply with such standards, but in no case are the separate grounding conductors to be of a cross-sectional area of less than indicated in 3-6/Table 2.

5.5.2 Lightning Protection

Equipment and structure are to be protected against lightning damage in accordance with NFPA 780 or other suitable standard.

5.7 System Grounding (Earthing)

Where electrical systems are used solely for process facilities, system grounding is to comply with 6.10.2 of API RP 14F.

5.7.1 Vessels with Integral Hull Tanks

If the facility has integral hull tanks containing liquids with a flash point not exceeding 60°C (140°F), a grounded distribution system is not to be used, except for the following:

i) Grounded intrinsically safe circuits

ii) Power supplied control circuits and instrumentation circuits where technical or safety reasons preclude the use of a system without a grounding connection, provided the current in the hull is limited to 5 Amperes or less in both normal and fault conditions.

iii) Limited and locally grounded systems, provided any possible resulting current does not flow directly through any hazardous areas.

iv) Alternating current power networks of 1 kV root mean square (r.m.s.) (line to line) and over, provided any possible resulting current does not flow directly through any hazardous areas.

5.7.2 Ground (Earth) Return Paths Through the Hull

The metal structure of an offshore installation is not to be used as a normal current return for the electrical distribution system, except for the following systems:

i) Impressed current cathodic protection

ii) Limited and locally grounded systems for battery systems for engine starting having a one-wire system and the ground lead connected to the engine

iii) Grounded intrinsically safe circuits

5.9 Distribution and Circuit Protection

Electrical installations are to comply with API 14F as noted herein.

5.9.1 General

All ungrounded conductors and the devices and circuits which they serve are to be protected against over-current. Protective devices are to be provided to guard against overload and short circuit currents, and to open the circuit if the current reaches a value that will cause excessive or dangerous temperatures in the conductor or conductor insulation.

5.9.2 Motor Controllers

Motor starting and control installations, including overload protection and short circuit protection, are to be in accordance with Section 7.4 of API RP 14F.

7 Rotating Electrical Machinery

7.1 General

Motors and generators are to be manufactured to NEMA Standard MG-1 or IEC 60034 for performance, manufacture, protection, and construction.

7.3 Temperature Rating

Equipment is to be selected for the rated ambient temperature. If equipment is intended to be used in a space where the equipment's rated ambient temperature is below the assumed ambient temperature of the space, it is to be used at a derated load.

The assumed ambient temperature of the space plus the machine's actual temperature rise at its derated load is not to exceed the machine's total rated temperature (rated ambient temperature of the machine plus rated temperature rise).

7.5 Moisture Condensation Protection

All generators and motors 50 hp or more are to be equipped with space heaters, to prevent accumulation of moisture and condensation when they are idle for appreciable periods. The space heaters are to be capable of being electrically isolated.

7.7 Temperature Detection

Generators larger than 500 KVA are to be provided with at least one embedded temperature detector per phase, at the hot end of the stationary winding, with temperature indication at a manned location.

9 Transformers

9.1 General

Each power transformer is to be provided with a corrosion resistant nameplate indicating the name of the manufacturer and all pertinent electrical characteristics. They are to be constructed and tested to ANSI C57 or equivalent. Transformers are to be protected in accordance with the recommended practices of API RP 14F Section 8.

9.3 Transformer Supplying Services Other than Oil or Gas Production

In addition to the above, transformers supplying services other than oil or gas production are to be selected, installed, and protected in accordance with their environmental conditions and subsection 4-8-3/7 of the *Steel Vessel Rules.*

11 Switchgear

11.1 Application

Main and emergency switchboards, power and lighting distribution boards, motor control centers and motor controllers, and battery charging panels, are to be designed, constructed, and tested in accordance with the provisions of this subsection.

11.3 Construction, Assembly and Components

11.3.1 Enclosures

Enclosures and assemblies are to be constructed of steel or other suitable incombustible, moisture-resistant materials, and reinforced as necessary to withstand the mechanical, electro-magnetic and thermal stresses which may be encountered under both normal and short circuit fault conditions. Enclosures are to be of the closed type. The degree of the protection is to be appropriate for the intended location. See also 3-6/5.1. All wearing parts are to be accessible for inspection and be readily renewable.

11.3.2 Bus Bars

11.3.2(a) General Bus bars are to be sized and arranged so that the temperature rise under the most severe loading conditions will not affect the normal operation of electrical devices mounted in the switchboard.

11.3.2(b) Bracing of Bus Bars Bus bars and circuit breakers are to be mounted, braced, and located to withstand thermal effects and magnetic forces resulting from the maximum prospective short circuit current.

11.3.2(c) Bolted Connections Bolted bus bar connections are to be suitably treated (e.g, silver plating) to avoid deterioration of electrical conductivity over time. Nuts are to be fitted with means to prevent loosening.

11.3.2(d) Cable connections Soldered connections are not to be used for connecting or terminating any cable of 2.5 mm^2 or greater. These connections are to be made with of soldered lugs or equivalent.

11.3.2(e) Clearance and creepage Minimum clearances and creepage distances between live parts of different potential, i.e., between phases and between phase and ground, are to be in accordance with API RP 14F or 3-6/Table 3, as appropriate.

11.3.3 Circuit Breakers

11.3.3(a) Compliance with a Standard Circuit breakers are to be designed, constructed, and tested to ANSI C37, NEMA AB-1, IEC 947-2, or other recognized standard. The certificates of tests are to be submitted upon request by the Bureau.

11.3.3(b) Short Circuit Capacity Circuit breakers are to have sufficient breaking and making capacities as specified in the short circuit calculation. See 3-6/27.

11.3.3(c) Isolation Circuit breakers are to be mounted or arranged in such a manner that the breakers may be removed from the front of the switchboard, without first de-energizing the bus bars to which the breakers are connected. Draw-out or plug-in type circuit breakers that are arranged in such a manner that the breaker may be removed from the front without disconnecting the copper bus or cable connections, are acceptable for this purpose. Alternatively, an isolation switch may be fitted upstream (line or supply side) of the breaker.

11.3.4 Fuses

Fuses are to be designed, constructed, and tested in accordance with UL 248 or IEC 269 or other recognized standard. The certificates of tests are to be submitted upon request from the Bureau. The requirements of 3-6/11.3.3(b) and 3-6/11.3.3(c) above are applicable. Where disconnecting means are fitted, they are to be on the supply side. If the switch is not rated to interrupt the circuit under load, it is to be provided with interlock to prevent opening until the load is de-energized.

11.3.5 Internal Wiring

11.3.5(a) Wires Internal instrumentation and control wiring is to be of the stranded type and is to have flame-retarding insulation. They are to be in compliance with a recognized standard.

11.3.5(b) Protection In general, internal instrumentation and control wiring is to be protected (by fuse or circuit breaker) against short circuit and overload, with the following exceptions:

i) generator voltage regulator circuits

ii) generator circuit breaker tripping control circuits, and

iii) secondary circuit of current transformer

These circuits, however, except that of the current transformer, may be fitted with short circuit protection only.

11.3.5(c) Terminals Terminals or terminal rows for systems of different voltages are to be clearly separated from each other, and the rated voltage is to be clearly marked. Each terminal is to have a nameplate indicating the circuit designation.

11.3.6 Circuit Identification

Identification plates for feeders and branch circuits are to be provided, and are to indicate the circuit designation and the rating or settings of the fuse or circuit breaker of the circuit.

11.5 Switchboards

In addition to the preceding requirements, main and emergency switchboards are to comply with 3-6/11.5.1 and 3-6/11.5.2.

11.5.1 Bus Bars

Bus bars for switchboards supplied by generators are to comply with Section 5.5.2.1 of API 14F.

11.5.2 Power Generation Switchboards

At minimum, the following equipment and instrumentation are to be provided for switchboards associated with power generation:

i) Voltage Regulators

ii) Synchronizing Controls

iii) Synchronizing Relay

iv) Ground Fault Detection

v) Prime Mover Speed Control

vi) Ammeter – with selector switch arranged to measure each phase

vii) Voltmeter – with a selector switch

viii) Frequency Meter

ix) Watt Meter / Power Factor Meter.

x) Space Heater Pilot Lamp – where required

xi) Stator Winding Temperature Indicator (500 kVA and larger Generators)

11.7 Motor Controllers

In addition to the applicable requirements in 3-6/11.3 above, motor controllers are to comply with the following:

11.7.1 Overload and Under-voltage Protection

Overload protection and low-voltage protection, if provided in the motor controllers, are to be in accordance with 7.4.4 of API RP 14F, or other appropriate standard.

11.7.2 Disconnecting Means

A circuit-disconnecting device is to be provided for each motor branch circuit so that the motor and the controller may be isolated from the power supply for maintenance purposes. The circuit-disconnecting device is to be operable externally.

11.9 Battery Charging Panels

In addition to the applicable requirements in 3-6/11.3 above, battery chargers are to comply with the following:

11.9.1 Battery Charger

Except when a different charging rate is necessary and is specified for a particular application, the charging facilities are to be such that the completely discharged battery can be recharged to 80 % capacity in not more than 10 hours.

11.9.2 Reversal of Charging Current

An acceptable means is to be installed, such as reverse current protection, to prevent the battery charger component failure from discharging the battery.

11.9.3 Instrumentation

The following are to be provided:

i) disconnect switch for power supply to the charge

ii) indicator light connected to the downstream side of the disconnect switch in (a)

iii) means for adjusting the voltage for charging

iv) voltmeter to indicate the charging voltage, and

v) ammeter to indicate the charging current.

11.11 Switchgear Supplying Services Other than Oil and Gas Production

Main and emergency switchboards, power and lighting distribution boards, motor control centers and motor controllers, and battery charging panels that are used to supply services other than Oil and Gas Production, are to comply with subsection 4-8-3-/5 of the *Steel Vessel Rules* in addition to the above mentioned sections.

13 Wire and Cable Construction

13.1 General

All wires and cables are to be constructed in accordance with IEEE, ICEA, IEC, or other recognized standards. All cable and conduit fittings and wiring devices are to be constructed in accordance with an appropriate recognized standard.

13.3 Conductor Type

Conductors are to be of copper, and stranded in all sizes. Conductor sizes are to be in accordance with API RP 14F or other recognized standards. But in no case are they to be less than the following in cross sectional size:

i) 1.5 mm^2 (2,960 circ. mils) for motor feeder and branch circuit cables

ii) 1.0 mm^2 (1,973 circ. mils) for power lighting and control cables

iii) 0.5 mm^2 (786.5 circ. mils) for essential or emergency signaling and communications cables, except for those assembled by the equipment manufacturer, and

iv) 0.375 mm^2 (739.3 circ. mils) for telephone cables for non-essential communications services, except for those assembled by the equipment manufacturer.

13.5 Insulation

Conductor insulation is to be rated suitable for a minimum operating temperature of 75°C (167°F) in wet environments. In addition, insulation rating is to be at least 10°C (50°F) higher than the maximum ambient temperature that the conductor can encounter at its service location.

13.7 Cable Flame Retardancy

13.7.1 Standards

All electric cables are to be at least of a flame-retardant type complying with the following:

i) Cables constructed in accordance with IEEE, ICEA, IEC, or other recognized standards, are to comply with the flammability criteria of IEEE Std. 45 or IEC 60332.3 Category A where installed in trays, bunches, or similar groupings.

ii) Cables constructed to IEEE Std. 45 are to comply with the flammability criteria of that standard.

iii) Cables constructed to IEC Publication 60092 standards are to comply with the flammability criteria of IEC Publication 60332-3, Category A.

Consideration will be given to special types of cables, such as radio frequency cables, which do not comply with the above requirements.

13.9 Fire Resistant Property

When electric cables are required to be fire-resistant, they are to comply with the requirements of IEC Publication 60331.

15 Hazardous Areas

15.1 General

Areas and spaces in which flammable vapors or gases are handled, processed, or stored, are to be classified in accordance with the following sections and/or API RP 500. Where installations are classified by zone, API RP 505 may be used in lieu of API RP 500.

15.3 Electrical Installations in Hazardous Areas

Electrical installations in classified areas are to be limited to those systems needed to carry out necessary control, monitoring and power distribution functions, and are to be in accordance with Section 4 of API RP 14F.

15.5 Area Classifications and Electrical Installations on Vessel Conversions

15.5.1 General

Electrical installations and delineation of classified areas for offshore installations having storage tanks for liquids with a flash point not exceeding 60°C (140°F), and that are integral with the hull structure, need not comply with Classification Rules with regard to the hull classification, provided they comply with applicable requirements as follows:

15.5.2 Area Classification

Delineation of classified areas is to be as follows:

15.5.2(a) 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 2.4m (8ft.), or to the height of the production deck, are to be considered Class I, Division 2 areas (Zone 2).

15.5.2(b) 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).

15.5.2(c) 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.

15.5.2(d) 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.

15.5.2(e) 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).

15.5.3 Electrical Interconnections

Where marine service systems are interconnected with hydrocarbon production systems, a point in the system 2.4 m (8 ft) above the oil storage tank deck, is to be designated as an electrical system design code demarcation point. Above this point, electrical system design is to be in accordance with this section; below this point, in accordance with applicable sections of the *Steel Vessel Rules* or *MODU Rules*.

15.7 Wiring Methods in Hazardous Areas

15.7.1 General

Threaded metal conduit, armored cable, metallic sheathed cable, or other approved methods or cable types, may be installed in Class I, Division 1 (Zone 1) areas. Cables with moisture resistant jacket (impervious sheathed) may be installed in Class I, Division 2 (Zone 2) areas, provided they are protected from mechanical damage.

15.7.2. Splicing

No splices are allowed in classified locations, except in intrinsically safe circuits.

15.7.3 Conduit Installations

Conduit wiring systems in classified areas are to be in accordance with the recommendations of API RP 14F Section 6.4.

17 Ventilation

17.1 General

Attention is to be given to ventilation inlet and outlet locations and air flow directions in order to minimize the possibility of cross contamination. Ventilation inlets are to be located in non-classified areas. Ventilation for classified spaces is to be completely separate from that for non-classified spaces. For engine and turbine air intakes, see 3-4/3.9.

17.3 Ventilation of Enclosed Classified Spaces

Ventilation of enclosed classified spaces is to be made with under-pressure in relation to adjacent, less hazardous areas. The arrangement of ventilation inlet and outlet openings for the enclosed classified space is to be such that the entire space is efficiently ventilated, giving special considerations to locations of equipment which may release gas, and to spaces where gas may accumulate. Ventilation inlets are to be from non-classified areas. Ventilation outlets are to be led to outdoor locations that are of the same or a less hazardous classification than the ventilated space.

Ventilating fans are to be of non-sparking construction. The capacity of the fan is to be such that the space is adequately ventilated, as defined by API RP 500.

17.5 Ventilation of Non-classified Spaces

Ventilation inlets and outlets for non-classified spaces are to be located in non-classified areas. Where passing through classified spaces, ducts are to have overpressure in relation to the classified spaces. Enclosed non-hazardous working spaces opening into hazardous locations do not need to be considered hazardous, provided the arrangements required by Part 4 Section 1.7.3 of the *MODU Rules* (6.3.1 of the 1989 IMO MODU Code) or NFPA 496 or IEC 60079-2, are complied with.

17.7 Emergency Shutdown

Means are to be provided for shutdown of ventilation fans and closing external openings from outside the spaces served, in the event of fire or detection of combustible or hydrogen or sulfide gas.

19 Cable Support and Installation

The cable installation is to be in accordance with the "standard details" submitted in accordance with 3-2/11.15 of this Guide.

19.1 Mechanical Protection

For cables which are not equipped with metal armor or metal sheathing, installation in rigid conduit or similar structural protection is to be utilized if such cable is employed near walkways, at deck level, near hoist or crane laydown or work areas, or where equipment maintenance work must be accomplished in a constrained area.

19.3 Splicing

19.3.1 General

In general, electrical cables are to be installed in continuous lengths between terminations. However, approved splices will be permitted for cables of exceptional length, to facilitate their installation. The location and particulars of the splices are to be submitted for review.

19.3.2 Construction

Cable splice is to be made of fire-resistant replacement insulation equivalent in electrical and thermal properties to the original insulation. The replacement jacket is to be at least equivalent to the original impervious sheath, and is to assure a watertight splice. Splices are to be made with an approved splice procedure addressing the following components:

i) Connector of correct size and number

ii) Replacement insulation

iii) Replacement jacket

iv) Instructions for use

19.3.3 Hazardous Areas

See 3-6/15.

21 Power Source Requirements

This section details minimum electrical power generation sources for main and emergency modes of operation. It should be noted that the governmental regulations might require reserve main power or an emergency power source in excess of these requirements. Where the main power source is used to supply services other than oil or gas production, the main power source is to comply with subsection 4-8-2/3 of the *Steel Vessel Rules*. Where the Flag Administration permits, the minimum number of required main power sources may be reduced to one.

21.1 Unmanned Facilities

21.1.1 Main Power

The main power source(s) is to be sufficient to maintain the maximum intended operational loads of the facility, without need to use the emergency source of power.

21.1.2. Emergency Power

An emergency power source, independent of the facility's main power, is to be sufficient to supply services for navigational aids as required by the cognizant Coastal Authority, but not for less than four (4) days.

21.3 Manned Facilities

21.3.1 Main Power

The main power source(s) is to be sufficient to maintain the maximum intended operational load of the facility.

21.3.2 Emergency Power

An emergency source of power for systems vital to safety, fire fighting, and protection of personnel, is to be provided to supply the services as listed herein. Where an emergency power supply has been provided for classification/flag state purposes, this source may also be used to provide emergency loads in production areas, provided the emergency source of power is adequately sized to supply all of the connected loads. Provision for emergency power supply, less than those listed herein, will be considered, provided adequate technical justification is submitted. Loads to be supplied by the emergency source of power are listed in 3-6/21.3.3 and 3-6/2.1.3.4 below.

21.3.3 Fire Pump

If both fire pumps required by 3-8/5.1.2 of this Guide are electric motor driven, one of these pumps is to be powered by the emergency source of power. The emergency source of power is to have sufficient fuel for at least 18 hours of fire pump operation.

21.3.4. Other Loads

The following loads are to be powered by the designated emergency source of power:

i)	Fire detection	18 hours
ii)	Gas detection	18 hours
iii)	Communication	18 hours
iv)	ESD system (if electric)	18 hours
v)	Paging and alarm system	18 hours
vi)	Emergency lighting from all spaces to all alternative egress points	18 hours
vii)	Electric blowout preventer control system	18 hours
viii)	Navigational aids	As required by the applicable Coastal Authority, but not less than 4 days

23 Emergency Source of Power

An emergency source of power as required by 3-6/21 may be supplied by an emergency generator or batteries, in accordance with section 5.6 of API 14F. Installations supplying services other than oil or gas production are to be in accordance with Part 4-8-2/5.9 through 4-8-2/5.15 of the *Steel Vessel Rules*.

25 Battery Systems

Battery installations are to comply with Section 10.3.4 of API RP 14F, except that equipment inside a battery room need to be certified for use in Division 1 or Division 2 only if the battery room is classified Division 1 or 2, respectively, in accordance with API RP 500. Ventilation of battery rooms is to be separate from all other ventilation. Arrangements of equivalent safety will be given special consideration.

27 Short Circuit Current Calculations and Coordination Study

27.1 General

The protection and coordination of power systems are to be in accordance with the *Steel Vessel Rules*, *MODU Rules*, IEC, IEEE 242, or equivalent standard.

27.3 Short Circuit Capacity

The maximum calculated short circuit current available at the main bus bars and at each point in the distribution system, is to be used to determine the adequacy of the short circuit capacities of the protective devices and bus bar bracing, as per 3-6/11.3.2(b).

27.5 Coordination

The power system coordination study is to show that the protective devices and their settings are properly selected to minimize damage to switchgear, transformers, generators, motors, conductors, conductor shielding and other equipment, as well as undesirable shutdowns.

29 Protection from Ignition by Static Charges

Any ignition hazard due to a difference in electrical potential to ground is to be effectively controlled. This may require the use of conductive belts, grounding of combustible fluid loading or discharge equipment and hose, and the grounding of helicopters prior to refueling.

All precautions against ignition due to static electric discharge are to be in accordance with NFPA-77, or other suitable standard.

TABLE 1a
Degree of Protection
(Indicated by the First Characteristic Numeral)

Degree of Protection		
First Characteristic Numeral	*Short Description*	*Definition*
0	Non-protected	No special protection
1	Protected against solid objects greater than 50 mm (2 in.)	A large surface of the body, such as a hand (but no protection against deliberate access). Solid object exceeding 50 mm (2 in.) in diameter.
2	Protected against solid objects greater than 12 mm (0.5 in.)	Fingers or similar objects not exceeding 80 mm (3.15 in) in length. Solid objects exceeding 12 mm (0.5 in.) in diameter.
3	Protected against solid objects greater than 2.5 mm (0.1 in.)	Tools, wires, etc. of diameter or thickness greater than 2.5 mm (0.1 in). Solid objects exceeding 2.5 mm (0.1 in.) in diameter.
4	Protected against solid objects greater than 1 mm (0.04 in.)	Wires or strips of thickness greater than 1 mm (0.04 in.). Solid objects exceeding1 mm (0.04 in.) in diameter.
5	Dust protected	Ingress of dust is not totally prevented, but dust does not enter in sufficient quantity to interfere with satisfactory operation of the equipment.
6	Dust-tight	No ingress of dust

Designation

The degree of protection is designated as shown in the following examples:

When it is required to indicate the degree of protection by only one characteristic numeral, which shows either degree of protection against foreign bodies and electrical shock or against liquid, the omitted numeral is to be replaced by the letter X.

Examples

1	IP56	The first characteristic numeral of “5”
2		The second characteristic numeral of “6”
3	IPX5	Degree of protection against only liquid
4	IP2X	Degree of protection against only foreign bodies and electrical shock

TABLE 1b
Degree of Protection
(Indicated by the Second Characteristic Numeral)

Degree of Protection		
Second Characteristic Numeral	*Short Description*	*Definition*
0	Non-protected	No special protection
1	Protected against dripping water	Dripping water (vertically falling drops) is to have no harmful effect.
2	Protected against dripping water when tilted up to 15 degrees	Vertically dripping water is to have no harmful effect when the enclosure is tilted at any angle up to 15 degrees from its normal position.
3	Protected against spraying water	Water falling as spray at an angle up to 60 degrees from the vertical is to have no harmful effect.
4	Protected against splashing water	Water splashed against the enclosure from any direction is to have no harmful effect.
5	Protected against water jets	Water projected by a nozzle against the enclosure from any direction is to have no harmful effect.
6	Protected against heavy seas	Water from heavy seas, or water projected in powerful jets, is not to enter the enclosure in harmful quantities.
7	Protected against the effects of immersion	Ingress of water in a harmful quantity is not to be possible when the enclosure is immersed in water under defined conditions of pressure and time.
8	Protected against submersion	The equipment is suitable for continuous submersion in water, under conditions that are to be specified by the manufacturer. Note. – Normally this will mean that the equipment is hermetically sealed. However, with certain types of equipment, it can mean that water can enter but only in such a manner that it produces no harmful effects.

See Designation and examples in 3-6/Table 1 “First characteristic numeral”.

TABLE 1c
NEMA Enclosures

NEMA Type No.	*Type of Enclosure*	*Characteristics*	*Intended Use*	*Typical Offshore Applications*
1	General Purpose, Surface Mounting	A general-purpose (NEMA Type 1) enclosure is designed to meet the latest general specifications for enclosures of Underwriters' Laboratories. This enclosure is intended primarily to prevent accidental contact with enclosed electrical apparatus. A NEMA Type 1 enclosure is suitable for general-purpose application indoors where atmospheric conditions are normal. It is not dust-tight or watertight.	To prevent accidental contact with live parts, indoors, where normal atmospheric conditions prevail.	Lighting panels, motor control centers, disconnect switches, etc., in unclassified locations inside buildings.
1-A	Semi-Dust-tight	A semi-dust-tight enclosure (NEMA type 1-A) is similar to the Type 1 enclosure, but with addition of a gasket around the cover. A NEMA Type 1-A enclosure is suitable for general-purpose application indoors and provides additional protection against dust, although it is not dust-tight.	Same as NEMA Type 1, but in locations where a small amount of dust is prevalent.	Same as NEMA Type 1.
1-B	General Purpose, Flush Mounting	A flush-type enclosure (NEMA Type 1.B) is similar to the Type 1 enclosure, but is designed for mounting in a wall and is provided with a cover that also serves as a flush plate.	Same as NEMA Type 1, but for flush-type mounting applications	Same as NEMA Type 1 where flush (versus surface) mounting is desired.
2	Drip-tight	A drip-tight enclosure (NEMA Type 2), also referred to as "Drip-proof", is similar to the Type 1 general-purpose enclosure, but with the addition of drip shields or their equivalent. A Type 2 enclosure is suitable for application where condensation may be severe. Note: Drip-tight apparatus may be semi-enclosed apparatus if it is provided with suitable protection integral with the apparatus, or enclosed in such a manner as to exclude effectively falling solid or liquid material.	Locations where condensation may be severe.	No typical offshore applications
3	Weather-tight	A weather-tight enclosure (NEMA Type 3) is designed for use outdoors to provide protection against weather hazards such as rain and sleet. A NEMA Type 3 enclosure is suitable for application outdoors.	Outdoors where it is necessary to provide protection against weather hazards, such as rain and sleet.	Refer to NEMA Type 12 applications
3R	Weather-resistant	A weather-resistant enclosure (NEMA Type 3R) is designed for use outdoors to provide protection against rain. Rain will not readily interfere with operation of internal components. NEMA Type 3R provides less protection than Type 3.	Same as NEMA Type 3, but in less severe application	Same as NEMA Type 3.
4	Watertight	A watertight enclosure (NEMA Type 4) is designed for outdoor use and is required to meet the hose test as follows: NEMA Type 4 Enclosures shall be tested by subjection to a stream of water. A hose with a 1-in. nozzle shall be used and shall deliver at least 65 gal/min. The water shall be directed on the enclosure from a distance of not less than 10ft and for a 5-minute period. During this period, it may be directed in one or more directions as desired. There shall be no leakage of water into the enclosure under these conditions.	Outdoor or indoor locations where enclosed equipment might be subjected to splashing or dripping water. Not suitable for submersion in water.	Equipment enclosures and junction boxes subject to wind-driven rain or hose wash-down.
4X	Watertight	A watertight corrosion-resistant (NEMA Type 4X) enclosure is similar to Type 4 enclosure but is manufactured from corrosion-resistant materials, such as glass polyester or stainless steel.	Same as NEMA Type 4, but designed for a more corrosive environment.	Same as NEMA Type 4.

TABLE 1c (continued)
NEMA Enclosures

NEMA Type No.	*Type of Enclosure*	*Characteristics*	*Intended Use*	*Typical Offshore Applications*
5	Dust-tight	A dust-tight (NEMA Type 5) enclosure is provided with gaskets and is suitable for application in locations where it is desirable to exclude dirt.	In locations where it is necessary to protect the enclosed equipment against injurious accumulation of dust or lint.	No typical offshore applications.
6, 6P	Submersible	A submersible enclosure is suitable for applications where the equipment may be subject to occasional temporary submersion (NEMA Type 6) and prolonged submersion (NEMA Type 6P) in water. The design of the enclosure will depend upon the specified conditions of pressure and time.	Locations where the equipment is subject to submersion in water.	Junction boxes installed in the splash zone.
7	Explosion proof, Class 1	An explosion proof enclosure (NEMA Type 7) is designed to meet the application requirements in NEC Art. 500 for Class I locations and is designed in accordance with the latest specifications of Underwriters' laboratories for particular groups of gases. Certain NEMA 7 enclosures are approved for several groups (such as Groups B, C, and D). NEMA 7 enclosures are not necessarily suitable for outdoor use.	Locations classified as Class I, Division 1 or 2 hazardous locations.	Widely used in classified locations when arcing or high temperature devices are utilised.
8		Explosion, oil-filled, Class I. An explosion proof, oil-filled enclosure (NEMA Type 8) is designed to meet the application requirements in NEC Art. 500 for Class I locations and is designed in accordance with the latest specifications of Underwriters' laboratories for specific gases. The apparatus is immersed in oil.	Same as NEMA Type 7	Not widely utilized offshore, but suitable for same areas as NEMA Type.7.
9	Dust-ignition Proof, Class II	A dust-ignition-proof enclosure (NEMA Type 9) is designed to meet the application requirements in NEC Art. 500 for Class II locations and is designed in accordance with the latest specifications of Underwriters' Laboratories for particular dusts.	Locations classified as Class II hazardous locations (containing combustible dust).	No typical offshore applications.
10		A Type 10 enclosure is designed to meet the latest requirements of the Bureau of Mines and is suitable for applications in coal mines.	Locations required to meet the latest requirements of the Bureau of Mines.	No typical offshore applications.
11	Acid-and fume resistant, oil-immersed	An acid-and fume-resistant (NEMA Type 11) enclosure is suitable for applications indoors where the equipment may be subject to corrosive acid or fumes. The apparatus is immersed in oil.	Locations where acid or fumes are present.	No typical offshore applications.
12	Dust-tight and Drip-tight	A dust-tight and drip-tight (NEMA Type 12) enclosure is provided with an oil-resistant synthetic gasket between the case and the cover. To avoid loss, any fastener parts are held in place when the door is opened. There are no holes through the enclosures for mounting or for mounting controls within the enclosure and no conduit knockouts or conduit openings. Mounting feet or other suitable means for mounting are provided. A NEMA Type 12 enclosure is suitable for industrial application in locations where oil or coolant might enter the enclosure. NEMA Type 12 enclosures are not suitable for outdoor use, but may be modified to meet Type 3 requirements with the addition of a drip shield. Enclosures carrying a NEMA 3.12 rating area superior to those carrying only a NEMA 3 rating.	Indoor locations where oil or coolant might enter the enclosure.	Indoors in areas protected from the environment, or outdoors when modified, to meet NEMA Type 3 requirements.

NEMA Type No.	*Type of Enclosure*	*Characteristics*	*Intended Use*	*Typical Offshore Applications*
13	Oil-tight and Dust-tight	An oil-tight and dust-tight (NEMA 13) enclosure is intended for use indoors primarily to house pilot devices such as limit switches, push buttons, selector switches pilot, lights, etc., and to protect these devices against lint and dust, seepage, external condensation, and spraying of water, oil or coolant. They have oil-resistant gaskets and, when intended for mounting on the wall or on machines, have mounting means external to the equipment cavity. They have no conduit knockouts or unsealed openings providing access into the equipment cavity. All conduit openings have provision for oil-tight conduit entry.	Indoor locations where spraying oil or coolant might enter the enclosure.	Indoors in areas protected from the environment for control panels.

TABLE 2
Size of Ground (Earth)-continuity Conductors and Grounding (Earthing) Connections

Type of Grounding Connection		*Cross-sectional Area of Associated Current Carrying Conductor (A)*	*Minimum cross-sectional Area of Copper Grounding Connection*
Ground-continuity conductor in flexible cable or flexible cord	A1	$A \le 16$ mm^2	A
	A2	16 mm^2 $< A \le 32$ mm^2	16 mm^2
	A3	$A > 32$ mm^2	A/2
Ground-continuity conductor incorporated in fixed cable	*For cables having an insulated ground-continuity conductor*		
	B1a	$A \le 1.5$ mm^2	1.5 mm^2
	B1b	1.5 mm^2 $< A \le 16$ mm^2	A
	B1c	16 mm^2 $< A \le 32$ mm^2	16 mm^2
	B1d	$A > 32$ mm^2	A/2
	For cables with bare ground wire in direct contact with the lead sheath		
	B2	$A \le 2.5$ mm^2	1 mm^2
	B2b	2.5 mm^2 $< A \le 6$ mm^2	1.5 mm^2
Separate fixed grounding conductor	C1a	$A \le 2.5$ mm^2	Stranded grounding connection: 1.5 mm^2 $< A \le 1.5$ mm^2 A for $A > 1.5$ mm^2
	C1b		Unstranded grounding connection: 2.5 mm^2
	C2	2.5 mm^2 $< A \le 8$ mm^2	4 mm^2
	C3	8 mm^2 $< A \le 120$ mm^2	A/2
	C4	$A > 120$ mm^2	70 mm^2 (See note 1)

NOTE:

For grounded distribution systems, the size of grounding conductor need not exceed A/2.

Conversion Table for mm^2 to circular mils:

mm^2	*Circ. mils*		*mm^2*	*Circ. mils*		*mm^2*	*Circ. mils*		*mm^2*	*Circ. mils*
1	1,973		2.5	4,933		6	11,841		70	138,147
1.5	2,960		4	7,894		16	31,576		120	236,823

TABLE 3
Clearance and Creepage Distance for Switchboards, Distribution Boards, Chargers, Motor Control Centers and Controllers [1]

Rate Insulation Voltage (V)	*Minimum Clearances, mm (in.)*	*Minimum Creepage Distances, mm (in.)*
Up to 250	15 ($^{19}/_{32}$)	20 ($^{25}/_{32}$)
From 251 to 660	20 ($^{25}/_{32}$)	30 (1$^{3}/_{16}$)
Above 660[2]	25 (1)	35 (1$^{3}/_{8}$)

NOTES:

1 The values in this table apply to clearances and creepage distances between live parts as well as between live parts and exposed conductive parts, including grounding.

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CHAPTER 3 Floating Installations

SECTION 7 Instrumentation & Control Systems

1 Applicability

This section defines criteria for the instrumentation and control systems for offshore facilities. The design of these systems is to comply with API RPI4C or other acceptable standards and the additional criteria contained in this section. Statutory governmental regulation or guidance, which may be applicable, is to be taken into consideration. The documentation pertaining to instrumentation and control systems required for submittal is listed in 3-2/13.

1.1 General

The control and instrumentation systems are to provide an effective means for monitoring and controlling pressures, temperatures, flow rates, liquid levels and other process variables for the safe and continuous operation of the facilities. Where control over the electrical power generation and distribution is required for the operation of the facilities then the control system should also be arranged to cover this. Control and instrumentation systems for process, process support, utility and electrical systems are to be suitable for the intended application All control and safety shutdown, systems are to be designed for safe operation of the equipment during start-up, shutdown and normal operational conditions.

It is the intention of this section to identify systems (either through experience or the application of the FMEAs) on which safety relies and then to incorporate requirements commensurate with this the importance of that function. The technical requirements included are considered to be consistent and complimentary to the associated API standards. Should the designer wish to apply other techniques e.g. the Safety Integrity Levels (SILs) incorporated in IEC 61508 this equivalent approach will be considered.

1.3 Installation

1.3.1 Electrical Installations

Electrical installations for instrumentation and control systems are to be in accordance with Chapter 3, Section 6 and Chapter 4, Section 6 as applicable.

1.3.2 Hydraulic and Pneumatic Control Systems

Piping systems for hydraulic and pneumatic controls are to be in accordance with 3-4/5.13 and Chapter 4, Section 4 as applicable.

3 Components

3.1 Environmental Considerations

All instrumentation control and safety system components, including alarm and indicator devices, are to be designed for use in a marine environment, resistant to corrosion, and capable of operating under all prevailing environmental conditions. Each component is to be designed and tested for the extremes of pressure and temperature that it can encounter in service.

3.3 Suitability of Computer Based Equipment

Where safety related functions are performed by computer based equipment then the equipment is to be tested in accordance with the requirements of 4-9-13/1 of the *Steel Vessel Rules*.

3.5 Electrical Variations

Electrical and electronic components in AC systems are to be capable of operating satisfactorily under normally occurring variations in voltage and frequency. Unless otherwise stated, the variations from the rated value may be taken from 3-7/Table 1. DC system devices are to be capable of operating satisfactorily at minus 15% voltage.

TABLE 1
Electrical Variations

Quantity in Operations	*Permanent variation*	*Transient Variation*
Frequency	±5%	±10% (5s)
Voltage	+6%, -10%	±20% (1.5s)

3.7 Loss of Power

Loss of control power (pneumatic, hydraulic or electric) to any device is not to cause the system to go into an unsafe condition. Cause and effect matrices are to demonstrate loss of control power effects.

5 Instruments

5.1 Temperature

All temperature-sensing elements or devices are to be installed in separable socket type thermowells, so that they can be removed without danger of pressure or fluid release.

5.3 Pressure

Pressure switches supplied as safety devices are to be equipped with test connections to enable application of an external pressure source without disturbing the switch installation. Pressure gauges and sensors are to be provided with an isolation valve to permit the safe removal of the gauge without the need to reduce the pressure in the system. The open or closed position of the valve is to be readily identifiable from the position of the handle or stem.

5.5 Level

Liquid or interface level gauges are to be installed to cover the operating range and set points of level controllers or level switches.

Direct viewing level gauges in processing or combustible fluid service are to be of the heavy-duty flat glass type and are to be equipped with self-closing valves at their ends. An equivalent type of level gauge may also be acceptable.

7 Alarm Systems

7.1 Characteristics

Alarm systems are to be of the self-monitoring type and designed so that a fault in the alarm system is self-revealing or will cause it to fail to the alarmed condition. Additionally, alarms are not to react to normal transient conditions or false signals.

7.3 Independence

Alarm systems are to be independent of control and safety systems, except that common sensors will be acceptable for non-shutdown related systems.

7.5 Visual and Audible Alarms

Alarms are to be both audible and visual, and are to be provided at the control stations, as required in this Section. Alarms are to clearly identify the system and service of the faulted system or process components. Visual alarms are to be displayed in a distinguishable manner such that alarms for similar process components or systems are grouped together, and the colors representing a particular function or condition remain uniform. Visual alarms are to flash when first activated. Audible alarms associated with the process plant are to be of distinctive tone from other alarms such as fire alarm, general alarm, gas detection, etc., and they are to be of sufficient loudness to attract the attention of personnel on duty; for spaces of unusual high noise levels, a beacon light or similar device, installed in a conspicuous place is to supplement any of the audible alarms in such spaces; however, red light beacons are only to be used for fire alarms.

A fault in the visual alarm circuits is not to affect the operation of the audible alarm circuits. For computer-based systems, see 3-7/15.

7.7 Acknowledgement of Alarms

Alarms are to be acknowledged by manually changing the flashing display of the incoming alarm to a steady display and by silencing the audible signal; the steady state light display is to remain activated until the fault condition is rectified. Alarming of other faults that may occur during the acknowledgement process is not to be suppressed by such action, and is to be alarmed and displayed accordingly. Where a centralized control and monitoring station is provided, the silencing of the audible alarm from an associated remote control station is not to lead automatically to the silencing of the original alarm at the centralized control and monitoring station.

7.9 Disconnection and Resumption of Alarm Functions

Alarm circuits may be temporarily disabled for maintenance purposes or during initial plant start-up, provided such action is clearly indicated at the associated station in control and, where such station is provided, at the centralized control and monitoring station. However, such alarm is to be automatically re-activated after a preset time period.

7.11 Summary Alarms

When individual alarms are displayed and alarmed at a centralized control and monitoring station, the visual alarms may be displayed and alarmed at other associated remote control stations as summary alarms.

7.13 Built-in Testing

Alarm systems are to be provided with effective means for testing all audible and visual alarms and indicating lamps without disrupting the normal machinery or system operation. Such means are to be fitted in the associated remote stations.

7.15 Adjustable Set-points

Where means are provided to field adjustable set-points, either locally or remotely, positive indication of the value of the set-point is to be clearly identified at the control location.

9 Control and Monitoring

9.1 General

Display systems are to comply with 3-7/7.1, 3-7/7.5, 3-7/7.13 and 3-7/7.15

9.3 Loss of Signal

Loss of control signal from a field sensing device required to comply with this Guide is to initiate an alarm or cause a shutdown.

9.5 Display of Parameters

Operating parameter displays are to be clear, concise, consistent and grouped logically. Operating parameter displays are to be included in control stations as required in this Section.

(Note: Further guidance regarding the display of information may be found in the ABS *Guidance Notes on the Application of Ergonomics to Marine Environments*)

9.7 Logic Circuit Features

When logic circuits are used for sequential start-up or for operating individual process 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 process component. If some particular step is not carried out during the sequence, the sequence is to stop at this point, and such condition is to be alarmed at the control console or, where provided, at the centralized control and monitoring station.

Feedback devices are to be employed in order to sense steps carried out during the start-up sequence. Sequence operation is to stop upon lack of feedback signal.

Where valves are employed in any start-up sequence, valve condition is to be sensed as valve stem position and not as a function of control or power signal to the valve.

9.9 Overrides

No condition of operation within normal ranges is to require the override of a required protective device or function. Where shutdown functions are bypassed during special operational modes described below, sensing devices are to be arranged to continue to indicate the condition of each process variable. In addition, an indicator for each function is to alert the operator that the shutdown function is being "bypassed". Provisions to override shutdown functions may include the following:

9.9.1 Calibration

To periodically test or calibrate field sensing device.

9.9.2 Out of Service

To take the vessel or other process component out of service.

9.9.3 Start-up

To allow process conditions to stabilize, automatic bypass of shutdown functions on start-up may be installed, provided the process variable condition is indicated, and an automated device is fitted which will return the shutdown function to operation once the normal process condition has been attained. The use of timers in association with this required automatic function will be considered.

11 Safety Systems

11.1 General

Safety systems are to be of the fail-safe type and are to respond automatically to fault conditions that may endanger the plant or safety of the crew. Unless otherwise required in this Section or specially approved, this automatic action is to cause the plant to take the least drastic action first, as appropriate, by reducing its normal operating output or switching to a stand-by process component, and last, by stopping it. Actuation is to result in audible and visual alarm.

(See also 3-3/7.3 for number of safety levels required)

11.3 Independence

Safety systems are to be completely independent of the control and alarm systems so that a failure in one of these systems will not prevent the safety system from operating.

11.5 Activation

Each safety action is to be alarmed at the associated remote station. Where a centralized control and monitoring station is fitted, individual alarms are to be provided at that station; in which case, a summary alarm for the specific safety system will be acceptable at other associated remote stations. When both an alarm and a safety action are required for a specific failure condition the operating points are to be arranged such that alarm is activated earlier.

11.7 Resumption of Operation

Process components that are stopped as a result of a safety action are to be manually reset before their operation is resumed.

11.9 Override of Safety Provisions

Remote overrides are not to be provided for those safety actions specified in other Sections of this Guide. For safety actions specified in 3-7/9.9, any overrides of safety provisions are to be so arranged that they cannot go unnoticed, and their activation and condition are to be alarmed and indicated at the associated remote station.

The override is to be arranged to preclude inadvertent operation and is not to deactivate alarms associated with safety provisions. The override mechanism to disconnect safety provisions is to be fitted at the associated remote station, except that where a centralized control and monitoring station is fitted, the override mechanism may be fitted at the centralized station instead.

11.11 Adjustable Set-points

Where means are provided to the field adjustable set points, either locally or remotely, positive indication of the value of the set point is to be clearly identified at the control location.

13 Shutdown Systems

13.1 General

Shutdown systems are to comply with the requirements of safety systems given in 3-7/11, except that systems supplied in accordance with 3-8/5.11 or 4-8/5.9, as applicable, are not to be automatically actuated and need not be fail safe. Additionally, computer-based systems are to comply with the requirements of 3-7/15.

13.3 Safety Analysis

Where alarm and shutdown functions are required, a Safety Analysis Function Evaluation (SAFE) Chart is to be provided for equipment packages with their own control/shutdown panels, as well as for individual process components protected by a common safety shutdown system.

13.5 Emergency Shutdown

13.5.1 General

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

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

13.5.2 Emergency Shutdown – Automatic

See 3-3/7.3.

13.5.3 Emergency Shutdown – Manual

See 3-3/9.

All electrical circuits used in the manual ESD system are to be dedicated to this purpose and hard wired.

15 Computer-based Systems for Alarm, Control and Safety Systems

15.1 General

Computer-based systems are to be designed so that failure of any of the system's process components will not cause unsafe operation of the system. Hardware and software serving vital and non-vital systems are to be arranged to give priority to vital systems.

15.3 Independence

Control, alarm and safety shutdown system functions are to be arranged such that a single failure or malfunction of the electronic computer equipment will not affect more than one of these system functions. This is to be achieved by dedicated equipment for each of these functions within a single system, or by the provision of back-up equipment, or by other suitable means considered equal or more effective.

15.5 Failure Mode and Effect Analysis (FMEA)

Where computer-based systems include safety functions (i.e.. safety functions are not backed-up by hard-wired safety systems) an FMEA is to be performed and submitted for review.

15.7 Visual Display of Alarms

15.7.1 Incoming Signals

In addition to the requirements contained in 3-7/7, alarms are to be presented in an identifiable manner when displayed by way of a computer monitor (video display unit), and are to appear in the sequence the incoming signals are received. Alarming of incoming fault signals are to automatically appear on the screen to alert the on-duty personnel, regardless of whether the computer and monitor (video display unit) are in a mode other than the monitoring mode, i.e., computing or displaying other system's mimic or schematic diagrams.

15.7.2 Unrectified Alarms

Alarms associated with faults which have not been rectified may be displayed in a summarized fashion until all the faults have been dealt with.

15.7.3 Computer Monitor (Video Display Unit)

Displays on the computer monitor (video display unit) are to be clearly visible under ambient lighting conditions. Data displayed on computer monitors are to be readable by the operator from normal operating position.

15.9 Memory Capacity and Response Time

Computer system's memory is to be of sufficient capacity to handle the operation of all computer programs (software) as configured in the computer system. The time response for processing and transmitting data is to be such that an undesirable chain of events may not arise as a result of unacceptable data delay or response time during the computer system's worst data overload operating condition (multi-tasking mode).

15.11 Data Loss and Corruption

To preclude the possible loss or corruption of data as a result of power disruption, programs and data considered to be essential to the operation of a specific system are to be stored in non-volatile memory, or in volatile memory with a secure un-interruptible power supply (UPS).

15.13 Local Area Network (LAN)

For safety systems where an automatic or remote control and monitoring system for specific process components is arranged to operate in a local area network (LAN), the following is to be complied with:

i) The network topology is to be configured so that in the case of a failure between nodes, or at a node, the system on the network remains operational.

ii) In case of failure of the network controller, the network is to be arranged to automatically switch to a standby controller. A network controller failure is to be alarmed at the associated remote control station.

iii) Safeguards are to be provided to prevent unacceptable data transmission delays (overloading of network). An alarm is to be activated at the associated remote control stations prior to a critical network data overload condition. See 3-7/15.9.

iv) The communication data highway is to be provided in duplicate and is to be arranged so that upon failure of the on-line highway, the standby data highway is automatically connected to the system. The standby data highway is not to be used to reduce traffic in the on-line highway.

15.15 Power Supply Disruption

The system's software and hardware is to be designed so that upon restoration of power supply after power failure, automatic or remote control and monitoring capabilities can immediately be available after the pre-established computer control access (sign-in) procedure has been completed.

15.17 Parameters and Program Changes

Alteration of parameters that may affect the system's performance is to be limited to authorized personnel by means of keyswitch, keycard, password, or other approved methods.

15.19 Multiple Points of Control

Systems with multiple control stations are to be provided with clear indication at each location to identify the station in control, and are to be provided with procedures to ensure proper transfer of control.

17 Relief Valves

17.1 General

Where spare relief valves are provided, the upstream block valve is to be locked closed and the downstream block valve is to be locked open to prevent the relief valve from being over-pressurized due to the leakage of the upstream block valve. The practice of using check valves in lieu of downstream block valves is not permitted. The upstream block valve is to have a full bore area equal to or greater than the pressure relief valve inlet. Similarly, the downstream block valve is to have a full bore area equal to or greater than the pressure relief valve outlet.

17.3 Provisions for Testing

Provision is to be made for periodic testing of each relief valve without removing it from the line or vessel. Where necessary, relief valves are to be individually equipped with an inlet block or check valve and test connection so that an external pressure source can be applied.

17.5 Block Valve Locking Devices

Any block valve upstream or downstream of a relief valve or rupture disc is to be equipped with a carseal or locking device to prevent the relief valve from being isolated while in service.

19 Shutdown Valves, Blowdown Valves and Diverter Valves

Automatically actuated shutdown, blowdown or diverter valves are to be equipped with position indicators at the valve operating station, or be of a type that valve position (open or closed) is externally obvious.

CHAPTER 3 Floating Installations

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CHAPTER 3 Floating Installations

SECTION 8 Fire Protection and Personnel Safety

1 General

1.1 Scope

The fire protection and personnel safety features are to comply with this section and other applicable industrial standards, as referenced herein. Due to the varying configurations of offshore production facilities, fire protection requirements will vary accordingly. The documentation requirements for Design Review are given in 3-2/15 of this Guide.

1.3 Governmental Authority

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

3 Applicability

Fire protection and personnel safety features for hydrocarbon processing systems on a floating installation are to meet the requirements described in this Chapter. Fire protection systems for vessel service functions on installations are to be in accordance with the *Steel Vessel Rules* or *MODU Rules*, as applicable.

5 Fire Fighting Systems

5.1 Firewater Systems

Fixed water fire fighting systems are to be provided as follows:

5.1.1 Piping

5.1.1(a) General Water fire fighting systems are to be capable of maintaining a continuous supply in the event of damage to water piping. Piping is to be arranged so that the supply of water could be from two different sources. Isolation valves are to be provided such that damage to any part of the system would result in the loss in use of the least possible number of hydrants, water spray branches, or foam water supplies. In most facility arrangements, this will require a loop type fire main. Connections of the primary and standby pump supplies are to be as remote from each other as possible.

5.1.1(b) Materials Materials rendered ineffective by heat are not to be used in firewater piping systems. Resilient seated valves may be considered for use in firewater systems, provided the proposed valves are capable of passing an appropriate fire test acceptable to ABS (e.g., UK/DOT Appendix D "Fire Test Requirements to Fire Mains and Fittings"). Additionally, the valves must be capable of being effectively closed even with the resilient seat damaged or destroyed, such that leakage through the closed valve is insignificant. The leakage rate at the firewater pressure through the closed damaged-seated valves still permits the firewater to deliver at least two jets of water at the required pressure.

Similarly, non-metallic expansion joints and flexible hoses may be considered for use in firewater systems, provided the proposed joints are capable of passing a recognized fire test such as the UK/DOT Appendix D. See Appendix 2 of the Guide for details.

All plastic piping materials are to meet Appendix 1 of this Guide. Generally, plastic (GRP/FRP) materials used in firewater systems are to pass Level 1 fire endurance test. However, a plastic piping material that passes Level 3 fire endurance requirements in lieu of Level 1 requirements may be considered when conditions listed in 3-8/5.1.1(e) below are fully met and accepted by the Flag Administration.

*5.1.1(*c) *Charging* The firewater distribution system may be maintained in a charged or dry condition. Where a system is maintained dry, relief devices and additional pipe bracing is to be considered to prevent damage to the piping system due to water hammer when the system is charged. When plastic pipe that passes only Level 3 fire endurance test is used, the firewater system design is to be pressurized (wet main) or be permanently in a charged condition.

5.1.1(d) Piping Maintenance The distribution system is to be maintained such that internal and external corrosion of the piping is minimized. In areas where the system is subject to freezing, steps are to be taken to prevent freezing. For instance, drains, circulation loops or other means may be provided for cold water protection. If drains are provided, they are to be located at the lowest points in the system.

5.1.1(e) Additional System Requirements for Level 3 Plastic Pipe The following additional requirements are applicable to the plastic material piping that passes Level 3 in lieu of Level 1 fire endurance tests and is used in the fire main system:

i) Plastic piping must be located on the exterior perimeter of the vessels/units and shielded by primary structural members from potential sources of fire that may occur on or emanate from the vessels/units.

ii) Plastic piping must be located so that pooling of flammable liquids below the piping is not possible. A properly designed drainage system may be provided to mitigate the pooling of flammable liquid below the piping system.

iii) The firewater system design is to be such that the plastic sections are continuously maintained in the wet condition.

iv) The firewater system is to be equipped with an adequate number of isolation and cut-off valves such that, if a section of the system were to fail, it could be isolated and the remainder of the system would still be capable of supplying firewater.

5.1.2 Fire Pumps

5.1.2(a) General There are to be at least two independently driven and self-priming fire pumps. The fire pumps, together with their respective source of power, fuel supply, electric cables, lighting, ventilation, piping and control valves, are to be located such that a fire in any one location will not render both fire pumps inoperable. One of the two pumps is to be designated as the primary fire pump, and the other as the standby fire pump. At least one of the pumps is to be diesel engine driven, unless the emergency power supply can supply the load for an electric motor driven pump (see 3-6/19.3.3). See paragraph 4-3-3/1.5 of the *Steel*

Vessel Rules or Part 4 Section 4/4.7 of the *MODU Rules* for applicable fire protection requirements for fire pumps.

5.1.2(b) Capacity The primary and standby fire pumps are each to be capable of supplying the maximum probable water demand for the facility. The maximum probable water demand is the total water requirement for protection of the largest single fire area plus two jets of firewater at a pressure of at least 3.5 kg/cm^2 (50 psi). Multiple-pump installations will be considered in lieu of a single primary and standby pump installation, provided they are arranged in such a manner that a fire in one area would not reduce the available supply of firewater required to handle that fire, or such that if the largest pump is out of service for maintenance, the available supply of water would not be reduced below the maximum probable water demand. A means is to be provided for periodic testing of each fire pump. See 3-8/Figure 1 through 3-8/Figure 3 for typical arrangement of fire pumps on newly constructed floating installations.

For a FPSO conversion from an existing tanker based or a FPS conversion from an existing MODU (built prior to 1996) based, the capacity of the primary and standby fire pumps is to be in accordance with this section of the Guide, except that the pressure at the nozzles for the two jets of firewater is to be at least 2.7 kg/cm^2 (40 psi). See 3-8/Figure 4.

For a typical FPSO arrangement, the maximum probable water demand includes the water supply to the water spray system for a single fire on the production deck as discussed above, the water supply to the foam system on the tanker deck below, plus two jets of firewater. For detailed requirements of the water spray system, see 3-8/5.1.4.

To determine the maximum probable water demand, the fire risk areas on the production deck may be divided into fire zones. If a fire is being considered in a single zone, the water supply for the water spray system is to be sufficient for that zone and adjacent zones. The water spray system requirement may be ignored for adjacent zones if these zones are separated by a firewall (no less than A-60) or by an adequate distance between process components to justify such zoning. See 3-8/Figure 5a for reference.

Note that the system emergency shutdown and the equipment blowdown may be considered a safe alternative to the water spray for low hydrocarbon liquid inventory equipment such as the gas compressor units. See 3-8/Figure 5b for reference.

FIGURE 1
Floating Installation
Fire Pump Arrangement
Two-Pump Scenario

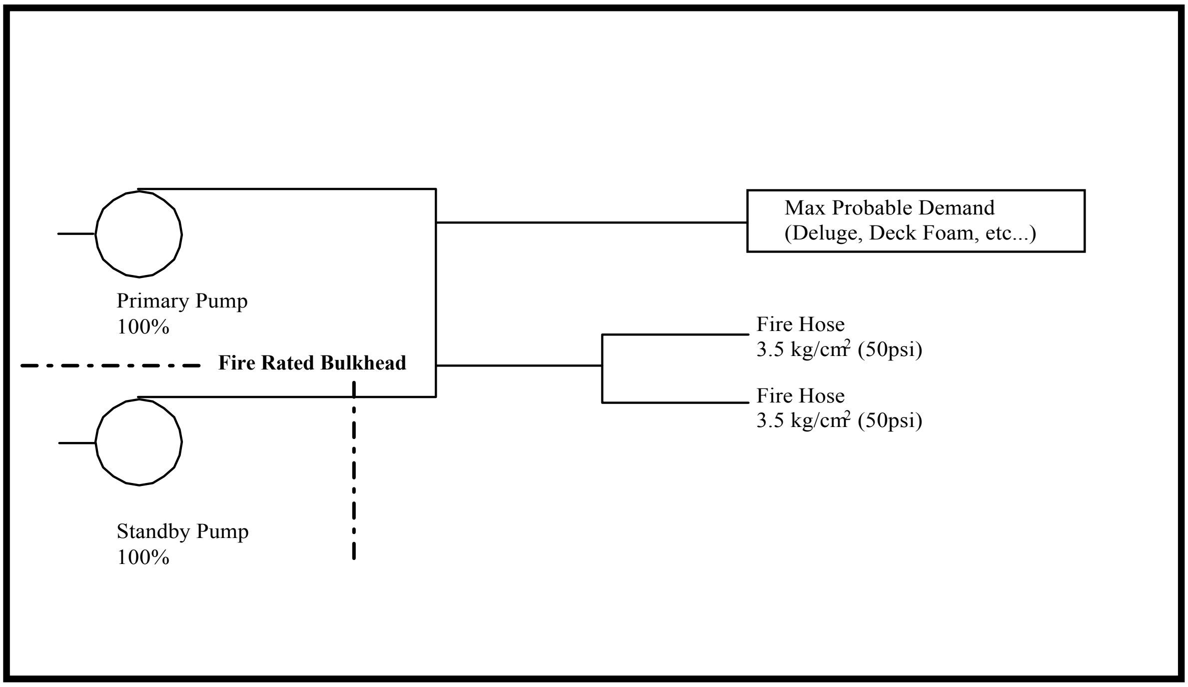


FIGURE 2
Floating Installation
Fire Pump Arrangement
Multiple-pump (Even Power) Scenario

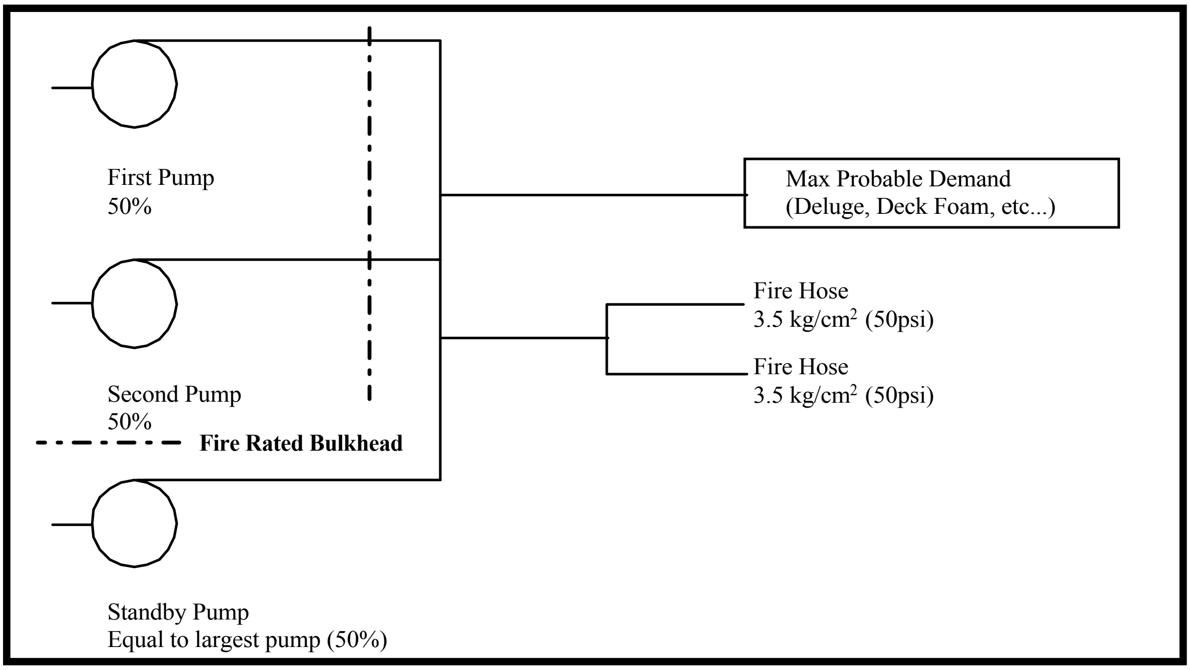


FIGURE 3
Floating Installation
Fire Pump Arrangement
Multiple-pump (Uneven Power) Scenario

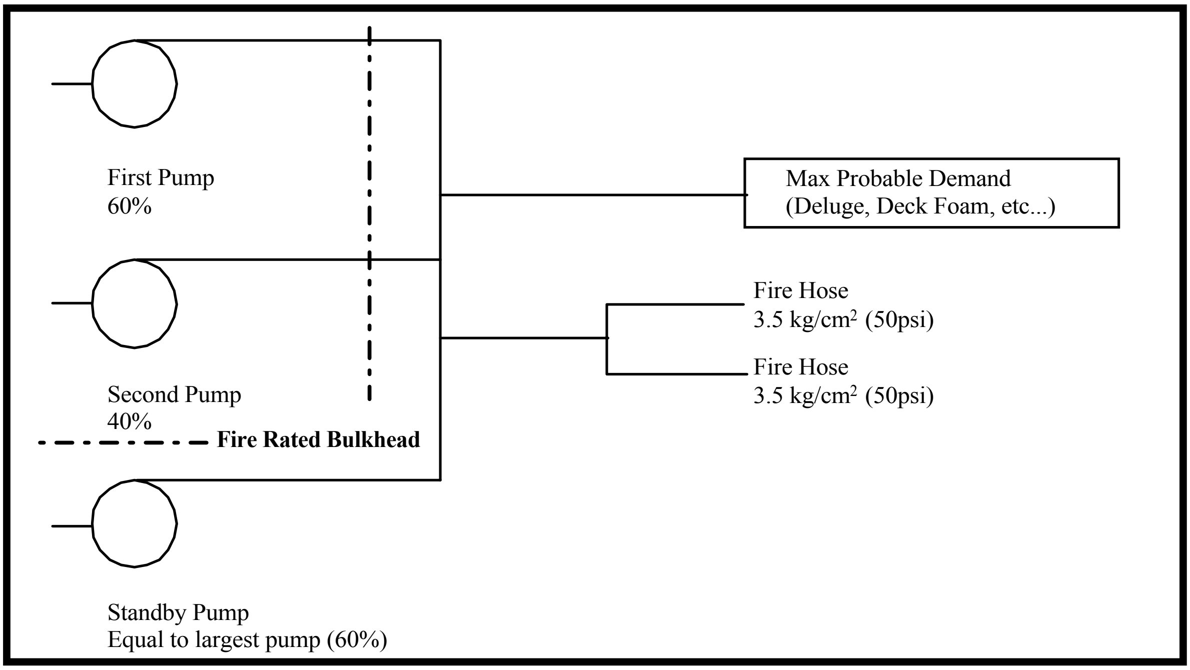


FIGURE 4
Floating Installation
Fire Pump Arrangement
Multiple-pump Scenario for Oil Carrier Converted to Offshore Installation

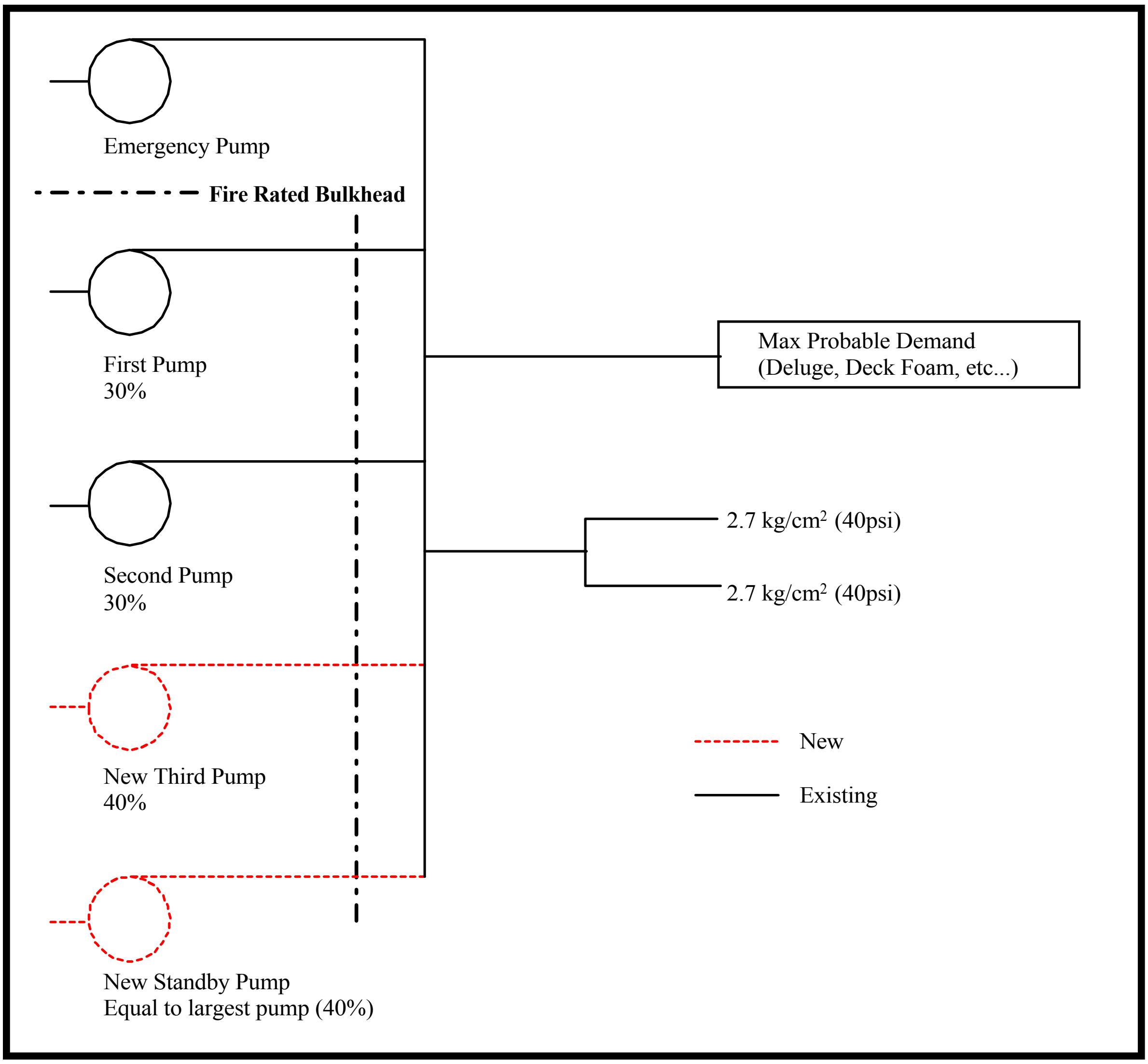


FIGURE 5a
Typical Fire Zones Arrangement on a Production Deck of a FPSO Single Fire with A-60 Fire Wall

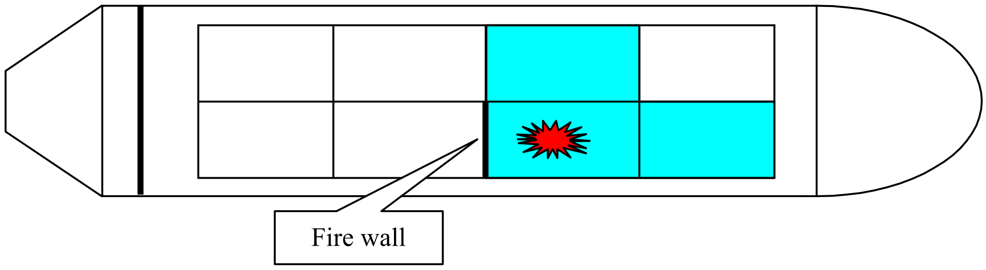
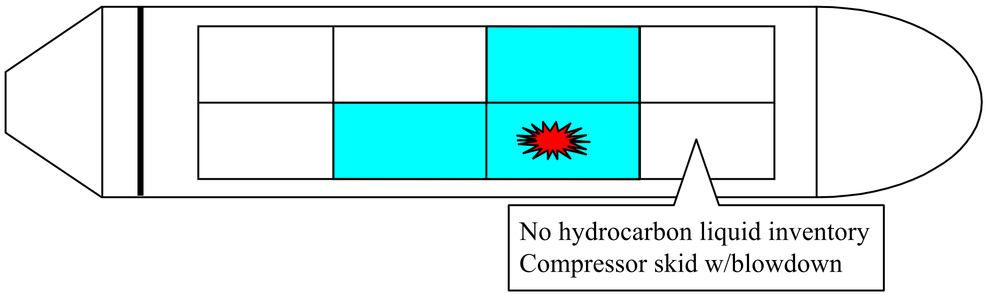
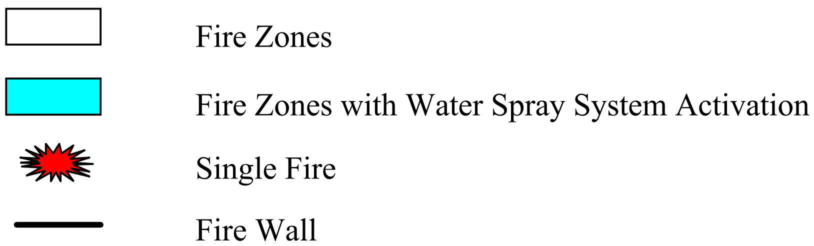


FIGURE 5b
Typical Fire Zones Arrangement on a Production Deck of a FPSO Single Fire with an Adjacent Zone that has no Liquid Inventory





5.1.2(c) Operability and Control Pump(s) with sufficient capacity for process water spray systems is (are) to be provided with automatic starting. In addition to the pump automatic starting requirement, pump driver starters are to be provided with means for local and remote operation from a permanently manned station or a fire control station. Pump discharge control valves, used to separate the section of the firewater service system and the fire pump(s), are to be fitted in an easily accessible location outside of the pump space. Diesel-driven fire pumps may be provided with electrical or pneumatic starting and control systems. Diesel drives using electrical starting and control systems are to be maintained in a weather-protected enclosure. Alternative means of protecting electrical starting and control systems will be considered.

5.1.2(d) Pump Drivers Pump drivers may include diesel engines, natural gas engines, or electric motors. The pump drivers are to be in general accordance with Section 5.2(4)(a), (b) and (c) of API RP 14G with respect to their types and installation requirements. Fuel tanks, fuel lines to engines, and power cables and starters for electric motors, are to be protected against fire and mechanical damage.

Where diesel and natural gas engine fire pumps are considered, the arrangements are to comply with requirements of 3-4/3.9, 3-6/19.3.3, 3-6/21, 3-6/23.3. For electrical motor-driven fire pumps, see 3-6/7 and 3-6/19.3.3 for applicable requirements.

5.1.2(e) Fuel Systems Fuel systems are to comply with the requirements of 3-4/5.11. Fuel supply for diesel engines is to be sufficient for 18 hours operation.

5.1.2(f) Lift Columns Water lift columns are to be encased in pipe for protection against wave action and mechanical damage, and the protective pipes are to be securely attached to the structure in order to lessen wave action damage. Corrosion allowance is to be considered when the water lift column is designed. Where pipes for lift columns pass through floating structures, penetrations are to be made by approved methods to maintain the watertight integrity of the structure. Intake strainers constructed of corrosion-resistant materials are to be fitted at the suction end of the fire pump's water lift column.

5.1.3 Firewater Stations

5.1.3(a) General Firewater stations are to be located so that each station will be readily accessible in the event of a fire. All materials that comprise the firewater station and the access to firewater stations are to be of steel or equivalent material which would not be rendered ineffective by heat. Fiber Reinforced Plastic (FRP) grating may be considered, provided all conditions listed in Appendix 3 are fully met and are accepted by the Flag Administration.

5.1.3(b) Arrangement Firewater stations are to be located on the perimeter of process areas. 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 production facility that may be exposed to fire.

The firewater stations are also to be arranged to provide protection against fire damage or mechanical damage, operation free from interference by other emergency activities, and effective co-ordination with other stations.

5.1.3(c) Monitors and Nozzles Monitors are to be sized for a minimum flow of 1,892 liters/min. at 7.3 kg/cm^2 (500 gpm at 100 psig). Nozzles are to be adjustable from straight stream to full fog and to have a nozzle diameter of at least 12mm (0.5 in.). Monitors and nozzles are to be of corrosion-resistant materials and/or be protected with a suitable coating to protect the equipment from the offshore environment. All nozzles are to incorporate means for a shut-off.

5.1.3(d) Hoses Fire hoses located on the production deck are to be of a non-collapsible type mounted on reels, and are to be certified by a competent independent testing laboratory as being constructed of non-perishable material to recognized standards. The hoses are to be of material resistant to oil and chemical deterioration, mildew and rot, and exposure to the offshore environment. They are to be sufficient in length to project a jet of water to any location in the areas where they may be required to be used. Each hose is to be provided with a nozzle and the necessary couplings. Unlike collapsible hoses, which require more space for handling, the maximum length of hose reels used on the production deck may be as long as 30 m (100 ft).

All indoor fire stations (i.e., quarters areas, machinery spaces, office spaces, etc.), where required, are to be provided with collapsible hoses. The maximum length of collapsible hoses is not to exceed 23 m (75 ft).

5.1.4 Water Spray (Deluge) Systems for Process Equipment

*5.1.4(*a) *General* A fixed water spray system is to be installed for the process equipment. The intent of the water spray system is to keep the process equipment cool and reduce the risk of escalation of a fire. Water spray systems are to be capable of being actuated both automatically by a fire detection system and manually. Installations are generally to be in accordance with NFPA Standard 15, or other equivalent standard such as API Publication

2030. Deluge isolation valves are to be located in a safe area and outside the fire zone they protect.

Consideration will be given to the use of manual actuation alone, provided that the combined volume of process and storage vessels is less than 15 m^3 (530 ft^3), and the installation is manned on a 24-hour basis and the manual actuation station is readily accessible.

5.1.4(b) Materials All requirements in 3-8/5.1.1(b) are applicable, except the requirements for plastic piping materials, which are modified and listed below.

Plastic piping materials are to meet Appendix 1 of this Guide. Generally, plastic (GRP/FRP) materials used in water spray systems are to pass Level 1 fire endurance test. However, a plastic piping material that passes Level 3 Modified Test – Level 3 WD fire endurance requirements in lieu of Level 1 requirements may be considered when the following design conditions are fully met and accepted by the Flag Administration.

i) Plastic piping is installed in open deck or semi-enclosed locations.

ii) The water spray piping system must meet the Level 3 fire endurance requirements as specified in Appendix 1.

iii) In addition to meeting the Level 3 fire endurance requirements, the water spray piping system must meet the requirements of the wet/dry fire endurance testing specified in Appendix 1, Section 8. Other wet/dry fire endurance test methods that may be equivalent to or more severe than the methods described in Appendix 1, Section 8, will be considered on a case-by-case basis.

iv) An automatic fire detection system is to be installed in areas protected by the water spray system.

v) The water spray system is to be designed to activate automatically upon detection by the automatic fire detection system.

vi) Each section or area served by a water spray system is to be capable of being isolated by one water supply valve only. The stop valve in each section is to be readily accessible, and its location clearly and permanently indicated.

vii) The design of the water spray system is to be such that upon fire detection, the time required to have water flowing through the hydraulically most remote nozzle is less than one minute. This requirement will be verified by system testing at the time of installation and at subsequent annual inspections.

viii) The water spray system piping is to be located downstream of the water supply valve. All piping upstream of the water supply valve is to meet the requirements for fire main and water spray systems as specified in Appendix 1, or be of metallic material.

5.1.4(c) Process Equipment Process equipment, including hydrocarbon vessels, heat exchangers, fired heaters and other hydrocarbon handling systems, are to be protected with a water spray system. The system is to be designed to provide a water density of 10.2 liters/min/m^2 (0.25 gpm/ft^2) of exposed surface area for uninsulated vessels, or 6.1 liters/min/m^2 (0.15 gpm/ft^2) of exposed surface area for insulated vessels.

Process equipment support structure, including saddles, skirt, legs, but not secondary deck structure members, is to be protected with a water spray system designed to provide a water density of 4.1 liters/min/m^2 (0.10 gpm/ft^2). Alternatively, the use of intumescent coatings may be acceptable in protecting the support structure, provided the selection of the fire rating of the coating is based on the results from a risk analysis and/or fire load calculation which must be reviewed and accepted by ABS. The condition (intactness) of the coatings will be the subject of surveyor inspection during attendance of the unit following normal survey intervals.

For gas-handling equipment, such as gas compressor skids, where the hydrocarbon liquid inventory is kept minimal, a water spray system is not required if the equipment is provided with an automatic blowdown upon the process shutdown.

5.1.4(d) Wellhead Areas Wellheads with maximum shut-in tubing pressures exceeding 42 kg/cm^2 (600 psi) are to be protected with a water spray system. The water spray system is to be designed to provide a minimum water density of 20.4 liters/min/m^2 (0.50 gpm/ft^2) based on the protection of wellheads, ESD valves, and critical structural components including the firewall.

5.1.4(e) Turret Areas (Internal Turret) Internal turrets with swivel pressure ratings exceeding 42 kg/cm^2 (600 psi) are to be protected with a water spray system. Turret areas, including the swivel and its associated equipment, are to be protected by a water spray system designed to provide a minimum water density of 20.4 liters/min/m^2 (0.50 gpm/ft^2).

5.1.5 Foam Systems for Crude Storage Tanks

Deck foam systems are to be provided for all facilities storing crude oil in integral storage tanks, in accordance with subparagraph 3-4-1/5.3.1 and 5-1-7/27 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.

5.3 Dry Chemical Systems

For production facilities with no liquid hydrocarbon storage capabilities and limited hydrocarbon liquid retention in processing equipment, dry chemical hose reel units may be used for fire fighting in lieu of firewater station required by 3-8/5.1.3. Design of the dry chemical systems is to be in accordance with NFPA Standard 17.

5.5 Fixed Fire Extinguishing Systems

A fixed fire fighting system complying with 3-8/5.5.1, 3-8/5.5.2 or 3-8/5.5.3 is to be provided in each enclosed space and enclosed skid module containing the following equipment:

i) Internal combustion machinery, including diesel and gas engines, having a total power output of not less than 750 kW (1000 hp).

ii) Oil or gas-fired boilers and other processes such as incinerators and inert gas generators.

iii) Oil fuel units. An oil fuel unit is defined as any equipment such as pumps, filters and heaters, used for the preparation and delivery of fuel oil to oil-fired boilers (including incinerators and inert gas generators), internal combustion engines or gas turbines at a pressure of more than 1.8 bar (26 psi).

iv) Settling tanks for boilers.

v) Gas compressors

vi) Transfer pumps for crude oil and flammable liquid with low flash point (below 60°C~140°F) such as methanol. See subsection 5-1-7/29 of the *Steel Vessel Rules* for reference.

If a fixed foam system is to be used for the methanol pump room and methanol tank space, the type of foam selected is to be suitable for use with methane (alcohol-resistant foams).

5.5.1 Gas Smothering Systems

5.5.1(a) General

i) *Storage* Smothering medium storage location is to be outside of protected space. If gas bottles are kept in an enclosed compartment, the storage space is not to be used for purposes other than storing the bottles. The storage space is also to be situated in a safe and readily accessible position, and be effectively ventilated by a ventilation system independent of other spaces, including the protected space.

ii) *Controls* Automatic release of fire-extinguishing medium for total flooding systems is not permitted. Two separate controls are to be provided for releasing the fire-extinguishing medium into a protected space and to ensure the activities of the alarm. One control is to be used to discharge the gas from its storage containers. A second control is to be used for opening the valve of the piping, which conveys the gas into the protected space. This requirement is not applicable if the system is provided for a single space and the protected space is relatively small [under 170 m^3 (6000 ft^3)]. Controls are to be grouped together to provide complete actuation of the system from their location. The number of release stations is to be limited to as few as possible, typically two, one at the gas storage location and another outside of the protected space. For the one outside of the protected space, it is to be located in proximity and along the main escape route of the space.

iii) *Alarms* Means are to be provided for automatically giving audible warning of the release of fire-extinguishing gas into any space to which personnel normally have access. The alarm is to operate for at least a 20-second period before the gas is released. Alarms may be pneumatically (by the extinguishing medium or by air) or electrically operated. If electrically operated, the alarms are to be supplied with power from the main and an emergency source of electrical power. If pneumatically operated by air, the air supply is to be dry and clean and the supply reservoir is to be atomically kept charged at all times, and is to be fitted with a low-pressure alarm. The air supply may be taken from the starting air receivers. Any stop valve fitted in the air supply line is to be locked or sealed in the open position. Any electrical components associated with the pneumatic system are to be powered from the main and an emergency source of electrical power.

5.5.1(b) Carbon Dioxide Systems In addition to the above general requirements, the design philosophy of CO_2 fire extinguishing systems is to be in compliance with a single standard/code (i.e., Chapter II-2, Regulation 5 of SOLAS 1974 and Amendments, NFPA 12, or other recognized fire code). Once a standard is chosen for a design basis, the standard is to be used throughout the design, and criteria from other standards may not be used.

5.5.1(c) Halon and Halon Alternative Systems

Halon is not permitted in new installations.

Halon alternative systems are to meet IMO MSC Circ. 848 general requirements, and above.

Halon alternative agents are to be accepted by the governmental authorities.

5.5.2 Foam Systems

*5.5.2(*a) *Fixed High Expansion Foam Systems* Fixed high expansion foam systems are to be in accordance with Chapter II-2, Regulation 9 of SOLAS 1974 and Amendments or other recognized fire code such as NFPA 11A. Note reference is made to the IMO MSC/Circular 670.

5.5.2(b) Fixed Low Expansion Foam Systems Fixed low expansion foam systems may be installed in machinery spaces in addition to the required fixed fire extinguishing system. Fixed low expansion foam systems are be in accordance with Chapter II-2, Regulation 8 of SOLAS 1974 and Amendments or other recognized fire code such as NFPA 11. Note reference is made to the IMO MSC/Circular 582.

5.5.3 Fixed Water Spray Systems

Fixed water spray systems are to be in accordance with Chapter II-2, Regulation 10 of SOLAS 1974 and Amendments or other recognized fire code such as NFPA 15.

5.7 Paint Lockers and Flammable Materials Storerooms

Paint lockers and flammable material storerooms located on the production decks with deck area in excess of 4 m^2 (43 ft^2) are to be protected by a fixed fire extinguishing system. One of the following systems may be considered:

i) CO_2 system designed for 40% of the gross volume of the space

ii) Dry powder system designed for at least 0.5 kg/m^3 (0.03 lb/ft^3)

iii) Water spray system designed for 5 $liters/min/m^2$ (0.12 gpm/ft^2). The water spraying systems may be connected to the unit's fire main system.

iv) Systems other than those mentioned above may also be considered.

For paint lockers and flammable material storerooms located on the installation but not on the production deck, see *MODU Rules* or *Steel Vessel Rules* for applicable comments.

5.9 Helicopter Facilities

For fire fighting requirements of helicopter facilities, refer to *MODU Rules* or *Steel Vessel Rules* for applicable comments.

5.11 Emergency Control Station

At least two emergency control stations are to be provided. One of the stations is to be located in a normally manned space such as the process control room, or near the drilling console if the facility is fitted with drilling and workover systems. The other is to be at a suitable location outside of the hazardous area. The emergency control stations are to be provided with the following:

i) Manually operated switches for actuating the general alarm system

ii) An efficient means of communication with locations vital to the safety of the installation

iii) Manual activation of all well and process system shutdowns (3-3/7.3.4 and 3-3/9)

iv) Means for shutdown, either selectively or simultaneously, of the following equipment, except for electrical equipment listed in 3-8/5.13: (1) ventilating systems, except for prime movers, (2) main generator prime movers, (3) emergency generator prime movers.

5.13 Operation after Facility Total Shutdown

The following services are to be operable after total shutdown of a facility:

i) Emergency lighting required for evacuation from service/accommodation spaces and machinery spaces to embarkation stations. This includes lighting at all control stations, stowage positions for firemen's outfits, helicopter landing deck, alleyways, stairways and exits, embarkation station deck, launching appliances, and the area of water where they are to be launched, etc. The lighting is to be provided for thirty minutes.

ii) General alarm

iii) Blowout preventer control system if fitted on the installations

iv) Public address system

v) Distress and safety radio communications

All equipment in exterior locations that is capable of operation after activation of the prime mover/ventilation shutdown system, is to be suitable for installation in Class I, Division 2 (Zone 2) locations.

5.15 Portable and Semi-portable Extinguishers

Locations, types and quantities of fire extinguishers provided for the production deck area are to be in accordance with 3-8/Table 1 and 3-8/Table 2. For areas not specifically addressed in these tables, NFPA Standard 10 is to be followed.

TABLE 1
Portable and Semi-portable Extinguishers

CLASSIFICATION TYPE & SIZE	*WATER* *LITERS (GALLONS)*	*FOAM* *LITERS (GALLONS)*	*CARBON DIOXIDE* *KILOGRAMS (POUNDS)*	*DRY CHEMICAL* *KILOGRAMS (POUNDS)*
A-II	9.5 (2 1/2)	9.5 (2 1/2)		2.25 (5)[1]
B-I		4.7 (1 1/4)	1.8 (4)	0.9 (2)
B-II		9.5 (2 1/2)	6.7 (15)	4.5 (10)
B-III		45 (12)	15.8 (35)	9.0 (20)
B-IV		76 (20)	22.5 (50)[2]	13.5 (30)
B-V		152 (40)	45 (100)[2]	22.5 (50)[2]
C-I			1.8 (4)	0.9 (2)
C-II			6.7 (15)	4.5 (10)
C-III			15.8 (35)	9.0 (20)
C-IV			22.5 (50)[2]	13.5 (30)

NOTES:

1 Must be approved as a Type A, B, and C extinguisher

2 For outside use only

Classification of Portable and Semi-portable Extinguishers

Fire extinguishers are designated by types as follows:

A For fires in combustible materials, such as wood

B For fires in flammable liquids and greases

C For fires in electrical equipment

Fire extinguishers are designated by size, where size I is the smallest and size V is the largest. Sizes I and II are portable extinguishers, and sizes III, IV and V are semi-portable extinguishers.

TABLE 2
Classification and Placement of Portable and Semi-portable Extinguishers

SPACE	*CLASSIFICATION*	*QUANTITY & LOCATION*
SAFETY AREAS		
Main control room	C-I or C-II	2 near the exit (See Note 1 on the next page)
Stairway and elevator enclosure	B-II	Within 3 m (10 ft) of each stairway on each deck level
Corridors	A-II	1 in each main corridor, not more than 45 m (150 ft.) apart
Lifeboat embarkation & lowering stations	- -	None required
Radio room	C-I or C-II	2 near the exit (See Note 1)
Paint storerooms	B-II	1 outside each room in vicinity of exit (See Note 2 on the next page)
Storerooms	A-II	1 for every 232 m^2 (2500 ft^2) or fraction thereof, located in vicinity of exits, either inside or outside of spaces (See Note 2)
Workshop and similar spaces	C-II	1 outside each space in vicinity of an exit (See Note 2)
ENCLOSED MACHINERY SPACES		
Gas/oil-fired boilers: spaces containing gas/oil-fired boilers, either main or auxiliary, or their fuel oil units	B-II	2 required in each space
	B-V	1 required in each space
Internal combustion or gas turbine machinery spaces	B-II	1 for every 745 kW (1,000 brake horsepower) but not less than 2 nor more than 6 in each space
	B-III	1 required in each space
ENCLOSED AUXILIARY SPACES		
Internal combustion engines or gas turbines	B-II	1 outside the space containing engines or turbines in vicinity of exit (See Note 2)
Electric emergency motors or gas turbines	C-II	1 outside the space containing motors or generators in vicinity of exit (See Note 2)
Steam drive auxiliary	- -	None required
Fuel tanks	- -	None required

TABLE 2 (continued)
Classification and Placement of Portable and Semi-portable Extinguishers

SPACE	*CLASSIFICATION*	*QUANTITY & LOCATION*
MISCELLANEOUS AREAS		
Cranes with internal combustion engines	B-II	1 required in vicinity of crane cab exit
Production areas	B-III or B-IV	(See Note 3)
Drilling areas	B-III or B-IV	(See Note 3)
Open areas	B-II	1 for every 3 internal combustion or gas turbine engines
	C-II	1 for every 2 electric generators and motors of 3.7 kW (5 hp) or greater
Turret areas for internal turret	B-III or B-IV	One for each level of turret area
CHEMICALS AND FUELS WITH FLASH POINT BELOW 60°C~140°F		
Pump room	B-II	1 required in vicinity of exit (See Note 4)
Storage tank area	B-V	1 required on open deck capable of reaching the storage tanks, tank vents, and transfer connections (See Note 4)

NOTES:

1 One of which must be placed inside (dry chemical extinguishers not recommended for these applications).

2 Vicinity is intended to mean within 1 m (3 ft.).

3 One B-III or B-IV extinguisher is to be provided at every entrance to any escape route, under no circumstances are two extinguishers to be placed more than 15.24 m (50 ft.) apart.

4 For methanol, foam extinguishers may be considered if the extinguishers are of the polar solvent type foam (alcohol-resistant type)

7 Fire and Gas Detection and Alarm Systems

7.1 Fire Detectors

Open or enclosed areas are to be provided with automatic fire detection such that all potential fire outbreak points are monitored. The automatic fire detection system will sound an alarm and initiate necessary shutdown functions for the facility. Guidelines for the selection and use of fire detectors are contained in API RP 14C, API 14F and API RP 14G.

7.3 Gas Detectors

7.3.1 Combustible Gases

In all enclosed and semi-enclosed areas that might accumulate combustible gases, gas sensors of an explosion (flame)-proof type are to be installed and operated in accordance with API RP 14C and API RP 14F, as applicable. Consideration is to be given to providing combustible gas sensors near points of a possible leak at process equipment and piping systems located in open areas. Sensors are also to be provided at fresh air inlets to non-classified areas.

7.3.2 Hydrogen Sulfide

Where hydrogen sulfide gas may be present in the well fluid in excess of 20 ppm, hydrogen sulfide gas detection systems are to be installed in accordance with API RP 55, as applicable.

7.3.3 Detector Set Points

The low and high gas alarm set points are to be at 20% L.E.L. and 60% L.E.L. for combustible gases, and 10 ppm and 50 ppm for hydrogen sulfide. Process safety shutdown functions are to be initiated upon high gas detection.

7.5 Smoke Detectors

A smoke detection and alarm system is to be provided for control rooms, switchgear rooms, and other areas where slow-developing fires might be expected.

7.7 Alarm Panel

A master fire and gas panel is to be provided to receive and process all fire and gas detection signals. The panel is to be located in the central control room or other normally manned non-classified area. The panel arrangement is to comply with Chapter 3, Section 7.

7.9 Fire and Gas Detection Wiring

Wiring arrangement is to comply with Chapter 3, Section 6.

7.11 General Alarm

Means are to be provided for manually activating a general alarm system capable of producing a distinctive audible sound in all areas of the facility. Alarm-actuating devices are to be located at points of egress from accommodation areas, process areas, and machinery spaces. Power for the general alarm system is to comply with Chapter 3, Section 6.

9 Structural Fire Protection

9.1 General

The term “structural fire protection” refers to the passive method of providing fire protection to the spaces/compartments of the unit through the usage of fire divisions and the limitation of combustibles in the construction materials. Maintaining the adequacy of the fire division includes proper protection of penetrations in those divisions, which includes electrical, piping, or ventilation systems penetrations.

The structural fire protection requirements of this section are intended to address the need for fire protection of boundaries separating new and/or existing areas/spaces onboard the installation from the process facility equipment. For ship shape FPSOs, SOLAS requirements will be followed along with any additional or more stringent items in the IMO MODU Code.

Existing spaces that do not share common boundaries with the process facility equipment are to be treated based on the requirements that were in effect at the time of construction.

Newly built spaces that do not share common boundaries with the process facility equipment and all portable/temporary living quarters are to comply with the latest Rule requirements.

9.3 Structural Fire Protection Requirements

The minimum fire integrity of bulkheads and decks is to be as prescribed in 3-8/Table 3a and 3-8/Table 3b.

Windows and sidescuttles that face the production facilities are to possess a fire rating equivalent to the bulkheads in which they are fitted.

TABLE 3a
Fire Integrity of Bulkheads Separating Adjacent Spaces/Areas

Spaces		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Control Stations including Central Process Control Rooms	(1)	A-0	A-0	A-60	A-0	A-15	A-60	A-15	H-60 (d)	A-60	A-60	*	A-0
Corridors	(2)		C	B-0	B-0 A-0 (b)	B-0	A-60	A-0	H-60 (d)	A-0	A-0	*	B-0
Accommodation Spaces	(3)			C	B-0 A-0 (b)	B-0	A-60	A-0	H-60 (d)	A-0	A-0	*	C
Stairways	(4)				B-0 A-0 (b)	B-0 A-0 (b)	A-60	A-0	H-60 (d)	A-0	A-0 *	*	B-0 A-0 (b)
Service Spaces (low risk)	(5)					C	A-60	A-0	H-60 (d)	A-0	A-0	*	B-0
Machinery Spaces of Category A	(6)						* (a)	A-0 (a)	H-60 (d)	A-60	A-60	*	A-0
Other Machinery Spaces	(7)							A-0 (a) (c)	H-0 (d)	A-0	A-0	*	A-0
Process Areas, Storage Tank Areas, Wellhead/manifold Areas	(8)				(Symmetrical)				----	H-60 (d)	H-60 (d)	*	H-60 (d)
Hazardous Areas	(9)									----	A-0	*	A-0
Service Spaces (high risk)	(10)										A-0 (c)	*	A-0
Open Decks	(11)											----	*
Sanitary and Similar Spaces	(12)												C

Please see the notes under 3-8/Table 3b for further interpretations.

TABLE 3b
Fire Integrity of Decks Separating Adjacent Spaces/Areas

Space below ↓ *Space → above*		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Control Stations including Central Process Control Rooms	(1)	A-0	A-0	A-0	A-0	A-0	A-60	A-0	H-60 (d)	A-0	A-0	*	A-0
Corridors	(2)	A-0	*	*	A-0	*	A-60	A-0	H-60 (d)	A-0	A-0	*	*
Accommodation Spaces	(3)	A-60	A-0	*	A-0	*	A-60	A-0	X	A-0	A-0	*	*
Stairways	(4)	A-0	A-0	A-0	*	A-0	A-60	A-0	H-60 (d)	A-0	A-0	*	A-0
Service Spaces (low risk)	(5)	A-15	A-0	A-0	A-0	*	A-60	A-0	H-60 (d)	A-0	A-0	*	A-0
Machinery Spaces of Category A	(6)	A-60	A-60	A-60	A-60	A-60	* (a)	A-60	H-60 (d)	A-60	A-60	*	A-0
Other Machinery Spaces	(7)	A-15	A-0	A-0	A-0	A-0	A-0 (a)	* (a)	H-0 (d)	A-0	A-0	*	A-0
Process Areas, Storage Tank Areas, Wellhead/manifold Areas	(8)	H-60 (d)	H-60 (d)	X	H-60 (d)	H-60 (d)	H-60 (d)	H-60 (d)	----	----	H-60 (d)	--	H-60 (d)
Hazardous Areas	(9)	A-60	A-0	A-0	A-0	A-0	A-60	A-0	----	----	A-0	--	A-0
Service Spaces (high risk)	(10)	A-60	A-0	A-0	A-0	A-0	A-0	A-0	H-60 (d)	A-0	A-0 (c)	*	A-0
Open Decks	(11)	*	*	*	*	*	*	*	----	----	*	--	*
Sanitary and Similar Spaces	(12)	A-0	A-0	*	A-0	*	A-0	A-0	H-60 (c)	A-0	*		*

Notes:

(a) If a space contains an emergency power source or components of an emergency power source, and adjoins a space containing a unit's service generator or components of a unit's service generator, the boundary bulkhead or deck between those spaces is to be an A-60 class division.

(b) For clarification as to which note applies, see paragraph 3.11.5.3 of the ABS *MODU Rules*.

(c) Where spaces are of the same numerical category and subscript (c) appears in the tables, a bulkhead or deck of the rating shown is only required when the adjacent spaces are for a different purpose. For example, in category (10), a galley next to another galley does not require a bulkhead, but a galley next to a paint room requires an A-0 bulkhead.

(d) If the results of a Risk Analysis or Fire Load Analysis (reviewed and accepted by ABS) justify such, an "A-60" fire division may be used in lieu of an "H-60" bulkhead. An "A-0" wall used in conjunction with a water curtain system designed to provide a density of at least 6.1 liters/min/m^2 (0.15 gpm/ft^2) of exposed surface area may be used as an equivalent means of meeting the "A-60" class division.

(e) Intumescent coatings may be acceptable in providing the "H" rating. The intumescent coating used is to have limited flame spread properties, low smoke development and low heat generation. In addition, an assessment is to be made of the toxicity of gases emitted in the event of a fire. The condition (intactness) of the coatings will be the subject of surveyor inspection during attendance of the unit following normal survey intervals.

* Where an asterisk appears in the tables, the division is to be of steel or equivalent material, but is not required to be of an A-class standard. However, where a deck is penetrated for the passage of electric cables, pipes, and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke.

Where an X appears in the table, the configuration is not allowed.

9.5 Wellhead Areas

A-0 firewalls are to be used to provide protection from potential uncontrolled flare front wellheads with shut-in pressure exceeding 42 kg/cm^2 (600 psi). These firewalls are independent of the requirements for structural fire protection of spaces. The intent of these firewalls is to provide protection for escape routes, temporary refuges, lifeboat embarkation stations, fire pumps and potential fire hazards. The dimensions of the firewall and distance from the wellhead are to be determined based on the results from fire load calculations or other recognized method. See 3-3/5.5.

9.7 Fired Vessels

A-0 firewalls are to be used to provide protection from potential fire hazard of fired vessels. These firewalls are independent of the requirements for structural fire protection of spaces. The intent of these firewalls is to provide protection for escape routes, temporary refuges, lifeboat embarkation stations, fire pumps and potential fire hazards. The dimensions of the firewall and distance from the direct-fired heaters are to be determined based on the results from fire load calculations or other recognized method. See 3-3/5.9.

9.9 Helideck

All helidecks are to be constructed of steel or other material which provides equivalent structural and fire integrity properties to that of steel. Helidecks which form the deckhead (roof) of the accommodations are to be insulated to an A-60 class standard. If the helideck is located less than one (1) meter above the deckhouse top, the helideck is to be constructed to an "A" class standard. Deckhouse roofs (below the helideck) are to have no openings.

9.11 Ventilation

Standards for ventilation are to be in accordance with the requirements for ventilation as contained in the *MODU Rules*, with the following additional requirements:

Non-ducted HVAC systems, i.e., those that use the plenum for return air, are discouraged. The use of a non-ducted system will need prior review of the design philosophy, taking into consideration the movement of smoke between spaces and the maintenance of "smoke free" escape routes. Prior design approval by ABS is mandatory before construction of such a system.

9.13 Penetrations

All penetrations through bulkheads and decks are to have the same fire integrity as the bulkhead and deck through which they penetrate. This is to be accomplished using ABS-established procedures with materials that have been approved by a major governmental maritime administration, or by approved procedures that have been tested.

9.15 Materials/Certification

All materials used in the construction of structural fire divisions and protection of the penetrations are to be certified for the fire rating in which they are fitted. This includes both structural fire protection and thermal insulation, joiner bulkheads, doors, HVAC ducts, flooring materials, windows, fire dampers, etc.

11 Muster Areas

11.1 General

All units are to have a designated muster station(s) were personnel can gather prior to entering the lifeboats.

11.3 Materials

All materials that comprise the muster stations routes are to be of steel or equivalent material. Fiber Reinforced Plastic (FRP) grating may be considered, provided all conditions listed in Appendix 3 are fully met and are accepted by the Flag Administration.

11.5 Muster Stations

The muster station is to be of sufficient area to accommodate the number of personnel to be gathered. The muster station is to be located in a safe location with respect to the processing equipment. The muster station may be a meeting room inside the accommodations or may be part of the lifeboat embarkation station.

13 Means of Escape

13.1 General

The escape route requirements of the applicable Rules and/or Regulations are to apply along with the requirements of 3-8/13.3, 3-8/13.7 and 3-8/13.9. In the absence of escape route requirements by the applicable Rules and/or Regulations, the requirements of 3-8/13.3 through 3-8/13.9 apply.

13.3 Materials

All materials that comprise the escape routes are to be of steel or equivalent material. Fiber Reinforced Plastic (FRP) grating may be considered, provided all conditions listed in Appendix 3 are fully met and are accepted by the Flag Administration.

13.5 Escape Routes

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

13.7 Marking and Lighting of Escape Routes

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

13.9 Escape Route Plan

An escape route plan is to be prominently displayed at various points in/of the facility. Alternatively, this information may be included in the Fire Control or Fire/Safety Plan.

15 Lifesaving Requirements

15.1 General

The lifesaving appliance requirements of the applicable governmental regulations are to apply along with the requirements of 3-8/15.5.5 and 3-8/15.5.6. In the absence of lifesaving appliance requirements by the applicable Regulations, or if no Regulations exist, the requirements of 3-8/15.3 and 3-8/15.5 apply.

Where the words "of an approved type" are indicated, the equipment is to meet the requirements of SOLAS or equivalent standard. Launching appliances for lifeboats and liferafts are also to meet the requirements of SOLAS or equivalent standard.

15.3 Lifeboat Embarkation Areas

All materials that comprise the lifeboat embarkation platform are to be of steel or equivalent material. Fiber Reinforced Plastic (FRP) grating may be considered, provided all conditions listed in Appendix 3 are fully met and are accepted by the Flag Administration.

15.5 Lifesaving Appliances and Equipment

15.5.1 Lifeboats

Lifeboats of an approved type are to be provided, with a total capacity to accommodate twice the total number of people onboard the subject unit. They are required to be installed on at least two sides of the installation, in safe areas in which there will be accommodation for 100%, in case one of the stations becomes inoperable.

15.5.2 Liferafts

Inflatable liferafts of an approved type are to be provided onboard such that their total capacity is sufficient to accommodate the total number of people expected to be onboard the facility. Liferafts are to be placed in or next to areas where personnel may be working, in sufficient quantity to hold the maximum number of people that might be present in the area at any one time.

15.5.3 Life Buoys

At least four life buoys of an approved type, with floating water lights, are to be provided. One ring life buoy is to be placed in a suitable rack on each side of the structure in an acceptable location. Multi-level structures may require the placement of additional life buoys.

15.5.4 Life Jackets

At least one life jacket of an approved type, is to be provided for each person on a manned facility. Life preservers/work vests are to be stored in readily accessible locations. In addition, life jackets numbering the same quantity as the maximum aggregate capacity of each life boat station must be stored next to the lifeboat station.

15.5.5 Work Vests

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

15.5.6 Breathing Apparatus

For operations involving hydrogen sulfide, each person expected on the facility is to be provided with a self-contained breathing apparatus of an approved type for escape purposes. The breathing apparatus for maintenance personnel is to have a minimum of thirty (30) minutes air supply. A designated safe area with proper supply of air is also to be provided and shown on the fire control/safety plan.

15.7 Means of Embarkation

15.7.1 General

The means of embarkation requirements of the applicable Rules and/or Regulations are to apply. In the absence of means of embarkation requirements by the applicable Rules and/or Regulations, the requirements of 3-8/15.7.2 below apply.

15.7.2 Means of Embarkation

Each facility is to have means of embarkation to allow personnel to leave the facility in an emergency. These are in addition to the equipment described in 3-8/15. The means of embarkation are to consist of at least two (2) fixed ladders or stairways, widely separated, and extending from the main and cellar decks to the water line. The ladders or stairways will preferably be located near lifeboat-launching stations. Ladder construction is to be in accordance with the appropriate governmental authority, or other recognized standard.

17 Personnel Safety Equipment and Safety Measures

17.1 Fireman’s Outfits

All fireman’s outfits and equipment are to be of an approved type, i.e., equipment is to meet the requirements of SOLAS or equivalent standard. The requirements below are in addition to those required by the applicable Rules and/or Regulations.

17.1.1 Fireman's Outfit

A minimum of two (2) sets of fire-fighting outfits and equipment is to be provided and stowed in a suitable container. The protective clothing is to be made of a material that will protect the skin from radiant heat of a fire, and be water-resistant. Boots and gloves are to be made of rubber or other electrically non-conducting material. The protective helmet is to be of rigid construction to resist impact, and be equipped with a face shield.

The fireman’s outfits or sets of personal equipment are to be stored as to be easily accessible and ready for use, and where more than one fireman’s outfit or more than one set of personal equipment is carried, they are to be stored in widely separated positions. One of the outfits should be readily accessible from the helicopter deck.

17.1.2. Breathing Apparatus

A minimum of two (2) self-contained breathing apparatus, of an approved type is to be provided and stowed with the fireman’s outfits. There is to be an adequate number of spare compressed air charges. The breathing apparatus is to have a minimum of thirty (30) minutes air supply.

17.3 Guard Rails

The perimeter of all open deck areas, walkways around accommodation spaces, catwalks and openings, are to be protected with guardrails. The height of the guard rails is to be at least 1 m (39.5 in.) above the deck, except where this height would interfere with normal operation, in which case, a lesser height may be considered if adequate protection is provided. The opening below the lowest course of the guardrails is not to exceed 230 mm (9 in.). The other courses are not to have more than 380 mm (15 in.) of clear opening. Toe plates are to be provided at the base of all guardrails.

17.5 Insulation of Hot Surfaces

17.5.1 Personal Protection

All exposed surfaces with which personnel are likely to come in contact are to have temperatures that do not exceed 71°C (160°F). If this can not be achieved, then the exposed surfaces are to be insulated or shielded.

17.5.2 Spillage Protection

Surfaces with temperatures in excess of 204°C (400°F) are to be protected from contact with liquid hydrocarbon spillage and mist.

17.5.3 Combustible Gases

Surfaces in excess of 482°C (900°F) are to be protected from contact with combustible gases.

17.5.4 Protection of Insulation

Insulation is to be protected from weather, oil spillage, mechanical wear, and physical damage.

CHAPTER 4 **Fixed Installations**

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CHAPTER 4 Fixed Installations

SECTION 1 General

1 Scope

This chapter defines the minimum criteria for ABS Class applicable to equipment and systems on a fixed installation. These systems include:

i) Hydrocarbon Production and Process systems

ii) Process Support and Platform Support Systems

iii) Electrical Systems

iv) Instrumentation and Control Systems

v) Fire Protection and Personnel Safety.

In the case of existing units (i.e. SEDU – Self-elevating Drilling Units) built to meet MODU Rules, consideration may be given for marine systems on such units to continue to meet MODU Rules, when these units are converted to a fixed platform.

Terms used in this Chapter are defined in Chapter 2, Section 1.

3 Applicability

The requirements described in this chapter are applicable to facilities on fixed installations of various configurations that provide hydrocarbon production and processing services. These services may include well fluid de-pressurization, phase separation, dehydration or other treatment, or just storage, metering and off-loading of process crude.

5 Conditions of Classification

Refer to Chapter 1, Sections 1 through 12 for information on Classification.

CHAPTER 4 **Fixed Installations**

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CHAPTER 4 Fixed Installations

SECTION 2 Plans and Particulars to be Submitted

1 Submissions

The following sections describe ABS documentation requirements for classing facilities on Fixed Installations. It should be noted that due to the varying configurations of offshore production facilities, portions of these requirements may not be applicable to a given installation. See 4-2/Table 1 for a summary of submission requirements.

The plans and data are generally to be submitted in triplicate: one copy to be returned to those making the submission, one copy for use by the Surveyor where the facilities are being constructed or modified, and one copy to be retained in the Technical office for record.

Manufacturers' plans are to be submitted in quadruplicate if construction is to be carried out at a plant other than where the facilities are being constructed or modified.

Additional copies may be required when the mandatory attendance of the Surveyor is anticipated at more than one location.

All plan submissions originating from manufacturers are understood to be made with the cognizance of the main contracting party. A fee may be charged for the review of plans that are not covered by the contract of Classification.

TABLE 1
Submission Requirements

ABS documentation requirements for classing facilities on Fixed Installations:

I. Hydrocarbon Production and Processing Systems

1. Project Specification
2. Process Flow Sheets
3. Heat and Mass Balance
4. Equipment Layout Drawings
5. Area Classification and Ventilation Drawings
6. Piping and Instrument Diagrams (P & ID's)
7. Safety Analysis Function Evaluation (SAFE) Charts
8. Pressure Relief and Depressurization Systems
9. Flare and Vent Systems
10. Spill Containment, Closed and Open Drain Systems
11. Process Equipment Documentation
12. Process Piping Systems
13. Sub-sea Production Systems (Optional)
14. Packaged Process Units

II. Process and Platform Support Systems

1. Piping and Instrument Diagrams for each system
2. Equipment Documentation
3. Process Support Piping Specifications
4. Internal-Combustion Engines and Turbines
5. Cranes (Optional)

III. Electrical Installations

1. Electrical One-line Diagrams
2. Short-Circuit Current Calculations
3. Coordination Study
4. Specifications and Data Sheets for Generators and Motors
5. Specifications and Data Sheets for Transformers
6. Details of Storage Batteries
7. Details of Emergency Power Source
8. Standard Details of Wiring Cable and Conduit Iinstallation Practices
9 Switchboard and Distribution Panel
10. Panelboard
11. Installations in Classified Areas

IV. Instrumentation and Control Systems

1. General Arrangements
2. Data Sheet
3. Schematic Drawings-Electrical Systems
4. Schematic Drawings-Hydraulic and Pneumatic Systems
5. Programmable Electronic Systems

TABLE 1 (continued)
Submission Requirements

V. Fire Protection and Personnel Safety

1. Firewater System
2. Water Spray (Deluge) Systems for Process Equipment
3. Foam Systems for Crude Storage Tanks
4. Fixed Fire Extinguishing Systems
5. Paint Lockers and Flammable Material Storerooms
6. Emergency Control Stations
7. Portable and Semi-Portable Extinguishers
8. Fire and Gas Detection and Alarm Systems
9. Fire and Gas Cause and Effect Chart
10. Structural Fire Protection
11. Guard Rails and Escape Routes
12. Lifesaving Appliances and Equipment
13. Insulation of Hot Surfaces

Due to the varying configurations of the project, some portions of these requirements may not be applicable.

VI. Specific Arrangements

1. Arrangements for Storage Tank Venting and Inerting
2. Arrangements for Use of Produced Gas as Fuel

VII. Start-up and Commissioning Manual

3 Details

The sizes, dimensions, welding and other details, make and size of standard approved appliances on the plans are to be shown as clearly and fully as possible.

5 Hydrocarbon Production and Process Systems

5.1 Project Specification

Submit project specification covering a brief description of field location, environmental conditions, well shut-in pressure, well fluid properties, production plans, oil/gas storage and transportation arrangements.

5.3 Process Flow Sheets

Submit process flow sheets identifying each process stream, process equipment component, planned addition and symbols used.

5.5 Heat and Mass Balance

Submit heat and mass balance specification, including flow rate, composition, and conditions (temperature, pressure, and vapor/liquid ratio) for each process stream under normal operating and expected extreme conditions.

5.7 Equipment Layout Drawings

Submit plans showing arrangements and locations of living quarters and control rooms including entrances and exits; openings to these spaces; layout of machinery, process equipment, crude storage.

5.9 Area Classification and Ventilation Drawings

Submit plans showing degree and extent of all Class I, Division 1 and 2, areas and spaces; or all Class 1, Zone 0, Zone 1 and Zone 2 areas and spaces, as applicable; and the arrangements for ventilation of enclosed spaces. Include locations of ventilation inlets and outlets, with respect to the hazardous areas.

5.11 Piping and Instrument Diagrams (P & ID's)

Submit P & IDs showing size, design, and operating conditions of each major process component, piping and valve designation and size, sensing and control instrumentation, shutdown and pressure relief devices with set points, signal circuits, set points for controllers, continuity of all line pipes, and boundaries of skid units and process packages.

Piping Class Specification and S.A.F.E. Charts included in 4-2/5.23 and 4-2/5.13 are preferably to be submitted with the Piping and Instrument Diagrams.

5.13 Safety Analysis Function Evaluation (S.A.F.E.) Charts

List all process components and emergency support systems with their required devices, and the functions to be performed by each sensing device, shutdown valve and shutdown device.

5.15 Pressure Relief and Depressurization Systems

Submit sizes, arrangements, materials, and design calculations for relief valves and depressurization systems.

5.17 Flare and Vent System

Submit sizes and arrangements, including details of flare tips, pilots, ignition system, water seals and gas purging systems, and provide design calculations for blow down rates, knockout drum sizing, flare and vent sizing, radiant heat intensities, and gas dispersion analysis including basis of analysis.

In the case of proprietary flare tips, submit validation report to supplement the radiant heat intensity values.

5.19 Spill Containment, Closed and Open Drain Systems

Submit arrangements for spill containment, details of piping connections to all process components, sealing, and slope of drains.

5.21 Process Equipment Documentation

Submit specification, data sheet, standard of construction and testing, and general arrangement plans for Christmas tree assemblies (optional), pumps, and compressors.

Submit complete design specification, including all design data such as pressure, temperature, corrosion allowances, service, external loads etc., dimensional drawings covering arrangements and details, material specification, weld details, extent of non-destructive testing, test pressure, and design calculations for verification of compliance to a recognized standard for process vessels, storage tanks, heat exchangers, fired heaters, manifolds and scraper launchers/receivers.

See 4-2/Table 2 “Major Equipment Plans/Calculations and Technical Documentation for Class Requirements”.

5.23 Process Piping Specifications

Submit line list with design conditions, pipe and fitting material lists, specifications, sizes, pressure ratings, calculations for pipe wall thickness, etc.

5.25 Sub-sea Production Systems (Optional)

Provide stress calculations for structural components, P & ID’s, S.A.F.E. Charts, equipment specifications and data sheets, control schematics, assembly drawings, and installation and operation procedures.

5.27 Packaged Process Units

Packaged process units include, but are not limited to, the following: dehydration, sweetening, stabilizing, vapor recovery and gas compression for fuel or re-injection. Documentation requirements for packaged process units include:

i) Skid arrangements

ii) P & ID's

iii) S.A.F.E. charts

iv) Process equipment and piping system documentation

v) Electrical one-line diagrams

vi) Specifications and data sheets

vii) Structural design calculations for skid units in dry condition with a center of gravity height of more than 1.5 m (5 ft.) or a maximum operating weight in excess of 10 MT (metric ton) or 22.05 Kips

TABLE 2
Major Equipment Plans/Calculations and Technical Documentation for Class Requirements

Column A: Drawings, calculations, detailed documentation to be submitted for technical review.

Column B: Technical documentation to be verified by the attending Surveyor at the shop.

Column C: Technical documentation to be verified by the attending Surveyor at the point of installation.

	A	B	C
HYDROCARBON PRODUCTION PROCESS SYSTEMS			
Production Vessels	X		
Storage Tanks	X		
Heat Exchangers	X		
Fired Vessels	X		
Meters, Strainers, Filters, And Other Fluid Conditioners			
< 254 mm (10 in.) and 10.54 kg/cm^2 (150 psi)		X	
> 254 mm (10 in.) or 10.54 kg/cm^2 (150 psi)	X		
Pumps			
< 7 kg/cm^2 (100 psi) and 757 liters/min (200 gpm)		X	
> 7 kg/cm^2 (100 psi) or 757 liters/min (200 gpm)	X		
Compressors			
< 7 kg/cm^2 (100 psi) and 28.3 m^3/min (1000 scfm)		X	
> 7 kg/cm^2 (100 psi) or 28.3 m^3/min (1000 scfm)	X		
Flowlines And Manifolds	X		
Scraper Launchers/Receivers	X		
Packaged Process Units	X		
Flare Systems	X		
Subsea Systems	X		
PROCESS and MARINE SUPPORT SYSTEMS			
Pressure Vessels			
<7 kg/cm^2 (100 psi) and 93.3°C (200°F)		X	
>7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X		
Heat Exchangers			
<7 kg/cm^2 (100 psi) and 93.3°C (200°F)		X	
>7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X		
Pumps			X
Air Compressors		X	

TABLE 2 (continued)
Major Equipment Plans/Calculations and Technical Documentation for Class Requirements

	A	B	C
Engines And Turbines			
< 100 kW (134 hp)		X	
> 100 kW (134 hp)	X		
Packaged Support Systems			
<7 kg/cm^2 (100 psi) and 93.3°C (200°F)		X	
>7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X		
ELECTRICAL SYSTEMS			
Generators			
<100 kW (134 hp)			X
>100 kW (134 hp)	X		
Motors			
<100 kW (134 hp)			X
>100 kW (134 hp)	X		
Distribution Transformers			X
Switchboard, MCC, Panelboards	X		
Storage Batteries	X		
INSTRUMENT AND CONTROL SYSTEMS			
Control Panels	X		
FIRE PROTECTION & SAFETY EQUIPMENT			
Fire Pumps		X	
Fire Pump Skid Package	X		
Alarm Panels		X	
Fixed Fire Extinguishing Systems	X		
COMPONENT SKID STRUCTURE For modules that require design review, see 3-3/23.3 and 3-2/5.27.	X		

7 Process and Platform Support Systems

Process and platform support systems include, but are not limited to, the following:

i) Utility/Instrument Air System

ii) Fuel/Instrument Gas System

iii) Use of produced gas as fuel for process equipment

iv) Purging System

v) Fuel Oil System

vi) Lubricating Oil System

vii) Crude Oil Storage and Flammable Liquid Facility

viii) Drainage System

ix) Hydraulic System

x) Sewage Treatment System

xi) Chemical Injection System

xii) Helicopter Refueling System

xiii) Vent System

xiv) Drain System

xv) Platform Drilling Systems

xvi) Heating and Cooling System

Documentation requirements for Process Support Systems are:

7.1 Piping and Instrument Diagrams (P & ID's)

Submit piping and Instrument Diagrams (P & ID's) for each system, details as per 4-2/5.11.

7.3 Equipment Documentation

Submit specifications, data sheets and drawings for each equipment component such as pressure vessels, heat exchangers, pumps and compressors. Details as per 4-2/5.21.

7.5 Piping Specifications

Submit specifications, materials, sizes and pressure ratings for all pipes, valves and fittings, calculations for pipe wall thickness, and line list with design conditions.

7.7 Internal-Combustion Engines and Turbines

Submit specifications for internal-combustion engines and turbines, including types, horsepower, revolutions per minute, shutdown arrangements and manufacturer's affidavit verifying compliance with recognized standards.

7.9 Cranes (Optional)

Submit specifications for cranes, including structural design calculations, load rating chart and test certificates for wire rope.

9 Electrical Systems

9.1 Electrical One-Line Diagrams

Indicate the ratings of generators, transformers and motors; rated load current for each branch circuit; type and size of wires or cables; rating or settings of circuit breakers; rating of fuses and switches; and the interrupting capacity of circuit breakers and fuses.

9.3 Short-circuit Current Calculations

To establish that the protective devices on the main and emergency switchboards have sufficient short-circuit breaking and making capacities, data are to be submitted giving the maximum calculated short-circuit current in symmetrical r.m.s. and asymmetrical peak values available at the main bus bars, together with the maximum allowable breaking and making capacities of the protective device.

Similar calculations are to be made at other points in the distribution system where necessary, to determine the adequacy of the interrupting capacities of protective devices.

9.5 Coordination Study

A protective device coordination study is be submitted. This protective device coordination study is to consist of an organized time-current study of all protective devices in series. The study is to be from the utilization equipment to the source for all circuit protection devices having different settings or time-current characteristics for long-time delay tripping, short-time delay tripping, and instantaneous tripping, where applicable.

Where an over-current relay is provided in series and is adjacent to the circuit protection device, the operating and time-current characteristics of the relay are to be considered for coordination.

9.7 Specifications and Data Sheets for Generators and Motors

For generators and motors of 100 kW (134 hp) and over, submit drawings showing assembly, seating arrangements, terminal arrangements, shafts, coupling, coupling bolts, stator and rotor details together with data for complete rating, class of insulation, designed ambient temperature, temperature rise, weights and speeds for rotating parts.

For generators and motors under 100 kW (134 hp), submit complete rating, class of insulation, and degree of enclosure.

9.9 Specifications and Data Sheets for Transformers

Submit rating, class of insulation, rated ambient temperature, rated temperature rise, details of enclosure and standard to which manufactured.

9.11 Details of Storage Batteries

Submit arrangement, ventilation, corrosion protection, types and capacities, conductors and charging facilities, over-current and reverse current protection.

9.13 Details of Emergency Power Source

Submit location, arrangement, and services required to maintain the integrity of the facility in the event of primary power loss.

9.15 Standard Details of Wiring Cable and Conduit Installation Practices

A booklet is to be submitted on the standard wiring practices and details, including such items as cable supports, earthing details, bulkhead and deck penetrations, cable joints and sealing, cable splicing, watertight and explosion-proof connections to equipment, earthing and bonding connections, etc., as applicable.

9.17 Switchboard, Distribution Boards and Motor Control Centers

i) A front outline of the switchboard, including overall dimensions, front view indicating instrumentation, circuit breakers, switches, drip-shields, hand-rail and securing/ supporting details.

ii) Complete list of materials, including manufacturer's name, model number, rating, size, type, testing laboratory's listing number (if any), or indication of construction standard for components such as: switchboard enclosure, circuit breakers, all types of fuses, power and control wiring, bus bars, connectors and terminals and power switches.

iii) Bracing arrangements and calculations to determine that bus bars and short runs of power cables are adequately braced to withstand the mechanical forces that the switchboard may be subjected to under fault conditions.

iv) A complete wiring schematic, including type of wiring, size, and setting of protective devices *v)* One line schematic of the bus bars, indicating rating for each of the horizontal and vertical buses, the exact connection of circuit breakers to the bus bars, setting of the power circuit breakers and loads ampacities and power cable sizes, if available.

vi) Actual bus bar arrangement of the horizontal, vertical, and ground buses, including bus bar material, size and rating, separation distances between bus bars, and between bus bars and bare metal parts.

vii) Grounding details

viii) If applicable, details of metal barriers provided to isolate bus bars, wiring, and associated components.

9.19 Panelboard

The information as requested in 4-2/9.17i), ii), v) and vii), as applicable.

9.21 Installations in Classified Areas

List of electrical equipment installed in classified areas, together with documentation issued by an independent testing laboratory certifying suitability of same for intended services.

11 Instrumentation and Control Systems

11.1 General Arrangements

Submit layout plans for local controllers, central controllers, displays, printers, and other instrumentation and control devices.

11.3 Instrumentation List

Submit a list of instrumentation and control equipment, including a list of monitoring, control, and alarm set points and ranges.

11.5 Schematic Drawings – Electrical Systems

Include types and sizes of electrical cables and wiring, voltage rating, service voltage and current, overload and short-circuit protection for the following systems:

i) Process control panels

ii) Emergency shut-down (ESD) panels

iii) Intrinsically safe systems

iv) Fire and gas detection and alarm panels

v) Fire alarm circuits

vi) Emergency generator or fire pump drive starting circuit

11.7 Schematic Drawings – Hydraulic and Pneumatic Systems

Submit system description of hydraulic and pneumatic control systems, including pipe sizes and materials, pressure ratings, and relief valve settings.

11.9 Programmable Electronic Systems

Submit the control philosophy, schematic alarm, monitoring and control arrangements, and redundancy arrangements. Provide failure modes of the system components.

13 Fire Protection and Personnel Safety

13.1 Firewater System

Submit plans indicating pump and piping arrangements, location of isolation valves, locations of firewater stations, details of fire pumps including pump drivers, pump capacity and pressure, and hydraulic calculations for sizing of fire pump capacity and fire main.

13.3 Water Spray Systems for Process Equipment

Submit plans showing the arrangement for firewater piping and spraying nozzles, as well as detailed hydraulic calculations.

13.5 Foam Systems for Helicopter Facilities with Refueling Capabilities and for Crude Oil Storage Tanks (if provided)

Indicate the arrangement for firewater supply, foam supply and delivery, type of foam and expansion ratio, as well as capacity calculations for areas protected.

13.7 Fixed Fire Extinguishing Systems

Submit plans showing the arrangement for piping, spraying nozzles, and storage of the extinguishing medium, and details of control and alarm for release of the extinguishing medium, as well as capacity calculations and discharge time calculations for areas protected.

13.9 Paint Lockers and Flammable Material Storerooms

Submit plans and calculations showing details of fixed fire extinguishing systems for the paint lockers and flammable material storerooms.

13.11 Fire Control and Lifesaving Equipment Plan

Submit a fire control and lifesaving equipment plan. The plan is to include the following:

13.11.1 Portable and Semi-portable Extinguishers

The plan is to include type(s), quantities, and locations of portable and semi-portable extinguishers for the platform.

13.11.2 Fixed Fire Detection, Alarm and Extinguishing Systems

The plan is to show locations, controls, protected spaces/areas and types of extinguishing systems.

13.11.3 Emergency Control Stations

The plan is to include location and equipment.

13.11.4 Lifesaving Appliances and Equipment

The plan is to show types, capacity, quantity and location.

13.11.5 Structural Fire Protection

The plan is to show arrangements, locations and types of fire walls.

13.11.6 Guard Rails and Escape Routes

The plan is to show arrangement of protective guard rails, toe plates and means of escape from normally manned spaces.

13.13 Fire and Gas Detection and Alarm Systems

Indicate the locations and details of power supplies, sensors, annunciation and indicating equipment, set points of alarm systems, and data sheets for detectors.

13.15 Fire and Gas Cause and Effect Chart

Relate all fire and gas sensors to shutdowns, operation of fixed systems and fire control plans.

13.17 Insulation of Hot Surfaces

Submit details of insulation and shielding provided for personnel safety and fire protection.

15 Arrangements for Storage Tank Venting and Inerting

Submit arrangements for storage tank venting and inerting systems if the fixed installation has the crude storage capability.

17 Arrangements for Use of Produced Gas as Fuel

Submit piping and control arrangements for use of produced gas as fuel, showing details of double wall or ducting arrangements for the pipe runs in way of the safe space.

19 Start-up and Commissioning Manual

The manual outlined in Chapter 5, Section 1 is to be submitted for review as early as possible, prior to the commissioning of the platform.

21 Maintenance of Class Modifications

Details of modifications to machinery, piping, process equipment, etc., which may affect classification, are to be submitted for approval. Typically, these may include the following:

i) Equipment changes and modifications, including changes in alarms, instrumentation, and control schemes

ii) Facility throughput changes and changes in feed and product compositions

iii) Changes in operating conditions, including pressures, temperatures, flow rates, or process conditions different from those in the original process or mechanical design

iv) Changes in relief requirements due to factors such as increased process throughput, operation at higher temperatures or pressures, increased size of equipment, or addition of equipment

v) Changes to process support systems, such as changes to chemical injection, gas dehydration, etc.

CHAPTER 4 Fixed Installations

SECTION 3 Hydrocarbon Production and Process Systems

1 General

1.1 Scope

The minimum criteria applicable to equipment and systems for handling and processing produced fluids from completed wells are defined in Chapter 3, Section 3 of this Guide, except items modified below. These requirements address process components such as process vessels, heat exchangers, fired heaters, compressors and pumps, as well as the associated piping, process control, and process safety systems. The documentation requirements for design review are given in Chapter 4, Section 2.

3 Design Load for Equipment

The design of all hydrocarbon liquid retaining equipment such as pressure vessels, heat exchangers, fired heaters, etc., is to ensure that stresses due to external nozzle loads and moments, stresses due to any other applicable external forces and environmental conditions such as wind and earthquake, are within the limits allowed by the Code.

CHAPTER 4 **Fixed Installations**

SECTION 4 **Process and Platform Support Systems**

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CHAPTER 4 **Fixed Installations**

SECTION 4 **Process and Platform Support Systems**

1 General

1.1 Scope

This section presents criteria for the design and installation of process and platform support systems on fixed installations. Process and platform support piping design criteria are to be in accordance with API RP 14E or other industrial recognized standard such as ASME B31.3. General arrangement of these systems is to comply with API RP 14J, or other applicable standard. The documentation requirements for design review are given in Chapter 4, Section 2.

Process and platform support systems include, but are not limited to, the following:

i) Utility/Instrument Air System

ii) Fuel/Instrument Gas System

iii) Use of Produced Gas as Fuel

iv) Purging Systems for Process Equipment

v) Chemical Injection System

vi) Heating and Cooling Systems

vii) Fuel Oil System

viii) Hydraulic System

ix) Lubricating Oil System

x) Sewage Treatment System

xi) Helicopter Refueling System

xii) Segregation of Piping Systems

xiii) Vent System

xiv) Drainage System

xv) Crude Oil Storage Tanks Venting System

xvi) Crude Oil Storage Tank Purging and Blanketing Systems

xvii) Inert Gas Supply

xviii) Oil Fired Inert Gas Generator

xix) Platform Drilling Systems

1.3 Applicability

Process support systems and platform support systems for fixed installations are to meet the requirements of Chapter 3, Section 4, except as modified below.

3 Components Requirements

3.1 Pressure Vessels and Heat Exchangers

In contrast to floating installations, the designer of a fixed installation may not have to address issues arising from the motion of the floating installation. However, the design of pressure vessels and heat exchangers for a fixed installation is to ensure that stresses due to external nozzle loads and moments, and stresses due to any other applicable external forces such as wind or seismic activity are within the limits allowed by the Code. (See also 3-4/3.1 and 3-4/3.3.)

5 System Requirements

Platform piping design, selection of valves, fittings, are to be in accordance with API RP 14E, ASME B31.3, or other recognized standards.

5.1 Use of Produced Gas as Fuel

The requirements of 3-4/5.7 are applicable to all enclosed spaces, including spaces located on the production deck, that have boilers, inert gas generators, and combustion engines using produced gas as fuel. (See also 3-4/5.7.)

5.3 Fuel Storage for Helicopter Facilities

5.3.1 Location

Fuel storage and transfer facilities are to be remote or suitably isolated from areas that contain a source of vapor ignition, and are not to be located in the approach path of the helicopter. The storage and transfer area is to be permanently marked as an area where smoking and open flames are not permitted.

5.3.2 Tank Construction

Fuel storage tanks are to be of approved metal construction. For pressurized tanks, the criteria for pressure vessels in 4-4/3.1 above are to be followed. The design and fabrication of atmospheric or low-pressure tanks are to be in accordance with Part 3 Section 4 of *Offshore Installation Rules*. Alternatively, the criteria for deep tanks as per ABS *Steel Vessel Rules* may be followed.

Special attention is to be given to the design, mounting, securing arrangement, and electrical bonding of the storage tank and the fuel transfer system.

5.3.3 Tank Vents

Tank vents are to be sized in accordance with API Standard 2000, "Venting Atmospheric and Low-Pressure Storage Tanks". Vent outlets are to be located so that vapors will disperse freely.

5.3.4 Remote Control

Storage tank outlet valves are to be provided with a means of remote closure in case of fire. Gray cast iron valves are not to be used as shutoff valves for fuel oil tanks. Means are also to be provided for remote shutdown of the fuel transfer unit.

5.3.5 Containment

A containment of at least 150 mm (6 in.) high is to be provided around the fuel storage area, including the pumping unit and associated piping, to contain spillage and retain fire extinguishing agents.

If the installation is designed with the fuel storage tank(s) cantilevered from the platform and arranged to be jettisoned, containment will be required only around the fuel-pumping unit.

5.3.6 Drain

Drainage is to be provided for the area enclosed by the containment and is to comply with the following:

i) The area within the containment is to be sloped toward the drain line.

ii) The drain line is to be led to a holding tank complying with 4-4/5.3.2 and 4-4/5.3.3.

iii) The drain line cross-sectional area is to be at least twice that of the fuel storage tank outlet connection.

5.3.7 Containment with No Drainage

Containment not provided with drainage arrangements in accordance with the above is to be sized to contain the full volume of the fuel storage tank plus 150 mm (6 in.) of foam.

5.5 Sewage Treatment Systems

Government Authority is to be consulted for requirements of sewage discharge to the sea.

5.7 Vent System

Vent pipes are to be fitted to all tanks and are to be located at the highest part of the tank. Vents for fuel oil tanks are to be led to the weather.

Where tanks are to be filled by pump pressure, the aggregate area of the vents in the tank is to be at least 125% of the effective area of the filling line.

Vent outlets from fuel oil tanks are to be fitted with corrosion-resistant flame screens having a clear area through the mesh not less than the required area of the vent pipe and are to be located where the possibility of ignition of gases issuing from the vent outlets is remote.

5.9 Drainage System

Efficient means are to be provided for draining water from all enclosed spaces where leakage or accumulation of water may be critical for structural strength or operation of equipment.

Drains from hazardous and non-hazardous areas are to be separated. See 3-4/5.5 and also 3-3/13.7 for reference.

Attention is to be directed to Governmental Authority requirements relative to the drain discharge to sea.

7 Crude Oil and Flammable Liquid Storage Facility Arrangement

The requirements of this section apply to fixed installations that have storage capability for crude oil or flammable liquids, such as methanol, with a flash point of 60°C (140°F) or less. See 4-8/5.5 or 4-8/5.7.4 for applicable fire protection requirements.

7.1 Tank Venting Systems

Where pressure/vacuum relief valves are fitted on crude oil storage tanks, pressure relief lines are to be connected to the low-pressure (less than 2.5 psig or 0.17 kg/cm^2) flare header, or vented to a safe location. The outlets of high velocity vents or free flow vents are to be located not less than 10 m (33 ft.) from the air intakes and openings to spaces containing the sources of ignition. Free flow vents are to be fitted with flame arresters.

7.3 Storage Tank Purging and Blanketing Systems

7.3.1 Purging and Blanketing

On facilities equipped for storage of liquid hydrocarbons, a permanently installed inert gas system is to be provided for purging and tank blanketing. Either inert gas or produced gas is to be used to maintain crude oil storage tanks with a positive pressure in relation to the surrounding atmosphere. The storage tanks are to be previously purged with inert gas when produced gas is used for tank blanketing. Inert gas and produced gas used for tank blanketing are to be in accordance with 4-4/7.3.2, 4-4/7.3.3, 4-4/7.3.4, below and 4-4/7.5 and 4-4/7.7.

7.3.2 Oxygen Content and Monitor

The oxygen content of the inert gas used is not to exceed five (5) percent by volume. Oxygen monitoring equipment is to be provided to monitor oxygen levels in the inert gas supply as well as in the storage facilities.

7.3.3 Capacity and Pressure

The inert gas source is to be capable of supplying gas at a rate not less than 125% of the highest possible oil transfer rate. The system is to be designed so that the maximum pressure which can be exerted on the tank(s) does not exceed 0.24 kg/cm^2 (3.5 psi).

7.3.4 Isolating Valves

Shutoff valves are to be fitted on both the suction and discharge connections for each blower, or at the inlet and outlet of the final pressure regulator in a stored gas system.

7.5 Inert Gas Supply

7.5.1 General

The inert gas may be treated flue gas from boiler(s) or from a separate inert gas generator. In all cases, automatic combustion control suitable for operation under all service conditions is to be fitted. The following specific requirements apply.

7.5.2 Demister

Demisters or equivalent devices are to be provided to minimize carryover of water from the scrubber and the deck water seal.

7.5.3 Gas-regulating Valve

The gas-regulating valve is to be arranged to close automatically when any of the following conditions occur:

i) Loss of water pressure to deck seal(s)

ii) Loss of control power

7.5.4 Blowers

When two blowers are provided, the total required capacity of the inert gas system is preferably to be divided equally between the two blowers, and in no case is one blower to have a capacity less than $^1/_3$ of the total capacity required.

7.7 Oil Fired Inert Gas Generators

7.7.1 Fire Protection

The space in which any oil fired inert gas generator is situated is to be protected with a fixed fire extinguishing system. See also 4-8/5.5.

7.7.2 Venting

Arrangements are to be made to vent the inert gas from oil fired inert gas generators to the atmosphere when the inert gas produced is off specification, e.g., during starting-up or in case of equipment failure.

7.7.3 Fuel Oil Shutdown

Automatic shutdown of the fuel oil supply to inert gas generators is to be arranged on predetermined limits being reached with respect to low water pressure or low water flow rate of the cooling and scrubbing arrangement, and with respect to high gas temperature.

9 Platform Drilling Systems

The requirements of this section apply to drilling, workover and completion systems.

9.1 General Arrangement

Drilling areas are to be located away from quarters, process facilities and sources of ignition. See 3-3/5 for additional precautions.

9.3 Equipment and Systems

Manufacturing of drilling equipment and systems is to comply with applicable, recognized standards having criteria for design, manufacture, testing and installation. Where equipment or systems comply with (unpublished) manufacturer's standards, it is to be demonstrated that their design, manufacture, testing and installation requirements offer an equivalent level of safety.

9.5 Area Classification

Considerations for delineation of classified areas are to be in accordance with API RP 500 or 505.

9.7 Piping Systems

Piping system design, selection of valves, fittings and flanges, fabrication, and testing are to be in compliance with ASME B31.3, except that well control components constructed in accordance with API Spec 16D will also be acceptable.

Hydraulic hoses for BOP Control Systems are to meet Section 4.3.1.2.2 of API Spec 16D “Control Systems for Drilling Well Control Equipment” (2000°F) at normal working pressure for 3 minutes, or equivalent recognized fire tests.

Burst pressure of the hose is not to be less than three times the relief valve setting.

9.9 Electrical Systems

Electrical components and systems are to comply with Chapter 4, Section 6, except that flexible cables, provided they are of the heavy-duty type may be installed where necessary.

9.11 Safety Features

Mud tank level alarms are to be provided at the driller’s console and the mud tank space.

CHAPTER 4 Fixed Installations

SECTION 5

(SECTION 5 INTENTIONALLY LEFT BLANK.)

CHAPTER 4 Fixed Installations

SECTION 6 Electrical Systems

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CHAPTER 4 Fixed Installations

SECTION 6 Electrical Systems

1 Applicability

Electrical installations for all fixed installations are to meet the requirements of Chapter 3, Section 6, except as modified as follows herein. They need not meet the requirements of the *Steel Vessel Rules* or *Mobile Offshore Drilling Unit Rules*.

3 Transformers

Fixed platforms need not comply with 3-6/9.3.

5 Switchgear

Fixed platforms need not comply with 3-6/11.11.

7 Hazardous Areas

Fixed platforms need not comply with 3-6/15.5.

9 Power Source Requirements

Fixed platforms need not comply with 3-6/21, provided they comply with the requirements listed below.

This section details minimum electrical power generation for operation. It is to be noted that governmental regulations may require reserve main power or an emergency power source in excess of these requirements.

9.1 Unmanned Facilities

9.1.1 Main Power

The main power source(s) is to be sufficient to maintain the maximum intended operational loads of the facility without need to use the emergency source of power.

9.1.2 Emergency Power

An emergency power source, independent of the facility's main power, is to be sufficient to supply services for navigational aids as required by the local Coastal Authority, but not for less than four (4).

9.3 Manned Facilities

9.3.1 Main Power

The main power source(s) is to be sufficient to maintain the maximum intended operational load of the facility.

9.5 Manned Facilities in Severe Environments

In areas of severe environment (See 2-1/99), sources of power for systems vital to safety, such as firefighting and protection of personnel from severe environmental effects, are to include at least the following:

9.5.1 Main Power

Two main generators, each of which is to be capable of maintaining the operation of essential equipment on the platform.

9.5.2 Emergency Power

An emergency source of power for systems vital to safety, firefighting and protection of personnel, is to be provided to supply the services as listed herein. Provision for emergency power supply less than those listed herein will be considered, provided adequate technical justification is submitted. Loads to be supplied by the emergency source of power are listed in 4-6/21.5.3 and 4-6/21.5.4:

9.5.3 Fire Pump

Where both fire pumps, required by 4-8/5.1.2 of this Guide, are electric motor-driven, one of these pumps is to be powered by the emergency source of power. The emergency source of power is to have sufficient fuel for at least 18 hours of fire pump operation.

9.5.4 Other Loads

The following loads are to be powered by the designated emergency source of power:

i)	Fire detection	18 hours
ii)	Gas detection	18 hours
iii)	Communication	18 hours
iv)	ESD system (if electric)	18 hours
v)	Paging and alarm system	18 hours
vi)	Emergency lighting from all spaces to all alternative egress points	18 hours
vii)	Electric blowout preventer control system	18 hours
viii)	Navigational aids	As required by the applicable Coastal Authority, but not less than 4 days

11 Emergency Source of Power

Manned facilities on fixed installations in severe environment need not comply with 3-6/23, provided they comply with the requirements listed below.

11.1 General

An emergency source of power as required by 4-6/9 may be supplied by an emergency generator (3-6/23) or batteries (3-6/25). Installations are to be in accordance with section 5.6 of API RP 14F and the following:

11.3 Location

The emergency power source is to be self-contained on the same platform or structure as the loads it supplies (unless the power source and loads are each on fixed platforms connected by a permanent means such as a bridge). The emergency power source is to be installed in a safe space that is to be outside the space containing the main power source and other machinery spaces.

11.5 Operability

Boundaries of spaces containing the emergency source(s) of power are to be insulated to not less than A-60 when these boundaries are common with any machinery space or hazardous area.

Emergency source of power is to be capable of starting and/or operating independently, whether hydrocarbon production and processing facilities are on stream or shut down.

CHAPTER 4 Fixed Installations

SECTION 7 Instrumentation and Control Systems

(SEE CHAPTER 3, SECTION 7)

CHAPTER 4 Fixed Installations

SECTION 8 Fire Protection and Personnel Safety

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CHAPTER 4 **Fixed Installations**

SECTION 8 **Fire Protection and Personnel Safety**

1 General

1.1 Scope

The fire protection and personnel safety features are to comply with this section, NFPA Standards and Recommended Practices, and API RP 14G, as referenced herein. Due to the varying configurations of offshore production facilities, fire protection requirements will vary accordingly. This section primarily addresses requirements for manned production facilities. The documentation requirements for Design Review are given in Chapter 4, Section 2.

1.3 Governmental Authority

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

1.5 Applicability

Fire protection and personnel safety features for fixed platforms and self-elevating drilling units (SEDU) which convert into fixed platforms are to meet this Section of the Guide.

3 Requirements for Fire Fighting Systems

The following are minimum requirements for fire fighting systems on fixed facilities:

3.1 Unmanned Platforms

i) Portable fire extinguishers per 4-8/5.13.

ii) Fire detection systems per 4-8/7

3.3 Manned Production Platforms

All applicable requirements of Chapter 4, Section 8 of this Guide.

5 Fire Fighting Systems

5.1 Firewater System

Fixed water fire fighting systems are to be provided as follows:

5.1.1 Piping

5.1.1(a) General Water fire fighting systems are to be capable of maintaining a continuous supply in the event of damage to water piping. Piping is to be arranged so that the supply of water could be from two different sources. Isolation valves are to be provided such that damage to any part of the system would result in the loss in use of the least possible number of hydrants, water spray branches, or foam water supplies. In most facility arrangements this will require a loop type fire main. Connections of the primary and standby pump supplies are to be as remote from each other as possible.

5.1.1(b) Materials Materials rendered ineffective by heat are not to be used in firewater piping systems.

Resilient seated valves may be considered for use in firewater systems, provided the proposed valves are capable of passing an appropriate fire test acceptable to ABS (e.g. UK/DOT Appendix D "Fire Test Requirements to Fire Mains and Fittings"). Additionally, the valves must be capable of being effectively closed even with the resilient seat damaged or destroyed, such that leakage through the closed valve is insignificant. The leakage rate at the firewater pressure through the closed damaged-seated valves still permits the firewater to deliver at least two jets of water at the required pressure.

Similarly, non-metallic expansion joints may be considered for use in firewater systems, provided the proposed joints are capable of passing a recognized fire test such as the UK/DOT Appendix D. See Appendix 2 of this Guide for details.

All plastic piping materials are to meet Appendix 1 of this Guide. Generally, plastic (GRP/FRP) materials used in firewater systems are to pass Level 1 fire endurance test. However, a plastic piping material that passes Level 3 fire endurance requirements in lieu of Level 1 requirements may be considered when conditions listed in 4-8/5.1.1(e) below are fully met.

5.1.1(c) Charging The firewater distribution system may be maintained in a charged or dry condition. Where a system is maintained dry, relief devices and additional pipe bracing is to be considered to prevent damage to the piping system due to water hammer when the system is charged.

When plastic pipe that passes only Level 3 fire endurance test is used, the firewater system design is to be pressurized (wet main) and permanently in a charged condition.

5.1.1(d) Piping Maintenance The distribution system is to be maintained such that internal and external corrosion of the piping is minimized. In areas where the system is subject to freezing, steps are to be taken to prevent freezing. For instance, drains, circulation loops or other means may be provided for cold water protection. If drains are provided, they are to be located at the lowest points in the system.

5.1.1(e) Additional System Requirements for Level 3 Plastic Pipe The following additional requirements are applicable to the plastic material piping that passes Level 3 in lieu of Level 1 fire endurance tests and is used in the fire main system.

i) Plastic piping must be located on the exterior perimeter of the platform and shielded by primary structural members from potential sources of fire that may occur on or emanate from the platform.

ii) Plastic piping must be located so that pooling of flammable liquids below the piping is not possible. A properly designed drainage system may be provided to mitigate the pooling of flammable liquid below the piping system.

iii) The firewater system design is to be such that the plastic sections are continuously maintained in the wet condition.

iv) The firewater system is to be equipped with an adequate number of isolation and cut-off valves such that, if a section of the system were to fail, it could be isolated and the remainder of the system would still be capable of supplying firewater.

5.1.2 Fire Pumps

5.1.2(a) General There are to be at least two independently driven and self-priming fire pumps. The fire pumps, together with their respective source of power, fuel supply, electric cables, lighting, ventilation, piping and control valves, are to be located such that a fire in any one location will not render both fire pumps inoperable. One of the two pumps is to be designated as the primary fire pump, and the other as the standby fire pump. At least one of the pumps is to be diesel engine driven, unless the emergency power supply can supply the load for an electric motor driven pump. Fire pump installations are to be in accordance with NFPA 20, or an equivalent standard.

5.1.2(b) Capacity The primary and standby fire pumps are each to be capable of supplying the maximum probable water demand for the facility. The maximum probable water demand is the total water requirement for protection of the largest single fire area plus two jets of firewater at a pressure of at least 5.3 kg/cm^2 (75 psi). Multiple pump installations will be considered in lieu of a single primary and/or standby pump installation, provided they are arranged in such a manner that a fire in one area would not reduce the available supply of firewater required to handle that fire, or such that if the largest pump is out of service for maintenance, the available supply of water would not be reduced below the maximum probable water demand. A means is to be provided for periodic testing of each fire pump. See 4-8/Figure 1 through 4-8/Figure 3 for typical arrangement of fire pumps on fixed installations.

For a typical fixed platform arrangement, the maximum probable water demand includes the water supply to the water spray system for a single fire on the production area as discussed above, plus two jets of firewater. For detailed requirements of the water spray system, see 4-8/5.1.4 below.

To determine the maximum probable water demand, the fire risk areas on the production deck may be divided into fire zones. If a fire is being considered in a single zone, the water supply for the water spray system is to be sufficient for that zone and adjacent zones. The water spray system requirement may be ignored for adjacent zones if these zones are separated by a firewall (no less than A-60) or by an adequate distance between process components to justify such zoning. See 4-8/Figure 4a for reference.

Note that the system emergency shutdown and the equipment blowdown may be considered a safe alternative to the water spray for low hydrocarbon liquid inventory equipment such as the gas compressor units. See 4-8/Figure 4b for reference.

FIGURE 1
Fixed Installation
Fire Pump Arrangement
Two-pump Scenario

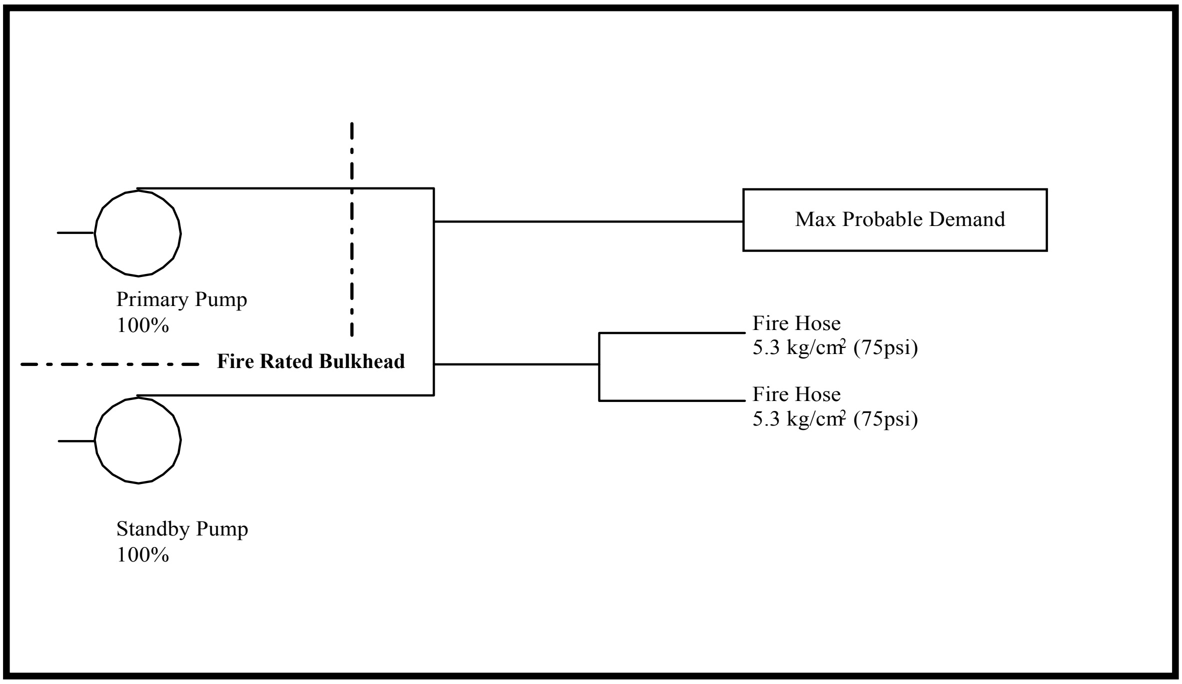


FIGURE 2
Fixed Installation
Fire Pump Arrangement
Multiple-pump (Even Power) Scenario

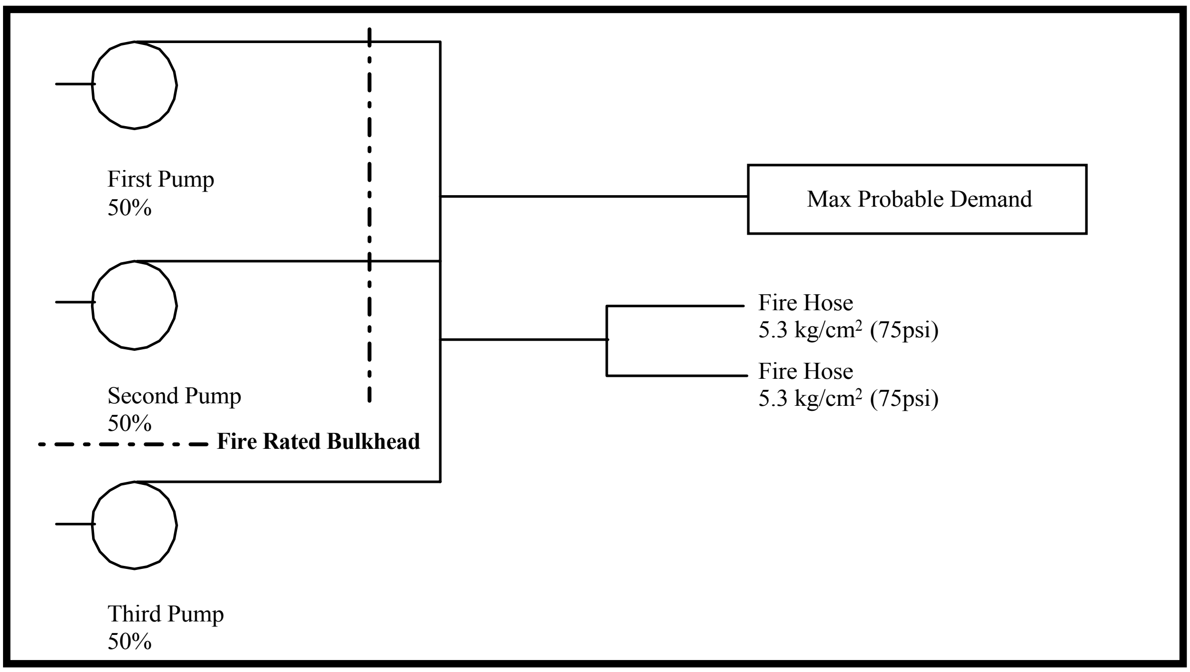


FIGURE 3
Fixed Installation
Fire Pump Arrangement
Multiple-pump (Uneven Power) Scenario

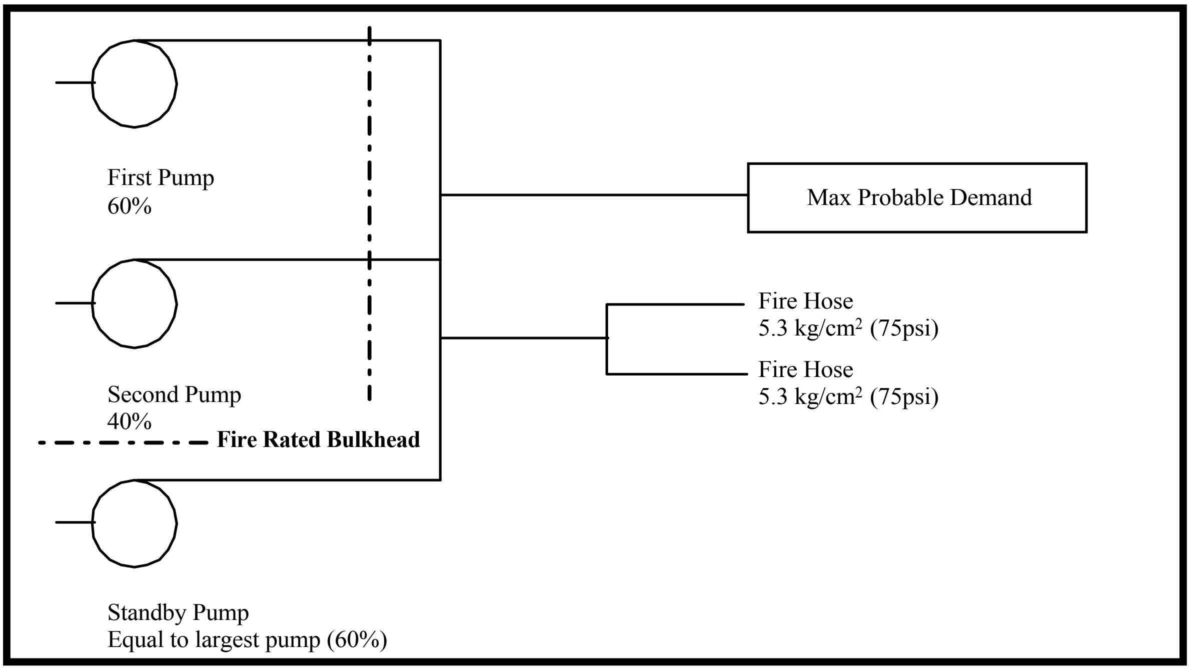


FIGURE 4a
Typical Fire Zones Arrangement on Process Area of a Fixed Installation Single Fire with A-0 Fire Wall

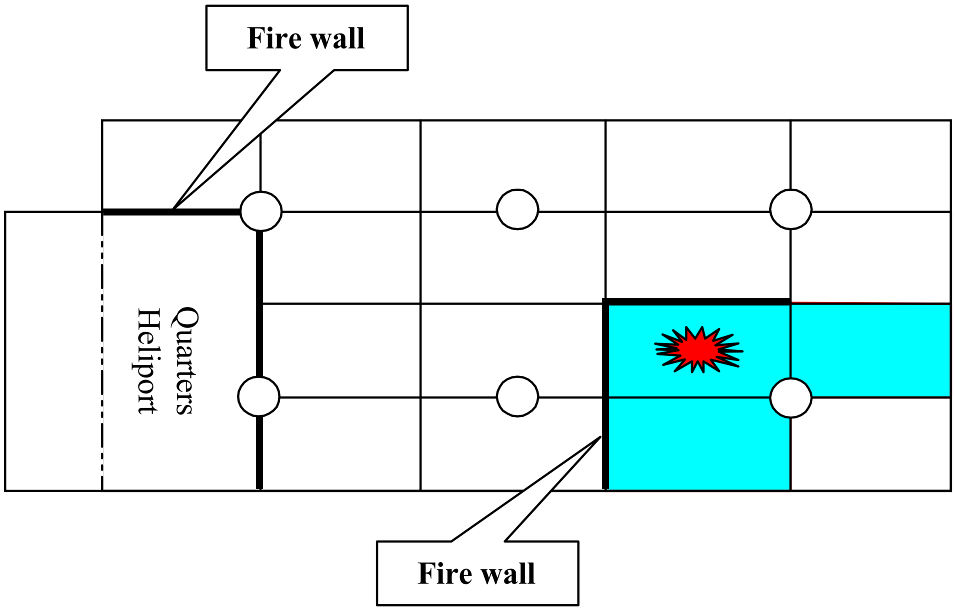
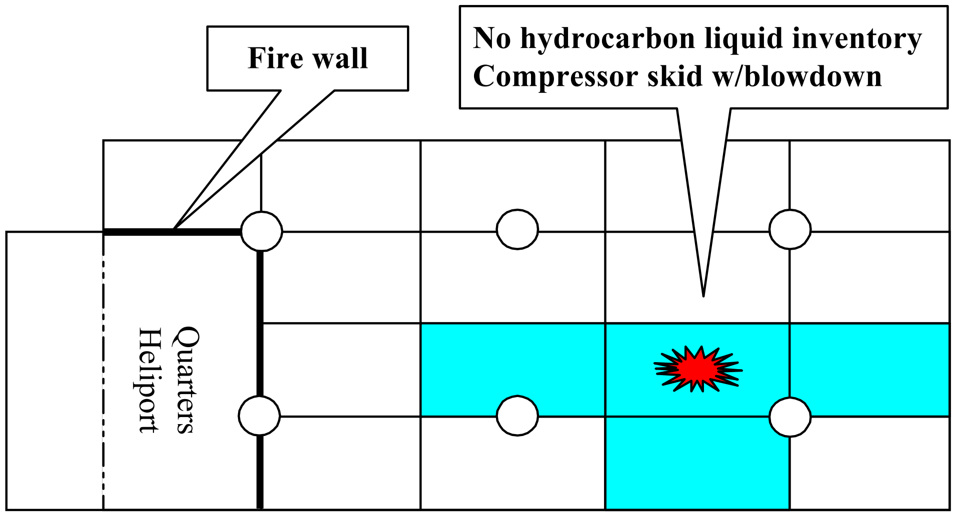
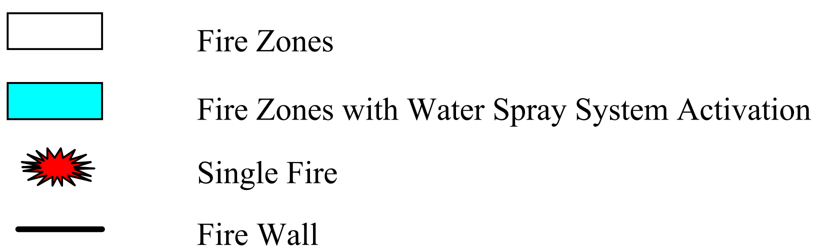


FIGURE 4b
Typical Fire Zones Arrangement on Process Area of a Fixed Installation Single Fire with an Adjacent Zone that has no Liquid Inventory





5.1.2(c) Operability and Control Pump(s) with sufficient capacity for process water spray systems is (are) to be provided with automatic starting. In addition to the pump automatic starting requirement, pump driver starters are to be provided with means for local and remote operation from a permanently manned station or a fire control station. Pump discharge control valves, used to separate the section of the firewater service system and the fire pump(s), are to be fitted in an easily accessible location outside of the pump space. Diesel-driven fire pumps may be provided with electrical or pneumatic starting and control systems. Diesel drives using electrical starting and control systems are to be maintained in a weather-protected enclosure. Alternative means of protecting electrical starting and control system will be considered.

5.1.2(d) Pump Drivers Pump drivers may include diesel engines, natural gas engines, or electric motors. The pump drivers are to be in general accordance with Section 5.2(4)(a), (b) and (c) of API RP 14G with respect to their types and installation requirements. Fuel tanks, fuel lines to engines, and power cables and starters for electric motors, are to be protected against fire and mechanical damage.

Where diesel and natural gas engine fire pumps are considered, the arrangements are to comply with requirements of 3-4/3.9 and Chapter 4, Section 6. For electrical motor-driven fire pumps, see Chapter 4, Section 6 for applicable requirements

5.1.2(e) Fuel Systems Fuel systems are to comply with the requirements of Chapter 4, Section 4 and 3-4/5.11. Fuel supplies for diesel engines are to be sufficient for 18 hours operation.

5.1.2(f) Lift Columns Water lift columns are to be encased in pipe for protection against wave action and mechanical damage, and the protective pipe is to be securely attached to the structure in order to lessen wave action damage. Corrosion allowance is to be considered when the water lift column is designed. Where pipes for lift columns pass through floating structures, penetrations are to be made by approved methods to maintain the watertight integrity of the structure. Intake strainers constructed of corrosion-resistant materials are to be fitted at the suction end of the fire pump's water lift column.

5.1.3 Firewater Stations

5.1.3(a) General Firewater stations are to be located so that each station will be readily accessible in the event of a fire. All materials that comprise the firewater station and the access to firewater stations are to be of steel or equivalent material which would not be rendered ineffective by heat. Fiber Reinforced Plastic (FRP) grating may be used if the layout is designed in accordance with Appendix 3, and provided that the FRP grating is approved as meeting the applicable criteria defined in same.

5.1.3(b) Arrangement Firewater stations are to be located on the perimeter of process areas. 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 production facility that may be exposed to fire.

The firewater stations are also to be arranged to provide protection against fire damage or mechanical damage, operation free from interference by other emergency activities, and effective coordination with other stations.

5.1.3(c) Monitors and Nozzles Monitors are to be sized for a minimum flow of 1,892 liters/min. at 7.3 kg/cm^2 (500 gpm at 100 psig). Nozzles are to be adjustable from straight stream to full fog and to have a nozzle diameter of at least 12 mm (0.5 in.). Monitors and nozzles are to be of corrosion-resistant materials, and/or be protected with a suitable coating to protect the equipment from the offshore environment. All nozzles are to incorporate means for a shut-off.

5.1.3(d) Hoses Fire hoses located outside, in the production area, are to be of a non-collapsible type mounted on reels, and are to be certified by a competent independent testing laboratory as being constructed of non-perishable material to recognized standards. The hoses are to be of material resistant to oil and chemical deterioration, mildew and rot, and exposure to the offshore environment. They are to be sufficient in length to project a jet of water to any location in the areas where they may be required to be used. Each hose is to be provided with a nozzle and the necessary couplings. The maximum length of hose is not to exceed 30 m (100 ft.).

For hoses located in the living quarters areas, machinery spaces, or other enclosed areas, consideration is to be given to providing semi-automatic hose racks to permit one-man operation.

5.1.4 Water Spray (Deluge) Systems for Process Equipment

5.1.4(a) General A fixed water spray system is to be installed for the process equipment. The intent of the water spray system is to keep the process equipment cool and reduce the risk of escalation of a fire. Water spray systems are to be capable of being actuated both automatically by a fire detection system and manually. Installations are generally to be in accordance with NFPA Standard 15, or other equivalent standard such as API Publication 2030. Deluge isolation valves are to be located in a safe area and outside the fire zone they protect.

Consideration will be given to the use of manual actuation alone, provided that the combined volume of process and storage vessels is less than 15 m^3 (530 ft^3), and the installation is manned on a 24-hour basis and the manual actuation station is readily accessible.

5.1.4(b) Materials All requirements in 4-8/5.1.1(b) are applicable, except the requirements for plastic piping materials, which are modified and listed below.

Plastic piping materials are to meet Appendix 1 of this Guide. Generally, plastic (GRP/FRP) materials used in water spray systems are to pass Level 1 fire endurance test. However, a plastic piping material that passes Level 3 Modified Test- Level 3 WD fire endurance requirements in lieu of Level 1 requirements may be considered when the following design conditions are fully met.

i) Plastic piping is installed in open deck or semi-enclosed locations.

ii) The water spray piping system must meet the Level 3 fire endurance requirements as specified in Appendix 1.

iii) In addition to meeting the Level 3 fire endurance requirements, the water spray piping system must meet the requirements of the wet/dry fire endurance testing specified in Appendix 1, Section 8. Other wet/dry fire endurance test methods that may be equivalent to or more severe than the methods described in Appendix 1, Section 8 will be considered on a case-by-case basis.

iv) An automatic fire detection system is to be installed in areas protected by the water spray system.

v) The water spray system is to be designed to activate automatically upon detection by the automatic fire detection system.

vi) Each section or area served by a water spray system is to be capable of being isolated by one water supply valve only. The stop valve in each section is to be readily accessible, and its location clearly and permanently indicated.

vii) The design of the water spray system is to be such that upon fire detection, the time required to have water flowing through the hydraulically most remote nozzle is less than one minute. This requirement will be verified by system testing at the time of installation and at subsequent annual inspections.

viii) The water spray system piping is to be located downstream of the water supply valve. All piping upstream of the water supply valve is to meet the requirements for fire main and water spray systems as specified in Appendix 1, or be of metallic material.

5.1.4(c) Process Equipment Process equipment, including hydrocarbon vessels, heat exchangers, fired heaters and other hydrocarbon handling systems, are to be protected with a water spray system. The system is to be designed to provide a water density of 10.2 liters/min/m^2 (0.25 gpm/ft^2) of exposed surface area for uninsulated vessels, or 6.1 liters/min/m^2 (0.15 gpm/ft^2) of exposed surface area for insulated vessels.

Process equipment support structure, including saddles, skirt, legs, but not secondary deck structural members, is to be protected with a water spray system designed to provide a water density of 4.1 liters/min/m^2 (0.10 gpm/ft^2). Alternatively, the use of intumescent coatings may be acceptable in protecting the support structure, provided the selection of the fire rating of the coating is based on the results from a risk analysis and/or fire load calculation which must be reviewed and accepted by ABS. The condition (intactness) of the coatings will be the subject of surveyor inspection during attendance of the unit following normal survey intervals.

For gas-handling equipment, such as gas compressor skids, where the hydrocarbon liquid inventory is kept minimal, a water spray system is not required if the equipment is provided with an automatic blowdown upon the process shutdown.

5.1.4(d) Wellhead Areas Wellheads with maximum shut-in tubing pressures exceeding 42 kg/cm^2 (600 psi) are to be protected with a water spray system. The water spray system is to be designed to provide a minimum water density of 20.4 liters/min/m^2 (0.50 gpm/ft^2) based on the protection of wellheads, ESD valves, and critical structural components including the firewall.

5.1.5 Accommodation Sprinkler Systems

For existing fixed installations where passive protection requirements are not fully met, the accommodation spaces are to be protected by an automatic wet pipe sprinkler system supplied from the firewater system. Design of the system is to be based on NFPA Standard 13 requirements for light hazard occupancies, or other acceptable standards such as Chapter II-2, Regulations 12 of SOLAS 1974 and Amendments.

Fresh water is normally to be provided to fill the sprinkler piping. However, the system may be charged with seawater if precautions are taken to eliminate sediment and marine growth in the system.

5.3 Dry Chemical Systems

For production facilities with no liquid hydrocarbon storage capabilities and limited hydrocarbon liquid retention in processing equipment, dry chemical hose reel units may be used for fire fighting in lieu of firewater station required by 4-8/5.1.3 above. Design of the dry chemical systems is to be in accordance with NFPA Standard 17.

5.5 Fixed Fire Extinguishing Systems

A fixed fire fighting system complying with 4-8/5.5.1, 4-8/5.5.2 or 4-8/5.5.3 is to be provided in each enclosed space and enclosed skid module containing the following equipment:

i) Internal combustion machinery, including diesel and gas engines, having a total power output of not less than 750 kW (1000 hp)

ii) Oil- or gas-fired boilers and other processes such as incinerators and inert gas generators

iii) Oil fuel units. An oil fuel unit is defined as any equipment such as pumps, filters and heaters, used for the preparation and delivery of fuel oil to oil-fired boilers (including incinerators and inert gas generators), internal combustion engines or gas turbines at a pressure of more than 1.8 bar (26 psi).

iv) Settling tanks for boilers

v) Gas compressors

vi) Transfer pumps for crude oil (storage facilities) and flammable liquid with low flash point (below 60°C~140°F) such as methanol.

If a fixed foam system is to be used for the methanol pump room and methanol tank space, the type of foam selected is to be suitable for use with methane (alcohol-resistant foams).

5.5.1 Gas Smothering Systems

5.5.1(a) General

i) *Storage* Smothering medium storage location is to be outside of protected space. If gas bottles are kept in an enclosed compartment, the storage space is not to be used for purposes other than storing the bottles. The storage space is also to be situated in a safe and readily accessible position, and be effectively ventilated by a ventilation system independent of other spaces, including the protected space.

ii) *Controls* Automatic release of fire-extinguishing medium for total flooding systems is not permitted. Two separate controls are to be provided for releasing the fire-extinguishing medium into a protected space and to ensure the activities of the alarm. One control is to be used to discharge the gas from its storage containers. A second control is to be used for opening the valve of the piping, which conveys the gas into the protected space. This requirement is not applicable if the system is provided for a single space and the protected space is relatively small (under 170 m^3 or 6,000 ft^3). Controls are to be grouped together to provide complete actuation of the system from their location. The number of release stations is to be limited to as few as possible, typically two, one at the gas storage location and another outside of the protected space. For the one outside of the protected space, it is to be located in proximity and along the main escape route of the space.

iii) *Alarms* Means are to be provided for automatically giving audible warning of the release of fire-extinguishing gas into any space to which personnel normally have access. The alarm is to operate for at least a 20-second period before the gas is released. Alarms may be pneumatically (by the extinguishing medium or by air) or electrically operated. If electrically operated, the alarms are to be supplied with power from the main and an emergency source of electrical power. If pneumatically operated by air, the air supply is to be dry and clean and the supply reservoir is to be atomically kept charged at all times, and is to be fitted with a low-pressure alarm. The air supply may be taken from the starting air receivers. Any stop valve fitted in the air supply line is to be locked or sealed in the open position.

Any electrical components associated with the pneumatic system are to be powered from the main and an emergency source of electrical power.

5.5.1(b) Carbon Dioxide Systems In addition to the above general requirements, the design philosophy of CO_2 fire extinguishing systems is to be in compliance with a single standard/code (i.e., Chapter II-2, Regulations 5 of SOLAS 1974 and Amendments, NFPA 12, or other recognized fire code). Once a standard is chosen for a design basis, the standard is to be used throughout the design, and criteria from other standards may not be used.

5.5.1(c) Halon and Halon Alternative Systems

Halon is not permitted in new installations.

Halon alternative systems are to meet IMO MSC Circ. 848 and general requirements above.

Halon alternative agents are to be accepted by the governmental authorities.

5.5.2 Foam Systems

5.5.2(a) Fixed High Expansion Foam Systems Fixed high expansion foam systems are to be in accordance with Chapter II-2, Regulation 9 of SOLAS 1974 and Amendments or other recognized fire code such as NFPA 11A. Note reference is made to the IMO MSC/Circular 670.

5.5.2(b) Fixed Low Expansion Foam Systems Fixed low expansion foam systems may be installed in machinery spaces in addition to the required fixed fire extinguishing system. Fixed low expansion foam systems are be in accordance with Chapter II-2, Regulation 8 of SOLAS 1974 and Amendments or other recognized fire code such as NFPA 11. Note reference is made to the IMO MSC/Circular 582.

5.5.3 Fixed Water Spray Systems

Fixed water spray systems are be in accordance with Chapter II-2, Regulation 10 of SOLAS 1974 and Amendments or other recognized fire code such as NFPA 15.

5.7 Fire Fighting Requirements Pertaining to Specific Locations

5.7.1 Paint Lockers and Flammable Materials Storerooms

Paint lockers and flammable material storerooms are to be protected by a fixed fire extinguishing system. One of the following systems may be considered:

i) CO_2 system designed for 40% of the gross volume of the space

ii) Dry powder system designed for at least 0.5 kg /m^3 (0.03 lb/ft^3)

iii) Water spray system designed for 5 liters/min/m^2 (0.12 gpm/ft^2). The water spraying systems may be connected to the unit's fire main system.

iv) Systems other than those mentioned above may also be considered.

5.7.2 Galley Range Hoods

An automatic fire extinguishing system is to be provided for galley range hoods. Design and installation of range hood systems are to be in accordance with NFPA Standard 96.

5.7.3 Helicopter Facilities

5.7.3(a) Helicopter Decks With No Refueling Capabilities

i) *Firewater Stations* At least two firewater stations are to be provided. These fire stations are to be located so that the water supply would come from two different directions. Normally, they are located at the access routes to the helicopter deck. The firewater stations may consist of hoses with adjustable nozzles and detachable applicators. Adjustable nozzles are designed to provide both solid stream and water spray. The hose stream discharge from each firewater station is to be sufficient to reach any part of the helicopter deck.

ii) *Extinguishers* The helicopter deck area is to be protected by two approved dry chemical extinguishers of a total capacity of not less than 45 kg (100 lb.).

iii) *Back-up System* An additional back-up fire fighting system, consisting of CO_2 extinguishers of total capacity of not less than 18 kg (40 lbs.) or equivalent, is to be provided. One of these extinguishers is to be equipped so as to enable it to reach the engine area of any helicopter using the deck. The back-up system is to be located where the equipment would not be vulnerable to the same damage as the equipment required in 4-8/5.7.3(a)i) and 4-8/5.7.3(a)ii) above.

5.7.3(b) Helicopter Decks With Refueling Capabilities

i) *Fire Fighting Equipment* A fire fighting system as described in 4-8/5.7.3(a)i) through 4-8/5.7.3(a)iii) above is to be provided for the helideck area. An additional dry chemical extinguisher is to be provided for the fuel storage area, having a capacity of 13.5 kg (30 lbs.).

ii) *Foam System* A foam fire extinguishing system is to be provided to protect the helicopter landing area and the fuel storage area. The foam system may be an independent system, or be arranged to proportion foam into the firewater stations described in 4-8/5.7.3(a)i) above. The helicopter landing area is the area contained within a circle of diameter D, where D is the distance in meters (feet) across the main rotor and tail rotor in the fore and aft line of a helicopter, with a single main rotor, and across both rotors for a tandem rotor helicopter, or the full area of the deck, whichever is less. The fuel storage area includes the fuel storage tank and the dispensing hose reel.

The foam system is to be capable of delivering foam solution at a rate of 6.0 liters/min/m^2 (0.15 gpm/ft^2) for protein foam, or 4.1 1iters/min/m^2 (0.10 gpm/ft^2) for aqueous film forming foam (AFFF) of the areas protected, for at least 5 minutes.

iii) *Fueling System* The arrangement of the helicopter fueling system is to be in accordance with Chapter 4, Section 4.

5.7.4 Foam Systems for Crude Storage Tanks

For fixed installations with crude oil storage capabilities, a fixed foam system is to be provided for all crude storage tanks. Chapter II-2, Regulation 61 of SOLAS 1974 and Amendments may be used as a design guidance. If process equipment is located or supported above crude storage areas in such a manner that a deck foam system may 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 other tank deck areas.

5.9 Emergency Control Station

At least two emergency control stations are to be provided. One of the stations is to be located in a normally manned space such as the process control room, or near the drilling console if the facility is fitted with drilling and work over systems. The other is to be at a suitable location outside of the hazardous area. The emergency control stations are to be provided with the following:

i) Manually operated switches for actuating the general alarm system

ii) An efficient means of communication with locations vital to the safety of the installation

iii) Manual activation of all well and process system shutdowns (3-3/7.3.4 and 3-3/9)

iv) Means for shutdown, either selectively or simultaneously, of the following equipment, except for electrical equipment listed in 4-8/5.11 below: (1) ventilating systems, except for prime movers, (2) main generator prime movers, (3) emergency generator prime movers.

5.11 Operation after Facility Total Shutdown

The following services are to be operable after a facility's total shutdown:

i) Emergency lighting required for evacuation from service/accommodation spaces and machinery spaces to embarkation stations. This includes lighting at all control stations, stowage positions for firemen's outfits, helicopter landing deck, alleyways, stairways and exits, embarkation station deck, launching appliances, and the area of water where they are to be launched, etc. The lighting is to be provided for thirty minutes.

ii) General alarm

iii) Blowout preventer control system if fitted on the installations

iv) Public address system

v) Distress and safety radio communications

All equipment in exterior locations which is capable of operation after activation of the prime mover/ventilation shutdown system, is to be suitable for installation in Class I, Division 2 (Zone 2) locations.

5.13 Portable and Semi-portable Extinguishers

Locations, types, and quantities of fire extinguishers provided for the production deck area are to be in accordance with 4-8/Table 1 and 4-8/Table 2. For areas not specifically addressed in these tables, NFPA Standard 10 is to be followed.

TABLE 1
Portable and Semi-portable Extinguishers

CLASSIFICATION TYPE & SIZE	*WATER* *LITERS (GALLONS)*	*FOAM* *LITERS (GALLONS)*	*CARBON DIOXIDE* *KILOGRAMS (POUNDS)*	*DRY CHEMICAL* *KILOGRAMS (POUNDS)*
A-II	9.5 (2$^1/_2$)	9.5 (2$^1/_2$)		2.25 (5)[1]
B-I		4.7 (1$^1/_4$)	1.8 (4)	0.9 (2)
B-II		9.5 (2$^1/_2$)	6.7 (15)	4.5 (10)
B-III		45 (12)	15.8 (35)	9.0 (20)
B-IV		76 (20)	22.5 (50)[2]	13.5 (30)
B-V		152 (40)	45 (100)[2]	22.5 (50)[2]
C-I			1.8 (4)	0.9 (2)
C-II			6.7 (15)	4.5 (10)
C-III			15.8 (35)	9.0 (20)
C-IV			22.5 (50)[2]	13.5 (30)

NOTES:

1 Must be approved as a Type A, B, and C extinguisher

2 For outside use only

Classification of Portable and Semi-portable Extinguishers

Fire extinguishers are designated by types as follows:

A For fires in combustible materials, such as wood

B For fires in flammable liquids and greases

C For fires in electrical equipment

Fire extinguishers are designated by size, where size I is the smallest and size V is the largest. Sizes I and II are portable extinguishers, and sizes III, IV and V are semi-portable extinguishers.

TABLE 2
Classification and Placement of Portable and Semi-portable Extinguishers

SPACE	*CLASSIFICATION*	*QUANTITY & LOCATION*
SAFETY AREAS		
Main control room	C-I or C-II	2 near the exit (See Note 1 on the next page)
Stairway enclosure	B-II	Within 3m (10 ft) of each stairway on each deck level
Corridors	A-II	1 in each main corridor, not more than 45m (150 ft.) apart
Lifeboat embarkation & lowering stations	- -	None required
Radio room	C-I or C-II	2 near the exit (See Note 1)
ACCOMMODATIONS		
State rooms (cabins)	A-II	One in each room occupied by more than 4 persons
Toilet spaces, lockers small storerooms, pantries	- -	None required
SERVICE SPACES		
Galleys	A, B, C-II	1 A-B-C fire classed for every 232m^2 (2500 ft^2) or fraction thereof, suitable for hazards involved
Paint storerooms	B-II	1 outside each room in vicinity of exit (See Note 2 on the next page)
Storerooms	A-II	1 for every 232m^2 (2500 ft^2) or fraction thereof, located in vicinity of exits, either inside or outside of spaces (See Note 2)
Workshop and similar spaces	C-II	1 outside each space in vicinity of an exit (See Note 2)
ENCLOSED MACHINERY SPACES		
Gas/oil-fired boilers: spaces containing gas/oil-fired boilers,	B-II	2 required in each space
either main or auxiliary, or their fuel oil units	B-V	1 required in each space
Internal combustion or gas turbine machinery spaces	B-II	1 for every 745kW (1,000 brake horsepower) but not less than 2 nor more than 6 in each space
	B-III	1 required in each space

TABLE 2 (continued)
Classification and Placement of Portable and Semi-portable Extinguishers

SPACE	*CLASSIFICATION*	*QUANTITY & LOCATION*
ENCLOSED AUXILIARY SPACES		
Internal combustion engines or gas turbines	B-II	1 outside the space containing engines or turbines in vicinity of exit (See Note 2)
Electric emergency motors or gas turbines	C-II	1 outside the space containing motors or generators in vicinity of exit (See Note 2)
Steam drive auxiliary	- -	None required
Fuel tanks	- -	None required
MISCELLANEOUS AREAS		
Helicopter landing decks	B-V	1 at each access route
Helicopter fueling facilities	B-IV	1 at each fuel transfer facility
Cranes with internal combustion engines	B-II	1 required in vicinity of crane cab exit
Production areas	B-III or B-IV	(See Note 3)
Drilling areas	B-III or B-IV	(See Note 3)
Open areas	B-II	1 for every 3 internal combustion or gas turbine engines
	C-II	1 for every 2 electric generators and motors of 3.7 kW (5 hp) or greater
CHEMICALS AND FUELS WITH FLASH POINT BELOW 60°C~140°F		
Pump room	B-II	1 required in vicinity of exit (See Note 4)
Storage tank area	B-V	1 required on open deck capable of reaching the storage tanks, tank vents, and transfer connections (See Note 4)

NOTES:

1 One of which must be placed inside (dry chemical extinguishers not recommended for these applications).

2 Vicinity is intended to mean within 1 meter (3 ft.).

3 One B-III or B-IV extinguisher is to be provided at every entrance to any escape route, under no circumstances are two extinguishers to be placed more than 15.24 m (50 ft.) apart.

4 For methanol, foam extinguishers may be considered if the extinguishers are of the polar solvent type foam (alcohol-resistant type)

7 Fire and Gas Detection and Alarm Systems

7.1 Fire Detectors

Open or enclosed areas are to be provided with automatic fire detection such that all potential fire outbreak points are monitored. The automatic fire detection system will sound an alarm and initiate necessary ESD functions for the facility. Guidelines for the selection and use of fire detectors are contained in API RP 14C and API RP 14G.

7.3 Gas Detectors

7.3.1 Combustible Gases

In all enclosed and semi-enclosed areas that might accumulate combustible gases, gas sensors of an explosion (flame)-proof type are to be installed and operated in accordance with API RP 14C and API RP 14F, as applicable. Consideration is to be given to providing combustible gas sensors near points of a possible leak at process equipment and piping systems located in open areas. Sensors are also to be provided at fresh air inlets to non-classified areas.

7.3.2 Hydrogen Sulfide

Where hydrogen sulfide gas may be present in the well fluid in excess of 20 ppm, hydrogen sulfide gas detection systems are to be installed in accordance with API RP 55, as applicable.

7.3.3 Detector Set Points

The low and high gas alarm set points are to be 20% L.E.L. and 60% L.E.L. for combustible gases, and 10 ppm and 50 ppm for hydrogen sulfide. ESD functions are to be initiated upon high gas detection.

7.5 Smoke Detectors

A smoke detection and alarm system is to be provided for control rooms, switchgear rooms, and other areas where slow-developing fires might be expected.

7.7 Alarm Panel

A master fire and gas panel is to be provided to receive and process all fire and gas detection signals. The panel is to be located in the central control room or other normally manned non-classified area. The panel arrangement is to comply with Chapter 3, Section 7.

7.9 Fire and Gas Detection Wiring

Wiring arrangement is to comply with Chapter 4, Section 6.

7.11 General Alarm

Means are to be provided for manually activating a general alarm system capable of producing a distinctive audible sound in all areas of the facility. Alarm-actuating devices are to be located at points of egress from accommodation areas, process areas, and machinery spaces. Power for the general alarm system is to comply with Chapter 4, Section 6.

9 Structural Fire Protection

9.1 General

The term "structural fire protection" refers to the passive method of providing fire protection to the spaces/compartments of the unit through the usage of fire divisions and the limitation of combustibles in the construction materials. Maintaining the adequacy of the fire division includes proper protection of penetrations in those divisions, which includes electrical, piping, or ventilation systems penetrations.

The structural fire protection requirements of this section are intended to address the need for fire protection of boundaries separating new and/or existing areas/spaces onboard the installation from the process facility equipment. In addition, it is the intention of these guidelines to ensure that separate accommodations platforms, where attached to the production facility via a bridge, are sufficiently protected so they may serve as the emergency muster area or “safe haven” for personnel on the facility.

Existing spaces that do not share common boundaries with the process facility equipment are to be treated based on the requirements that were in effect at the time of construction.

Newly built spaces that do not share common boundaries with the process facility equipment and all portable/temporary living quarters are to comply with the latest Rule requirements.

Spaces/Compartments that have been newly built or that have been modified internally either to enlarge or to change the function of that space (category change) are to comply with the latest Rule requirements.

9.3 Fire Integrity of Bulkheads and Decks

The minimum fire integrity of bulkheads and decks is to be as prescribed in 4-8/Table 3a and 4-8/Table 3b.

Windows and sidescuttles that face the production facilities are to possess a fire rating equivalent to the bulkheads in which they are fitted.

TABLE 3a
Fire Integrity of Bulkheads Separating Adjacent Spaces/Areas

Spaces		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Control Stations including Central Process Control Rooms	(1)	A-0	A-0	A-60	A-0	A-15	A-60	A-15	H-60 (d)	A-60	A-60	*	A-0
Corridors	(2)		C	B-0	B-0 A-0 (b)	B-0	A-60	A-0	H-60 (d)	A-0	A-0	*	B-0
Accommodation Spaces	(3)			C	B-0 A-0 (b)	B-0	A-60	A-0	H-60 (d)	A-0	A-0	*	C
Stairways	(4)				B-0 A-0 (b)	B-0 A-0 (b)	A-60	A-0	H-60 (d)	A-0	A-0 *	*	B-0 A-0 (b)
Service Spaces (low risk)	(5)					C	A-60	A-0	H-60 (d)	A-0	A-0	*	B-0
Machinery Spaces of Category A	(6)						*(a)	A-0 (a)	H-60 (d)	A-60	A-60	*	A-0
Other Machinery Spaces	(7)							A-0 (a) (c)	H-0 (d)	A-0	A-0	*	A-0
Process Areas, Storage Tank Areas, Wellhead/manifold Areas	(8)				(Symmetrical)				----	H-60 (d)	H-60 (d)	*	H-60 (d)
Hazardous Areas	(9)									----	A-0	*	A-0
Service Spaces (high risk)	(10)										A-0 (c)	*	A-0
Open Decks	(11)											----	*
Sanitary and Similar Spaces	(12)												C

Please see the notes under 4-8/Table 3b for further interpretations.

TABLE 3b
Fire Integrity of Decks Separating Adjacent Spaces/Areas

Space below ↓ / *Space→ above*		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Control Stations including Central Process Control Rooms	(1)	A-0	A-0	A-0	A-0	A-0	A-60	A-0	H-60 (d)	A-0	A-0	*	A-0
Corridors	(2)	A-0	*	*	A-0	*	A-60	A-0	H-60 (d)	A-0	A-0	*	*
Accommodation Spaces	(3)	A-60	A-0	*	A-0	*	A-60	A-0	**X**	A-0	A-0	*	*
Stairways	(4)	A-0	A-0	A-0	*	A-0	A-60	A-0	H-60 (d)	A-0	A-0	*	A-0
Service Spaces (low risk)	(5)	A-15	A-0	A-0	A-0	*	A-60	A-0	H-60 (d)	A-0	A-0	*	A-0
Machinery Spaces of Category A	(6)	A-60	A-60	A-60	A-60	A-60	* (a)	A-60	H-60 (d)	A-60	A-60	*	A-0
Other Machinery Spaces	(7)	A-15	A-0	A-0	A-0	A-0	A-0 (a)	* (a)	H-0 (d)	A-0	A-0	*	A-0
Process Areas, Storage Tank Areas, Wellhead/manifold Areas	(8)	H-60 (d)	H-60 (d)	**X**	H-60 (d)	H-60 (d)	H-60 (d)	H-60 (d)	----	----	H-60 (d)	--	H-60 (d)
Hazardous Areas	(9)	A-60	A-0	A-0	A-0	A-0	A-60	A-0	----	----	A-0	--	A-0
Service Spaces (high risk)	(10)	A-60	A-0	A-0	A-0	A-0	A-0	A-0	H-60 (d)	A-0	A-0 (c)	*	A-0
Open Decks	(11)	*	*	*	*	*	*	*	----	----	*	--	*
Sanitary and Similar Spaces	(12)	A-0	A-0	*	A-0	*	A-0	A-0	H-60 (c)	A-0	*		*

Notes:

(a) If a space contains an emergency power source or components of an emergency power source, and adjoins a space containing a unit's service generator or components of a unit's service generator, the boundary bulkhead or deck between those spaces is to be an A-60 class division.

(b) For clarification as to which note applies, see paragraph 3.11.5.3 of the ABS *MODU Rules*.

(c) Where spaces are of the same numerical category and subscript (c) appears in the tables, a bulkhead or deck of the rating shown is only required when the adjacent spaces are for a different purpose. For example, in category (10), a galley next to another galley does not require a bulkhead, but a galley next to a paint room requires an A-0 bulkhead.

(d) If the results of a Risk Analysis or Fire Load Analysis (reviewed and accepted by ABS) justify such, an "A-60" fire division may be used in lieu of an "H-60" bulkhead. An "A-0" wall used in conjunction with a water curtain system designed to provide a density of at least 6.1 liters/min/m^2 (0.15 gpm/ft^2) of exposed surface area may be used as an equivalent means of meeting the "A-60" class division.

(e) Intumescent coatings may be acceptable in providing the "H" rating. The intumescent coating used is to have limited flame spread properties, low smoke development and low heat generation. In addition, an assessment is to be made of the toxicity of gases emitted in the event of a fire. The condition (intactness) of the coatings will be the subject of surveyor inspection during attendance of the unit following normal survey intervals.

* Where an asterisk appears in the tables, the division is to be of steel or equivalent material, but is not required to be of an A-class standard. However, where a deck is penetrated for the passage of electric cables, pipes, and vent ducts, such penetrations are to be made tight to prevent the passage of flame and smoke.

Where an X appears in the table, the configuration is not allowed.

9.3.1 "B" Class Divisions

All bulkheads required to be "B" class divisions are to extend from deck to deck and to the deckhouse side or other boundaries, unless continuous "B" class ceilings or linings are fitted on both sides of the bulkhead, in which case the bulkhead may terminate at the continuous ceiling or lining. In corridor bulkheads, ventilation openings may be permitted only in and under the doors of cabins, public spaces, offices and sanitary spaces. The openings are to be provided only in the lower half of the door. Where such an opening is in or under a door, the total net area of such opening(s) is not to exceed 0.05 m^2. When such an opening is cut in a door, it is to be fitted with a grille constructed of non-combustible materials. Such openings are not to be provided in a door in a division forming a stairway enclosure.

9.3.2 Stairways

Stairways are to be constructed of steel or equivalent material.

9.3.3 Stairway Protection

Stairways, that penetrate only a single deck, are to be protected at least at one level by "A" or "B" class divisions and self-closing doors so as to limit the rapid spread of fire from one deck to another. Personnel lift trunks are to be protected by "A" class divisions. Stairways and lift trunks that penetrate more than a single deck are to be surrounded by "A" class divisions and protected by self-closing doors at all levels. Self-closing doors are not to be fitted with hold-back hooks. However, hold-back arrangements incorporating remote release fittings of the fail-safe type may be utilized.

9.3.4 Draft Stops

Air spaces enclosed behind ceilings, paneling or linings are to be divided by close-fitting draft stops spaced not more than 14 m apart.

9.3.5 Insulation Materials

Except for insulation in refrigerated compartments, insulation material, pipe and vent duct lagging, ceilings, linings and bulkheads are to be of non-combustible material. Insulation of pipe fittings for cold service systems and vapor barriers and adhesives used in conjunction with insulation need not be non-combustible, but they are to be kept to a minimum and their exposed surfaces are to have low flame spread characteristics. In spaces where penetration of oil products are possible, the surfaces of the insulation are to be impervious to oil or oil vapors.

The framing, including grounds and the joint pieces of bulkheads, linings, ceilings and draft stops, are to be of non-combustible material.

9.3.6 Exposed Surfaces

All exposed surfaces in corridors and stairway enclosures, and surfaces in concealed or inaccessible spaces in accommodation and service spaces and control stations, are to have low flame spread characteristics. Exposed surfaces of ceilings in accommodation and service spaces and control stations are to have low flame spread characteristics.

9.3.7 Veneers

Bulkheads, linings and ceilings may have combustible veneers, provided the thickness of such veneers does not exceed 2 mm within any space other than corridors stairway enclosures and control stations where the thickness is not to exceed 1.5 mm. Alternatively, veneers that have a calorific value not exceeding 45 mJ/m^2 of the area for the thickness used may be accepted irrespective of the thickness of those veneers.

9.3.8 Deck Coverings

Primary deck coverings, if applied, are to be of an approved material which will not readily ignite or give rise to toxic or explosive hazards at elevated temperatures.

9.3.9 Paints, Varnishes and Other Finishes

Paints, varnishes and other finishes used on exposed interior surfaces are not to offer an undue fire hazard and are not to be capable of producing excessive quantities of smoke.

9.5 Wellhead Areas

A-0 firewalls are to be used to provide protection from potential uncontrolled flare front wellheads with shut-in pressure exceeding 42 kg/cm^2 (600 psi). These firewalls are independent of the requirements for structural fire protection of spaces. The intent of these firewalls is to provide protection for escape routes, temporary refuges, lifeboat embarkation stations, fire pumps and potential fire hazards. The dimensions of the firewall and distance from the wellhead are to be determined based on the results from fire load calculations or other recognized method. See 3-3/5.5.

9.7 Fired Vessels

A-0 firewalls are to be used to provide protection from potential fire hazard of fired vessels. These firewalls are independent of the requirements for structural fire protection of spaces. The intent of these firewalls is to provide protection for escape routes, temporary refuges, lifeboat embarkation stations, fire pumps and potential fire hazards. The dimensions of the fire wall and distance from the direct fired heaters are to be determined based on the results from fire load calculations or other recognized method. See 3-3/5.9.

9.9 Helideck

All helidecks are to be constructed of steel or other material which provides equivalent structural and fire integrity properties to that of steel. Helidecks which form the deckhead (roof) of the accommodations are to be insulated to an A-60 class standard. If the helideck is located less than one (1) meter above the deckhouse top, the helideck is to be constructed to an "A" class standard. Deckhouse roofs (below the helideck) are to have no openings.

9.11 Ventilation

Standards for ventilation are to be in accordance with the requirements contained in this section. Ventilation systems are to be designed with an intent on maintaining structural fire divisions.

9.11.1 Non-Ducted HVAC Systems

Non-ducted HVAC systems, i.e., those that use the plenum (concealed space between the ceiling and overhead deck) for return air, are discouraged. The use of a non-ducted system will need prior review of the design philosophy, taking into consideration the movement of smoke between spaces and the maintenance of "smoke-free" escape routes. Prior design approval is mandatory before construction of such a system.

9.11.2 Air Balance Ducts

The use of air balance ducts ("jumper ducts") is not allowed in "A" Class Division or "B" Class Divisions that are required to extend deck to deck. Air balance ducts are also not to serve corridors.

9.11.3 Ventilation Duct Material

Ventilation ducts are to be of non-combustible material. Short ducts, however, not generally exceeding 2 m (78.5 in) in length and with a cross-sectional area not exceeding 0.02 m^2 (31 in^2), need not be non-combustible, subject to the following conditions:

i) these ducts are to be of a material which has a low fire risk;

ii) they may only be used at the end of the ventilation device;

iii) they are not to be situated less than 600 mm, measured along the duct, from where it penetrates any "A" or "B" class division, including continuous "B" class ceilings.

9.11.4 Ventilation Ducts Passing Through "A" Class Divisions

Where ventilation ducts with a cross-sectional area exceeding 0.02 m^2 (31 in^2) pass through class "A" bulkheads or decks, the opening is to be lined with a steel sheet sleeve unless the ducts passing through the bulkheads or decks are of steel in the vicinity of penetrations through the deck or bulkhead; the ducts and sleeves at such places are to comply with the following:

i) The ducts or sleeves are to have a thickness of at least 3 mm and a length of at least 900 mm (35.4 in.). When passing through bulkheads, this length is to be divided, preferably into 450 mm (17.7 in.) on each side of the bulkhead. These ducts, or sleeves lining such ducts, are to be provided with fire insulation. The insulation is to have at least the same fire integrity as the bulkhead or deck through which the duct passes.

ii) Ducts with a cross-sectional area exceeding 0.075 m^2, (116 in^2), except those serving hazardous areas, are to be fitted with fire dampers in addition to meeting the requirements of the above paragraph [4-8/9.11.4i)]. The fire damper is to operate automatically, but must also be capable of being closed manually from both sides of the bulkhead or deck. The damper is to be provided with an indicator, which shows whether the damper is open or closed. Fire dampers are not required, however, where ducts pass through spaces surrounded by "A" class divisions, without serving those spaces, provided those ducts have the same fire integrity as the divisions which they pierce.

9.11.5 Ventilation of Machinery Spaces of Category A, Galleys and Hazardous Areas

Ventilation ducts serving machinery spaces of category A, galleys or hazardous areas are not to pass through accommodation spaces, services spaces or control stations. Except for ventilation ducts serving hazardous areas, ducts serving machinery spaces of category A or galleys may pass through accommodation spaces, control stations and galleys if the ducts are:

i) constructed of steel having a thickness of at least 3 mm (0.12 in.) for ducts of 300 mm (11.8 in.) in width or less, and of at least 5 mm for ducts of 760 mm (30 in.) width and over; in the case of ducts the width or diameter of which is between 300 mm (11.8 in.) and 760 mm (30 in.), the thickness is to be obtained by interpolation; and

ii) fitted with automatic fire dampers close to the boundaries penetrated; and

iii) insulated to "A-60" standard from the machinery spaces or galleys to a point at least 5 m (197 in.) beyond each fire damper;

or

iv) constructed of steel in accordance with 4-8/9.11.4i) above; and

v) insulated to "A-60" standard throughout the accommodation spaces, service spaces or control stations.

9.11.6 Ventilation of Accommodation Spaces, Service Spaces or Control Stations

Ventilation ducts serving accommodation spaces, service spaces or control stations are not to pass through machinery spaces of category A, galleys or hazardous areas. Except for hazardous areas, ventilation ducts serving the accommodation spaces, service spaces or control stations may pass through machinery spaces of category A or galleys, provided that:

i) Where they pass through a machinery space of category A or a galley, the ducts are constructed of steel in accordance with 4-8/9.11.5i) above, and

ii) automatic fire dampers are fitted close to the boundaries penetrated; and

iii) the integrity of the machinery space or galley boundaries is maintained at the penetrations;

or

iv) where they pass through a machinery space of category A or a galley, the ducts are constructed of steel in accordance with 4-8/9.11.5i) above; and

v) are insulated to "A-60" standard within the machinery space or galley.

9.11.7 Ventilation Ducts Passing through "B" Class Division

Ventilation ducts with a cross-sectional area exceeding 0.02 m^2 (31 in^2) that pass through "B" class bulkheads are to be lined with steel sheet sleeves of 900 mm (35.4 in) in length, divided preferably into 450 mm (17.7 in) on each side of the bulkhead, unless the duct is of steel for this length.

9.11.8 Galley Ventilation

9.11.8(a) Separation of Galley Ventilation Galley ventilation system is to be separate from the ventilation system serving accommodation spaces. This can be achieved by using separate air-handlers and dedicated duct work for the galley ventilation which is not common with rest of the accommodations. Alternatively, a dual discharge system may be acceptable, provided the two systems are completely independent.

9.11.8(b) Galley Exhaust Ducts Where they pass through accommodation spaces or spaces containing combustible materials, the exhaust ducts from galley ranges are to be of equivalent fire integrity to "A" class divisions. Each such exhaust duct is to be fitted with the following:

i) a grease trap readily removable for cleaning;

ii) a fire damper located in the lower end of the duct;

iii) arrangements, operable from within the galley, for shutting off the exhaust fans;

and

iv) fixed means for extinguishing a fire within the duct.

9.11.9 Main Inlets and Outlets

The main inlets and outlets of all ventilation systems are to be capable of being closed from outside the spaces being ventilated.

9.11.10 Means of Stopping Ventilation

Power ventilation of accommodation spaces, service spaces, control stations, machinery spaces and hazardous areas is to be capable of being stopped from an easily accessible position outside the space being served. The accessibility of this position in the event of a fire in the spaces served is to be specially considered. The means provided for stopping the power ventilation serving machinery spaces or hazardous areas is to be entirely separate from the means provided for stopping ventilation of other spaces.

9.11.11 Prevention of Ingress of Flammable, Toxic or Noxious Gases

The ventilation of the accommodation spaces and control stations is to be arranged in such a way as to prevent the ingress of flammable, toxic or noxious gases, or smoke from surrounding areas.

9.11.12 Jumper Ducts

Jumper ducts provided for air balances between adjacent spaces are only acceptable in "C" class divisions.

9.13 Penetrations

All penetrations through bulkheads and decks are to have the same fire integrity as the bulkhead and deck through which they penetrate. This is to be accomplished using an ABS accepted procedure with approved materials or by a procedure that has been tested by an approved testing facility and approved by a major governmental maritime administration.

9.15 Materials/Certification

All materials used in the construction of structural fire divisions and protection of the penetrations are to be certified for the fire rating in which they are fitted. This includes structural fire protection and thermal insulation, joiner bulkheads, doors, HVAC ducts, flooring materials, windows, fire dampers, etc.

11 Muster Areas

11.1 General

All units are to have a designated muster station(s) were personnel can gather prior to entering the lifeboats.

11.3 Materials

All materials that comprise the muster stations routes are to be of steel or equivalent material. Fiber Reinforced Plastic (FRP) grating may be used if the layout is designed in accordance with Appendix 3, and provided that the FRP grating is approved as meeting the applicable criteria defined in same.

11.5 Muster Stations

The muster station is to be of sufficient area to accommodate the number of personnel to be gathered. The muster station is to be located in a safe location with respect to the processing equipment. The muster station may be a meeting room inside the accommodations or may be part of the lifeboat embarkation station.

13 Means of Escape

13.1 General

Arrangement of escape routes is to be in accordance with the requirements contained in this section. Escape routes are to be arranged to provide the most direct route to an area of temporary refuge or safe haven.

13.3 Materials

All materials that comprise the escape routes are to be of steel or equivalent material. Fiber Reinforced Plastic (FRP) grating may be used if the layout is designed in accordance with Appendix 3, and provided that the FRP grating is approved as meeting the applicable criteria as defined in same.

13.5 Escape Routes

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

13.7 Marking and Lighting of Escape Routes

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

13.9 Escape Route Plan

An escape route plan is to be prominently displayed at various points of the facility. Alternatively, this information may be included in the Fire Control or Fire/Safety Plan.

15 Lifesaving Requirements

15.1 General

Lifesaving appliances and equipment are to be in accordance with the requirements contained in this section. Lifesaving Appliances and equipment are to be provided, taking into account the arrangement of the installation and its area of operation.

Where the words "of an approved type" are indicated, the equipment is to meet the requirements of SOLAS or equivalent standard. Launching appliances for lifeboats and liferafts are also to meet the requirements of SOLAS or equivalent standard.

15.3 Lifeboat Embarkation Areas

All materials that comprise the lifeboat embarkation platform are to be of steel or equivalent material. Fiber Reinforced Plastic (FRP) grating may be used if the layout is designed in accordance with Appendix 3, and provided that the FRP grating is approved as meeting the applicable criteria defined in same.

15.5 Lifesaving Appliances and Equipment

15.5.1 Lifeboats

Lifeboats of an approved type with an aggregate capacity to accommodate the total number of persons onboard are to be provided and installed in safe areas on two sides of the installation.

15.5.2 Liferafts

Inflatable liferafts of an approved type are to be provided onboard such that their total capacity is sufficient to accommodate the total number of people expected to be onboard the facility. Liferafts are to be placed next to areas where personnel may be working, in sufficient quantity to hold the maximum number of people that might be present in the area at any one time.

15.5.3 Life Buoys

At least four life buoys of an approved type, with floating water lights, are to be provided. One ring life buoy is to be placed in a suitable rack on each side of the structure in an acceptable location. Multi-level structures may require the placement of additional life buoys.

15.5.4 Life Jackets

At least one life jacket of an approved type is to be provided for each person on a manned facility. Life preservers/work vests are to be stored in readily accessible locations. In addition, life jackets numbering the same quantity as the maximum aggregate capacity of each life boat station must be stored next to the lifeboat station.

15.5.5 Work Vests

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

15.5.6 Breathing Apparatus

For operations involving hydrogen sulfide, each person expected on the facility is to be provided with a self-contained breathing apparatus of an approved type for escape purposes. The breathing apparatus for maintenance personnel is to have a minimum of thirty (30) minutes air supply. A designated safe area with proper supply of air is also to be provided and shown on the fire control/safety plan.

15.7 Means of Embarkation

15.7.1 General

The means of embarkation requirements of the applicable Rules and/or Regulations are to apply. In the absence of means of embarkation requirements by the applicable Rules and/or Regulations, the requirements of 4-8/15.7.2 below apply.

15.7.2 Means of Embarkation

Each facility is to have means of embarkation to allow personnel to leave the facility in an emergency. These are in addition to the equipment described in 4-8/13. The means of embarkation are to consist of at least two (2) fixed ladders or stairways, widely separated, and extending from the main and cellar decks to the water line. The ladders or stairways will preferably be located near lifeboat-launching stations. Ladder construction is to be in accordance with the appropriate governmental authority, or other recognized standard.

17 Personnel Safety Equipment and Safety Measures

17.1 Fireman's Outfits

All fireman's outfits and equipment are to be of an approved type, i.e., equipment is to meet the requirements of SOLAS or equivalent standard. The requirements below are in addition to those required by the applicable Rules and/or Regulations.

17.1.1 Fireman's Outfit

A minimum of two (2) sets of fire-fighting outfits and equipment is to be provided and stowed in a suitable container. The protective clothing is to be made of a material that will protect the skin from radiant heat of a fire, and be water-resistant. Boots and gloves are to be made of rubber or other electrically non-conducting material. The protective helmet is to be of rigid construction to resist impact, and be equipped with a face shield.

The fireman's outfits or sets of personal equipment are to be stored as to be easily accessible and ready for use, and where more than one fireman's outfit or more than one set of personal equipment is carried, they are to be stored in widely separated positions. One of the outfits should be readily accessible from the helicopter deck.

17.1.2 Breathing Apparatus

A minimum of two (2) self-contained breathing apparatus of an approved type is to be provided and stowed with the fireman's outfits. There is to be a sufficient number of spare compressed air charges. The breathing apparatus is to have a minimum of thirty (30) minutes air supply.

17.3 Guard Rails

The perimeter of all open deck areas, walkways around accommodation spaces, catwalks and openings, are to be protected with guardrails. The height of the guard rails is to be at least 1 m (39.5 in.) above the deck, except where this height would interfere with normal operation, in which case a lesser height may be considered if adequate protection is provided. The opening below the lowest course of the guardrails is not to exceed 230 mm (9 in.). The other courses are not to have more than 380 mm (15 in.) of clear opening. Toe plates are to be provided at the base of all guardrails.

17.5 Insulation of Hot Surfaces

17.5.1 Personal Protection

All exposed surfaces with which personnel are likely to come in contact are to have temperatures that do not exceed 71°C (160°F). If this can not be achieved, then the exposed surfaces are to be insulated or shielded.

17.5.2 Spillage Protection

Surfaces with temperatures in excess of 204°C (400°F) are to be protected from contact with liquid hydrocarbon spillage and mist.

17.5.3 Combustible Gases

Surfaces in excess of 482°C (900°F) are to be protected from contact with combustible gases.

17.5.4 Protection of Insulation

Insulation is to be protected from weather, oil spillage, mechanical wear, and physical damage.

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SECTION 1 Survey During Construction and Commissioning

1 General

This section pertains to surveys and inspections during construction and start-up (commissioning) of an Offshore Production Facility. The documentation requirements for review are given in Chapter 3, Section 2 and Chapter 4, Section 2.

3 Construction Surveys

3.1 General

During construction of equipment components and assemblies for an Offshore Production Facility, ABS Surveyors are to have access to manufacturers' or fabricators' facilities to witness construction and/or testing as required by the Rules. The manufacturer/fabricator is to contact the ABS Surveyor to make necessary arrangements to examine equipment and components. If the ABS Surveyor finds reason to recommend repairs or additional surveys, notice will be immediately given to the Owner or his Representative so that appropriate action may be taken.

3.3 Survey at Vendor's Shop

Survey requirements for equipment components and packaged units at vendor's shop are summarized in 5-1/Table 1.

Each vendor is required to have an effective quality system, which is to be verified by the attending Surveyor prior to the start of fabrication. Additionally, vendors are encouraged to obtain ABS Quality System accreditation through the ABS Quality Assurance scheme.

3.5 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.

3.7 Module Hook-up

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

3.7.1

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.

3.7.2

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.

3.7.3

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.

3.7.4

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.

5 Commissioning and Start-up Surveys

The start-up and commissioning of all hydrocarbon production systems are to be verified by an attending ABS Surveyor. The scope of the survey is to include the following:

5.1

The start-up and commissioning are to be in accordance with the approved start-up and commissioning procedures.

5.3

Verify personnel safety precautions to be taken during commissioning, which are to include checks of operational readiness of all lifesaving, fire and gas detection, fire fighting equipment, ESD systems, unobstructed escape routes, etc.

5.5

Verify establishment of communication procedures prior to commissioning.

5.7

Verify that emergency procedures are provided to deal with any contingencies such as spillage, fire, and other hazards. Drills may have to be carried out to ensure the readiness of these procedures.

5.9

Verify start-up and testing of all support utility systems, including main and auxiliary sources for the process system, prior to commissioning.

5.11

Verify proper hook-up and testing of the entire process system, prior to commissioning. This is to include testing of the entire system for leaks, of the process control functions and the emergency shutdown system.

5.13

Verify purging of the entire production system of oxygen to an acceptable level, prior to the introduction of hydrocarbons into the production system.

5.15

Verify the introduction of hydrocarbon into the process system, and the system's capability to control the flow of the well affluent in the system in a stabilized manner, without undue control upsets.

5.17

Verify the starting up of the flare system, if applicable, including precautions taken to eliminate the risk of explosion or fire. The functional capability of the flare system is to be verified.

5.19

Verify that the post-commissioned process system is in satisfactory functioning order for a duration of at least 12 hours.

Equipment required to be verified but not used during the start-up and commissioning is to be identified for verification at the next annual survey.

7 Start-up and Commissioning Manual

The start-up and commissioning manual is to include, at minimum, the procedures listed in 5-1/7.1 and 5-1/7.3.

7.1 Functional Testing Procedures

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

7.1.1 Piping and Equipment

i) Pressure/Leak Test

ii) Purging

7.1.2 Utility Systems

i) Power Generation (Main & Emergency)

ii) Process Support Facilities

iii) Instrument Air

iv) Cooling Water

7.1.3 Fire Fighting and Safety Systems

i) Fire Pumps

ii) Fixed Fire Fighting Systems

iii) Manual Equipment

iv) Lifesaving Equipment

7.1.4 Detection and Alarm

i) Fire Detection

ii) Gas Detection

iii) Fire and Gas Panel

iv) ESD Systems

7.1.5 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

7.3 Start-up Procedure

A step by step procedure is to be followed for the displacement of air or other fluid from the process systems 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. The Surveyor is to observe the facilities operating at the initial production capacity for at least a 12 hour period of uninterrupted normal operation. As applicable, the Surveyor is also to observe the facilities operating at various capacities under various conditions.

TABLE 1
Construction Survey Guidelines

	A	B	C	D	E
HYDROCARBON PRODUCTION PROCESS SYSTEMS					
Production Vessels	X	X	X		
Storage Tanks	X	X	X		
Heat Exchangers	X	X	X		
Fired Vessels	X	X	X		
Meters, Strainers, Filters and Other Fluid Conditioners					
< 254 mm (10 in.) and 10.54 kg/cm^2 (150 psi)					X
> 254 mm (10 in.) or 10.54 kg/cm^2 (150 psi)	X	X	X		
Pumps					
< 7 kg/cm^2 (100 psi) and 757 liters/min (200 gpm)					X
> 7 kg/cm^2 (100 psi) or 757 liters/min (200 gpm)			X	X	
Compressors					
< 7 kg/cm^2 (100 psi) and 28.3 m^3 (1000 scfm)					X
> 7 kg/cm^2 (100 psi) or 28.3 m^3 (1000 scfm)			X	X	
Flowlines and Manifolds	X	X	X		
Scraper Launchers/Receivers	X	X	X		
Packaged Process Units	X	X	X	X	
Flare Systems	X	X			
Subsea Systems	X	X	X	X	
PROCESS SUPPORT SYSTEMS					
Pressure Vessels					
< 7 kg/cm^2 (100 psi) and 93.3°C (200°F)					X
> 7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X	X	X		
Heat Exchangers					
< 7 kg/cm^2 (100 psi) and 93.3°C (200°F)					X
> 7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X	X	X		
Pumps					X
Air Compressors					X
Engines And Turbines					
< 100 kW (134 hp)					X
> 100 kW (134 hp)			X	X	
Packaged Support Systems					
< 7 kg/cm^2 (100 psi) and 93.3°C (200°F)					X
> 7 kg/cm^2 (100 psi) or 93.3°C (200°F)	X	X	X	X	

TABLE 1 (continued)
Construction Survey Guidelines

	A	B	C	D	E
ELECTRICAL SYSTEMS					
Generators					
<100 kW (134 hp)					X
>100 kW (134 hp)				X	
Motors					
<100 kW (134 hp)					X
>100 kW (134 hp)				X	
Switchboard					X
INSTRUMENT AND CONTROL SYSTEMS					
Control Panels					X
FIRE PROTECTION & SAFETY EOUIPMENT					
Fire Pumps				X	
Alarm Panels				X	
Fire Extinguishing Systems (Components)			X		
COMPONENT SKID STRUCTURE For modules that require design review, see 3-3/23.2		X			

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A 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.

B ABS attendance at Vendor's shop during critical phases of fabrication such as fit-up, alignment, and NDT examination.

C ABS attendance at Vendor's shop to witness and report on pressure testing.

D ABS attendance at Vendor's shop to witness and report on operational tests to insure proper functioning of equipment.

E 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.

Notes:

1 Prior to the commencement of the construction surveys listed above, ABS technical staff should have completed the review of any documentation submitted for systems and components as listed in Chapter 3, Section 2 and Chapter 4, Section 2.

TABLE 1 (continued)
Construction Survey Guidelines

General Testing Requirements

Where components listed above are indicated as being tested under survey, the following list indicates general testing guidelines.

COMPONENT	*REFERENCE DOCUMENT*
Pressure Vessels	ASME Section VIII
Pumps	API Std. 610
Compressors	API Std. 617, 618, 619
Gas Turbines	API Std. 616
Storage Tanks	API Std. 620
Piping Systems	API RP 14E, ASME B31.3
Electrical Systems	API RP I4F
Instrument and Control Systems	API RP 554

Specific Testing Requirements

The following specific tests, if required, are to be witnessed by the ABS Surveyor. Other tests required by project specifications may also be witnessed and reported on by the Surveyor.

1 Pressure Vessels

a. Each vessel is to be subjected to a hydrostatic test which at every point in the vessel is at least equal to 1.5 times the maximum allowable working pressure.

b. For pressure vessels that cannot be safely filled with water, a pneumatic test equal to 1.25 times the maximum allowable working pressure is to be performed.

2 Pumps

a. Each pressure casing or pressure-retaining part is to be hydrostatically tested with water at ambient temperature at a minimum of 1.5 times the maximum allowable casing pressure.

b. An operational test of the pump is to be performed to demonstrate satisfactory performance.

3 Compressors

a. Pressure and operational tests, identical to items a and b under Pumps, are to be performed.

b. Each compressor intended for toxic or flammable gas service is to be pressurized with an inert gas to the rated discharge pressure. The casing is to be held at this pressure for a minimum of 30 minutes to check for gas leaks, when subjected to a soap-bubble test or to another approved leak test.

4 Gas Turbines

a. Pressure and operational tests, identical to items a and b under PUMPS, are to be performed.

b. See API Standard 616 for details of the mechanical running test.

5 Low Pressure Storage Tanks – 0.011 to 1.05 kg/cm^2 (2.5 oz/in^2 to 15 psi) for Crude or Flammable Fluids (with Flash Points < 60°C or 140°F) (2.5 oz/in^2 to 15 psi) or (0.0109 to 1.05 kg/cm^2)

a. Depending on the design of the tank, each storage tank is to be subjected to a combination hydrostatic-pneumatic test, or a completely hydrostatic test.

b. If the tank has not been designed to be filled with liquid to the tank, the tank is filled with water to its high liquid design level, and a test pressure of 1.25 times, design pressure of the vapor space is applied to the vapor space.

c. If the tank has been designed to be filled with liquid to the tank top, it is to be hydrostatically tested with a pressure under the topmost point equal to 1.25 times the vapor space design pressure.

d. Partial vacuum tests are to be conducted for tanks that are designed to withstand the partial vacuum.

6 Atmospheric Storage Tanks for Crude or Flammable Fluidswith Flash Points less than 60°C

a. Atmospheric storage tanks are to be hydrostatically tested to the maximum liquid head to which the tank is likely to be subjected.

TABLE 1 (continued)
Construction Survey Guidelines

7 *Piping Systems*

a. All piping systems are to be hydrostatically leak-tested prior to being placed into service. The test pressure is to be 1.5 times the design pressure, or 3.5 kg/cm^2 (50 psig), whichever is greater.

b. Where it is necessary to perform a pneumatic leak test, the test pressure is to be 1.1 times the design pressure.

c. All joints, including welds, are to be left uninsulated and exposed for examination during leak testing.

8 *Electrical Systems (Generators & Motors)*

a. Check windings for dryness. It is recommended that space heating be operated for a sufficient time prior to start-up to assure dryness.

b. Measurement of stator insulation resistance to the motor or generator frame is to be made with an instrument applying a minimum of 600 volts across the insulation. The suggested minimum insulation resistance is 2.0 meghoms; new or rebuilt machines should provide at least 10 megohms in insulation resistance readings.

c. If generators are to be operated in parallel, check their phase rotation and the synchronizing circuits for proper operation.

d. Check motor starter overload relay heater elements for proper sizing.

e. Check circuit breaker trip settings and fuse sizes.

f. Jog motors to check for proper direction of rotation, but only after uncoupling any loads which might be damaged by reverse rotation.

g. Check motor-to-load and generator-to-prime mover alignments.

h. Perform an insulation test of all electrical circuits to ensure that cables are not damaged during installation.

i. Ensure all components are properly grounded.

j. After motors and generators are started, check for abnormal line currents, vibration, and high bearing temperatures.

k. Witness full-load heat run and saturation curve tests for the first unit of a particular design.

9 *Electrical Systems (Switchboards)*

a. Check all bus-bars for correct sizing and spacing.

b. Check all components for correct voltage and current rating.

c. Ensure all components are properly grounded.

d. The various circuits of switchboard and panelboard assemblies are to be tested by conducting dielectric strength test and insulation resistance measurements.

e. Satisfactory tripping and operation of all relays, contactors and various safety devices is to be demonstrated.

10 *Instrument and Control System*

a. Witness calibration of all pressure, level and temperature switches necessary for functioning of controls in accordance with SAFE Charts.

b. Review calibration records of all other instruments.

c. Ensure all instruments used as pressure-retaining parts have correct pressure ratings.

d. Ensure all electrical/electronic instruments to be installed in a hazardous location are suitable for that environment.

e. Ensure all electrical/electronic instruments are properly grounded.

f. Ensure all electrical circuits are installed in a 'fail safe' manner, that is all circuits in normal working state are to be electrically continuous, and non-continuous when in an abnormal state.

g. Check logic functions with normal voltage applied to the control circuits, but preferably with the power circuits not energized.

h Check each sensor and end device individually for proper operation before incorporating them into the system.

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CHAPTER 5 Survey Requirements

SECTION 2 Survey for Maintenance of Class

1 General

The provisions of this section contain survey requirements for the maintenance of classification for facilities installed on an offshore installation. For modifications, the documentation requirements for review are given in 3-2/23 or 4-2/21.

3 Commissioning

For purposes of this section, the commissioning date will be the date on which a Surveyor issues the Interim Classification Certificate for the offshore facilities.

5 Surveys

5.1 Annual Survey

To maintain classification of the facilities, an annual survey is to be carried out by a Surveyor within three months before of each anniversary date of the initial Classification Survey.

5.3 Special Survey

A Special Survey of the facilities is to be carried out within five years of the initial Classification Survey, and at five-year intervals thereafter.

5.5 Timing of Surveys

Required surveys are to be completed within 3 months of their due dates, unless extended by agreement with ABS. Any part of an offshore installation 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.

5.7 Continuous Survey Program

A continuous survey program may be arranged whereby all required surveys are carried out on a continuing basis.

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 the ABS *Guide for Survey Based on Preventative Maintenance Techniques*.

7 Maintenance Records

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 Surveys which are to be carried out by a Surveyor. During the service life of the facilities, maintenance records are to be updated on a continuing basis. The operator 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 equipment. The Surveyor may determine during his periodic survey if the changes are sufficient to warrant review by the ABS technical staff.

7.1 Annual Survey

At each Annual survey, in addition to a general review of the maintenance records, the Surveyor is to verify the effectiveness of the following items by visual examination and operational testing, as appropriate.

i) Examination of corrosion protection system

ii) Examination and testing of remote shutdown arrangements for fuel and ventilation equipment

iii) Examination and testing of safety shutdown devices

iv) Examination and testing of Emergency Control Stations

v) External examination and testing of safety relief valves

vi) External examination during operation of all machinery, pumps and pumping arrangements, including valves, cocks and pipes

vii) Examination of preventative maintenance records

viii) Examination of fire hoses, nozzles, and spanners at each fire station

ix) Examination of fire protection system, including fire water pumps and related piping, hydrants, control valves and alarm systems

x) Operational check of fire protection systems, including fire pumps, water spray systems, and alarm and detection systems

xi) Examination of personnel protection, rescue and escape systems and devices, including alarm devices and emergency lighting for escape routes, landing platforms, etc.

xii) General examination of structure, piping, electrical systems and machinery foundations for damage, deterioration, or hazard. (i.e., flare tower or ground flare, production systems, power generation, etc.)

xiii) Examination of enclosed hazardous areas, including ventilation, electric lighting, electric fixtures and instrumentation

xiv) Verification of the integrity of explosion-proof equipment

xv) Operational test of emergency lighting systems, navigation and obstruction lights

xvi) External examination of boilers, separators, and similar process equipment and associated relief valves

xvii) Examination of steam-generating units

7.3 Special Survey

The Special Survey is to include all items listed under the Annual Survey with the following additions:

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

ii) Non-explosion proof electric motors are to be examined, including automatic power disconnect to motors that are arranged to shut down in case of loss of ventilation.

iii) Gauging of pressure vessels, heat exchangers, and storage tanks, as considered necessary

iv) Internal examination of pressure vessels, pumps, compressors, and safety relief valves

v) Random thickness gauging of process piping, as considered necessary

Hydrostatic testing of process related piping systems to 1.25 times the maximum allowable working pressure as considered necessary.

vi) Lube oil examination record review

vii) Measurement of the insulation resistance of generators and motors

viii) Running of generators of under load, separately and in parallel

ix) Examination of cable runs, bus ducts, insulators, etc.

x) Testing of circuit breakers, relays, etc.

xi) Examination of electrical equipment and circuits for possible damage or deterioration

xii) Vibration checks of rotating machinery

xiii) Internal examination of steam and gas turbines, as considered necessary

xiv) Testing of protective devices for engines, turbines, and gas compressors

xv) Internal examination of diesel engines and gas engines rated 1000 hp output and above, as considered necessary

xvi) Operational check of process control equipment.

7.5 Inspection Plan

The requirements of 5-2/7.1 and 5-2/7.3 above are intended to define the general scope of required surveys. Because of the varied nature and purposes of offshore installations, it is not considered practicable to establish a firm schedule of requirements. The Annual and Special Surveys are to be carried out in accordance with the reviewed inspection plan to confirm the fitness of the facility for continued operation.

9 Modifications

When it is intended to carry out any modifications to the machinery, piping, process equipment, etc., which may affect classification, the details of such modifications are to be submitted for review. If ABS determines that the modification will affect classification, the facility to be modified will be subject to the review, testing and inspection requirements of the Rules.

11 Damage and Repairs

If an offshore installation that has been classed suffers any damage to machinery, piping, process equipment, etc., which may affect classification, 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 Surveyor.

13 Certification on Behalf of Coastal States

When ABS is authorized to perform surveys on behalf of a governmental authority, and 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 accordingly.

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CHAPTER 5 Survey Requirements

SECTION 3 Risk Based Surveys for Maintenance of Class

1 General

The provisions of this section contain survey requirements specific to the maintenance of classification for facilities installed on an offshore installation for which inspection plans have been developed using risk based techniques.

1.1

While this section provides risk based survey requirements as an alternative for maintenance of Class, many of the sub-sections on the Classification Process contained in Chapter 1 of this Guide are still applicable. Where no specific references or guidance are given in this section, the relevant requirements of Chapter 1, Sections 3 through 12 remain valid.

1.3

Because of the diverse nature and purposes of offshore installations, and the varied contents of inspection plans likely to be developed as part of an Owner's risk based approach to Classification, it is not considered practicable to establish a firm schedule of survey requirements in this section for maintenance of Class.

1.5

Where modifications to the facilities are to be carried out after issuance of the Classification Certificate, all documentation requirements for review as defined in 3-2/23 or 4-2/21 of this Guide remain the same. Furthermore, the design documentation described in 3-2/1 or 4-2/1 is to be available to the attending Surveyor at the time of the modifications.

3 Requirements for Risk Based Survey

3.1

Where the risk based approach is to be adopted, the Owner's proposed maintenance and inspection plans, including details of frequency and extent of activities, are to be submitted for review. Where these plans deviate from the Survey requirements of Chapter 5, Section 2, the risk assessment methodology required by 5-3/3.1.1 below is to specifically address these deviations, which are not to result in an unacceptable level of safety or integrity of the facilities. In addition to the maintenance and inspection plans noted above, the following documentation is to be submitted to ABS at least six months before the plan is to be put into effect. This documentation is to establish, at a minimum:

3.1.1

The basis and methodology employed in the risk based techniques;

3.1.2

The means by which the technique is used to establish maintenance plans;

3.1.3

The means by which the technique is used to update and modify maintenance and inspection plans;

3.1.4

The means by which the following items are to be controlled:

i) Accident and Non-Conformity Reporting

ii) Overdue Inspections/Surveys

iii) Internal Audits and Management Reviews

iv) Control, Storage and Retention of Documents and Data

v) Change Procedures for ABS approved plans

3.3

Where the risk based approach is to be adopted on facilities installed on a Floating Installation, the risk assessment on which the inspection and maintenance plan is based is to be site-specific. If the installation is to be relocated, the risk assessment is to be reviewed by the Owner and resubmitted to ABS for approval.

5 Surveys

5.1 General

5.1.1

To credit a Special Survey based on risk based inspection techniques, the facilities are to be subject to a continuous survey program, whereby the survey of all applicable items is to be carried out on a continuous basis over the five-year special survey cycle. If this program includes a preventative maintenance/condition monitoring plan, this plan is to be in accordance with the *ABS Guide for Survey Based on Preventative Maintenance Techniques.*

5.1.2

The inspection plan detailing the timing and extent of activities will be reviewed to establish the scope and content of the Annual and Special Surveys which are required to be carried out by a Surveyor, who will also monitor the Owner's in-house quality management system required by 5-3/3.1.4 above. During the service life of the facilities, maintenance and inspection records are to be updated on a continuing basis and be available for reference by the attending Surveyor. The operator is to inform ABS of any changes to the maintenance procedures and their frequencies, as may be caused, for example, by changes, additions, or deletions to the original equipment.

5.3 Initial Survey

An Initial Survey is to be carried out to confirm that systems and plans required by 5-3/3.1above have been properly implemented. The survey is to be carried out a minimum of three (3) months after the date of implementation of the approved plans, but no later than concurrently with the next due annual survey.

5.5 Annual Survey

An Annual Survey is to be carried out by a Surveyor within three months before or after each anniversary date of the initial/renewal Classification Survey. The survey is to be carried out in accordance with the approved risk based inspection plan to confirm the fitness of the facility for continued operation. Where the inspection plan specifically applies ABS Rules, the applicable items listed in 5-2/7.1 of this chapter are to be complied with.

5.7 Special Survey

A Special Survey of the facilities is to be carried out within five years of the initial Classification Survey and at five-year intervals thereafter. The survey is to include all items in the approved risk based inspection plan listed under the Annual Survey, confirmation of the completion of the continuous survey program and where the inspection plan specifically applies ABS Rules, the applicable items listed in 5-2/7.3 of this chapter are to be complied with.

7 Notification and Availability for Survey

7.1

The requirements of 1-9/3, notwithstanding the maintenance and inspection plan required by 5-3/3.1 above is to be so structured as to ensure that all ABS survey activity is carried out during the annual and special surveys. If this is not possible, for instance during a planned/unplanned maintenance shutdown, or as a result of serious damage, adequate notification for Surveyor attendance is to be given by the owners.

7.3

If one of the situations noted in 5-3/7.1 above occurs within 2 months outside of the beginning or end of an annual survey window, due consideration may be given for the Annual Survey to be brought forward or postponed to coincide with the maintenance period. If an Annual Survey is brought forward, the next due Annual Survey is to be carried out within eighteen months of completion of that survey.

9 Modifications

When it is intended to carry out any modifications to the machinery, piping, process equipment, etc., which may affect classification, the details of such modifications are to be submitted for review. If ABS determines that the modification will affect classification, the facility to be modified will be subject to the review, testing and inspection requirements of the Rules.

11 Damage and Repairs

11.1

If an offshore installation that has been classed suffers any damage to machinery, piping, process equipment, etc., which may affect classification, 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 Surveyor.

11.3

When a piece of machinery, piping, or process equipment suffers a premature or unexpected failure, and is subsequently repaired or replaced without Surveyor attendance, details of the failure, including damaged parts where practicable, are to be retained on board for examination by the Surveyor during the next scheduled visit. Alternatively, the part or parts may be landed ashore for further examination and testing as required.

11.5

If failures noted in 5-3/11.3 above are deemed to be a result of inadequate or inappropriate maintenance, the maintenance and inspection plan is to be amended and resubmitted for approval.

13 Certification on Behalf of Coastal and Flag States

When ABS is authorized to perform surveys on behalf of a governmental authority, and 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 accordingly. Where the periodicity and types of surveys on behalf of a governmental authority differ from those required by the applicable sections of this chapter, the Coastal or Flag State requirements take precedence.

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A P P E N D I X **1** **Plastic Pipe Installations**

S E C T I O N **1** **General**

1 General

Pipes and piping components made of thermoplastic or thermosetting plastic materials, with or without reinforcement, may be used in piping systems referred to in A1-2/Table 1, subject to compliance with the following requirements. For the purpose of these Rules, "plastic" means both thermoplastic and thermosetting plastic materials, with or without reinforcement, such as polyvinyl chloride (PVC) and fiber-reinforced plastics (FRP).

3 Specification

Rigid plastic pipes are to be in accordance with a recognized national or international standard acceptable to ABS. Specification for the plastic pipe, including thermal and mechanical properties and chemical resistance, is to be submitted for review.

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SECTION 2 Design

1 Internal Pressure

A pipe is to be designed for an internal pressure not less than the design pressure of the system in which it will be used. The maximum internal pressure, P_{int}, for a pipe is to be the lesser of the following:

$P_{int} = P_{sth}/4$ or $P_{int} = P_{lth}/2.5$

where

P_{sth} = short-term hydrostatic test failure pressure

P_{lth} = long-term hydrostatic test failure pressure (>100,000 hours)

The hydrostatic tests are to be carried out under the following standard conditions:

atmospheric pressure = 1 bar (1 kgf/cm^2, 14.5 psi)

relative humidity = 30%

fluid temperature = 25°C (77°F)

The hydrostatic test failure pressure may be verified experimentally or determined by a combination of testing and calculation methods, which are to be submitted to ABS for approval.

3 External Pressure

External pressure is to be considered for any installation that may be subject to vacuum conditions inside the pipe or a head of liquid on the outside of the pipe. A pipe is to be designed for an external pressure not less than the sum of the pressure imposed by the maximum potential head of liquid outside the pipe plus full vacuum, 1 bar (1 kgf/cm^2, 14.5 psi), inside the pipe. The maximum external pressure for a pipe is to be determined by dividing the collapse test pressure by a safety factor of 3.

The collapse test pressure may be verified experimentally or be determined by a combination of testing and calculation methods, which are to be submitted ABS for approval.

5 Axial Strength

The sum of the longitudinal stresses due to pressure, weight and other dynamic and sustained loads, is not to exceed the allowable stress in the longitudinal direction. Forces due to thermal expansion, contraction and external loads, where applicable, are to be considered when determining longitudinal stresses in the system.

In the case of fiber-reinforced plastic pipes, unless the allowable longitudinal stress is verified experimentally or by a combination of testing and calculation methods, the sum of the longitudinal stresses is not to exceed one half of the nominal circumferential stress derived from the maximum internal pressure, determined according to A1-1/3.1.

7 Temperature

The maximum allowable working temperature of a pipe is to be in accordance with the manufacturer's recommendations, but in every instance, is to be at least 20°C (36°F) lower than the minimum heat distortion temperature of the pipe material, determined according to ISO 75 method A or equivalent. The minimum heat distortion temperature is not to be less than 80°C (176°F).

Where low temperature services are considered, special attention is to be given with respect to material properties.

9 Impact Resistance

Plastic pipes and joints are to meet a minimum resistance to impact in accordance with a recognized national or international standard such as ASTM D2444 or equivalent.

11 Fire Endurance

Fire endurance requirements for pipes based on system and location are specified in A1-2/Table 1. Pipes and their associated fittings whose functions or integrity are essential to the safety of the vessel are to meet the fire endurance requirements described below.

11.1 Level 1

Level 1 will ensure the integrity of the system during a full scale hydrocarbon fire, and is particularly applicable to systems where loss of integrity may cause outflow of flammable liquids and worsen the fire situation. Piping having passed the fire endurance test specified in Appendix 1, Section 6 for a minimum duration of one hour without loss of integrity in the dry condition is considered to meet Level 1 fire endurance standard (L1).

11.3 Level 2

Level 2 intends to ensure the availability of systems essential to the safe operation of the vessel after a fire of short duration, allowing the system to be restored after the fire has been extinguished. Piping having passed the fire endurance test specified in Appendix 1, Section 6 for a minimum duration of 30 minutes without loss of integrity in the dry condition is considered to meet Level 2 fire endurance standard (L2).

11.5 Level 3

Level 3 is considered to provide the fire endurance necessary for a water-filled piping system to survive a local fire of short duration. The system's functions are capable of being restored after the fire has been extinguished. Piping having passed the fire endurance test specified in Appendix 1, Section 7 for a minimum duration of 30 minutes without loss of integrity in the wet condition is considered to meet Level 3 fire endurance standard (L3).

11.7 Level 3 Modified Test

Level 3 modified test for deluge systems is considered to provide the fire endurance necessary for a piping system to survive a local fire of short duration, with a simulated dry condition and subsequent flowing water condition. The system's functions are capable of being restored after the fire has been extinguished. Piping having passed the fire endurance test specified in Appendix 1, Section 8 for a minimum duration of 5 minutes in dry condition and 25 minutes in wet condition without loss of integrity, is considered to meet the Wet/Dry fire endurance standard (L3-WD).

11.9 Fire Endurance Coating

When a fire protective coating of pipes and fittings is necessary for achieving the fire endurance standards required, the following requirements apply:

i) Pipes are generally to be delivered from the manufacturer with the protective coating applied, with onsite application limited to that necessary for installation purposes (i.e., joints). See A1-3/13 regarding the application of the fire protection coating on joints.

ii) The fire protection properties of the coating are not to be diminished when exposed to salt water, oil or bilge slops. It is to be demonstrated that the coating is resistant to products likely to come in contact with the piping.

iii) In considering fire protection coatings, such characteristics as thermal expansion, resistance against vibrations and elasticity are to be taken into account.

iv) The fire protection coatings are to have sufficient resistance to impact to retain their integrity.

13 Flame Spread

All pipes except those fitted on open decks and within tanks, cofferdams, void spaces, pipe tunnels and ducts, are to have low flame spread characteristics. The test procedures in IMO Resolution A.653 (16), modified for pipes as indicated in Appendix 1, Section 9, are to be used for determining the flame spread characteristics. Piping materials giving average values for all of the surface flammability criteria not exceeding the values listed in Resolution A.653 (16) (surface flammability criteria of bulkhead, wall and ceiling linings) are considered to meet the requirements for low flame spread.

Alternatively, flame spread testing in accordance with ASTM D635 may be used in lieu of the IMO flame spread test, provided such test is acceptable to the Administration. Under the ASTM D635 test method, the plastic pipe may be considered self-extinguishing if none of the ten, or no more than one of the twenty, specimens have burned to the 100-mm (3.9 in.) mark.

15 Electrical Conductivity

15.1 Piping Conductivity

Piping conveying fluids with a conductivity less than 1000 pico-siemens per meter is to be electrically conductive.

15.3 Hazardous Areas

Regardless of the fluid being conveyed, plastic pipes are to be electrically conductive if the piping passes through a hazardous area.

15.5 Electrical Resistance

Where electrically conductive pipe is required, the resistance per unit length of the pipes and fittings is not to exceed 1×10^5 Ohm/m (3×10^4 Ohm/ft). See also A1-4/7.

15.7 Non-homogeneous Conductivity

Pipes and fittings with layers having different conductivity are to be protected against the possibility of spark damage to the pipe wall.

17 Marking

Plastic pipes and other components are to be permanently marked with identification in accordance with a recognized standard. Identification is to include pressure ratings, the design standard to which the pipe or fitting is manufactured, and the material with which the pipe or fitting is constructed.

TABLE 1
Fire Endurance Requirements Matrix

PIPING SYSTEMS		*LOCATION*										
		A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*
HYDROCARBON & CARGO (Flammable cargoes with flash point < 60°C (140°F)												
1	Cargo lines	NA	NA	L1			0	NA	0	0	NA	L1[2]
2	Crude oil washing lines	NA	NA	L1			0	NA	0	0	NA	L1[2]
3	Vent lines	NA	NA	NA			0	NA	0	0	NA	X
3a	Process lines	NA	NA	NA			0	NA	0	0	NA	L1[2]
3b	Produced water lines	NA	NA	NA			0	NA	0	0	NA	L3[10]
INERT GAS												
4	Water seal effluent line	NA	NA	0[1]			0[1]	0[1]	0[1]	0[1]	NA	0
5	Scrubber effluent line	0[1]	0[1]	NA			NA	NA	0[1]	0[1]	NA	0
6	Main line	0	0	L1			NA	NA	NA	0	NA	L1[6]
7	Distribution lines	NA	NA	L1			0	NA	NA	0	NA	L1[2]
FLAMMABLE LIQUIDS (flash point > 60°C (140°F))												
8	Cargo lines	X	X	L1			NA[3]	0	0	0	NA	L1
9	Fuel oil	X	X	L1			NA[3]	0	0	0	L1	L1
10	Lubricating oil	X	X	L1			NA	NA	NA	0	L1	L1
11	Hydraulic oil	X	X	L1			0	0	0	0	L1	L1
SEA WATER (See Note 1)												
12	Bilge main and branches	L1[7]	L1[7]	L1			NA	0	0	0	NA	L1
13	Fire main	L1	L1	L1			NA	NA	0	0	X	L1/L3[11]
13a	Water spray (Deluge)	L1	L1	L1			NA	NA	0	0	X	L1/LWD[11]
14	Foam system	L1	L1	L1			NA	NA	NA	0	L1	L1
15	Sprinkler system	L1	L1	L3			NA	NA	0	0	L3	L3
16	Ballast	L3	L3	L3			0	0	0	0	L2	L2
17	Cooling water, essential services	L3	L3	NA			NA	NA	0	0	NA	L2
18	Tank cleaning services, fixed machines	NA	NA	L3			0	NA	0	0	NA	L3[2]
19	Non-essential systems	0	0	0			NA	0	0	0	0	0
FRESH WATER												
20	Cooling water, essential services	L3	L3	NA			NA	0	0	0	L3	L3
21	Condensate return	L3	L3	L3			NA	NA	NA	0	0	0
22	Non-essential systems	0	0	0			NA	0	0	0	0	0
SANITARY/DRAINS/SCUPPERS												
23	Deck drains (internal)	L1[4]	L1[4]	NA			NA	0	0	0	0	0
24	Sanitary drains (internal)	0	0	NA			NA	0	0	0	0	0
25	Scuppers and discharges (overboard)	0[1,8]	0[1,8]	0[1,8]			0	0	0	0	0[1,8]	0
VENT/SOUNDING												
26	Water tanks/dry spaces	0	0	0			0	0	0	0	0	0
27	Oil tanks (flash-point > 60°C (140°F))	X	X	X			X[3]	0	0	0	X	X
MISCELLANEOUS												
28	Control air	L1[5]	L1[5]	L1[5]			NA	0	0	0	L1[5]	L1[5]
29	Service air (non-essential)	0	0	0			NA	0	0	0	0	0
30	Brine	0	0	NA			NA	NA	NA	0	0	0
31	Auxiliary low pressure steam (Pressure ≤ bar (7 kgf/cm^2, 100 psi))	L2	L2	0[9]			0	0	0	0	0[9]	0[9]

Locations		*Abbreviations*	
A	Category A machinery spaces	L1	Fire endurance test in dry conditions, 60 minutes, in accordance with Appendix 1, Section 6
B	Other machinery spaces	L2	Fire endurance test in dry conditions, 30 minutes, in accordance with Appendix 1, Section 6
C	Cargo pump rooms	L3	Fire endurance test in wet conditions, 30 minutes, in accordance with Appendix 1, Section 7
D	Not needed	LWD	Fire endurance test in dry condition, 5 minutes, and wet condition in 25 minutes, in accordance with Appendix 1, Section 7 & Appendix 1, Section 8
E	Not needed	0	No fire endurance test required
F	Cargo tanks	NA	Not applicable
G	Fuel oil tanks	X	Metallic materials having a melting point greater than 925°C (1700°F)
H	Ballast water tanks		
I	Cofferdams, void spaces, pipe tunnels and ducts		
J	Accommodation, service and control spaces		
K	Open decks		

NOTES:

1. Where non-metallic piping is used, remotely controlled valves are to be provided at the ship's side. These valves are to be controlled from outside the space.
2. Remote closing valves are to be provided at the cargo tanks and hydrocarbon liquid and gas retaining components as applicable.
3. When cargo tanks contain flammable liquids with a flash point greater than 60°C (140°F), "0" may replace "NA" or "X".
4. For drains serving only the space concerned "0" may replace "L1".
5. When controlling functions are not required by statutory requirements "0" may replace "L1".
6. For pipe between machinery space and deck water seal, "0" may replace "L1".
7. For passenger vessels, "X" is to replace "L1".
8. Scuppers serving open decks in positions 1 and 2, as defined in Regulation 13 of the International Convention on Load Lines, 1966, are to be "X" throughout unless fitted at the upper end with the means of closing capable or being operated from a position above the freeboard deck in order to prevent down-flooding.
9. For essential services, such as fuel oil tank heating and ship's whistle, "X" is to replace "0".
10. Metallic ESD valves are to be provided together with fire detection, fire fighting and shutdown system
11. Lower level of fire resistant tests (Level 3 and Level WD) may be considered for the fire water ring main and deluge systems provided the system arrangement meet Appendix 1, Section 7 of this Guide.

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SECTION 3 Installation of Plastic Pipes

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APPENDIX 1 Plastic Pipe Installations

SECTION 3 Installation of Plastic Pipes

1 Supports

1.1 Spacing

Selection and spacing of pipe supports in shipboard systems are to be determined as a function of allowable stresses and maximum deflection criteria. Support spacing is not to be greater than the pipe manufacturer's recommended spacing. The selection and spacing of pipe supports are to take into account pipe dimensions, mechanical and physical properties of the pipe material, mass of pipe and contained fluid, external pressure, operating temperature, thermal expansion effects, loads due to external forces, thrust forces, water hammer and vibrations to which the system may be subjected. Combinations of these loads are to be taken into consideration for the design.

1.3 Bearing

Each support is to evenly distribute the load of the pipe and its contents over the full width of the support. Measures are to be taken to minimize wear of the pipes where they come in contact with the supports.

1.5 Heavy Components

Heavy components in the piping system, such as valves and expansion joints, are to be independently supported.

1.7 Working of the Hull on a Floating Installation

The supports are to allow for relative movement between the pipes and the vessel/unit's structure, properly accounting for the difference in the coefficients of thermal expansion and deformations of the vessel/unit's hull and its structure.

1.9 Thermal Expansion

When calculating the thermal expansion, the system's working temperature and the temperature at which assembling is performed are to be taken into account.

3 External Loads

When installing piping, allowance is to be made for temporary point loads, where applicable. Such allowances are to include at least the force exerted by a load (person) of 980 N (100 kgf, 220 lbf) at midspan on any pipe more than 100-mm (4 in.) nominal diameter. Pipes are to be protected from mechanical damage where necessary.

5 Plastic Pipe Connections

5.1 General Requirements

The following general principles are applicable to all pipe connections:

i) The strength of fittings and joints is not to be less than that of the piping they connect.

ii) Pipes may be joined using adhesive bonded, welded, flanged or other types of joints.

iii) Tightening of flanged or mechanically coupled joints is to be performed in accordance with manufacturer's instructions.

iv) Adhesives, when used for joint assembly, are to be suitable for providing a permanent seal between the pipes and fittings through the temperature and pressure range of the intended application.

5.3 Procedure and Personal Qualifications

Joining techniques are to be in accordance with manufacturer's installation guidelines. Personnel performing these tasks are to be qualified to the satisfaction of the ABS, and each bonding procedure is to be qualified before shipboard piping installation commences. Requirements for joint bonding procedures are in Appendix 1, Section 5.

7 Electrical Conductivity

Where electrically conductive pipe is required by A1-2/15, installation of the pipe is to be in accordance with the following:

7.1 Resistance Measurement

The resistance to earth (ground) from any point in the system is not to exceed 1 megohm. The resistance is to be checked in the presence of the Surveyor.

7.3 Grounding (Earthing) Wire

Where used, grounding (earthing) wires or bonding straps are to be accessible for inspection. The Surveyor is to verify that they are in visible locations.

9 Shell Connections on Floating Installations

Where plastic pipes are permitted in systems connected to the shell of the vessel/unit, the valves and the pipe connection to the shell are to be in accordance with applicable *Steel Vessel Rules* or *MODU Rules*. See 4-6-2/9.13 or 4/2.17.4, respectively.

11 Bulkhead and Deck Penetrations

i) The integrity of watertight bulkheads and decks is to be maintained where plastic pipes pass through them.

ii) Where plastic pipes pass through "A" or "B" class divisions, arrangements are to be made to ensure that fire endurance is not impaired. These arrangements are to be tested in accordance with IMO Resolution. A 754 (18), Recommendation on Fire Resistance Tests for "A", "B" and "F" Class Divisions, as amended.

iii) If the bulkhead or deck is also a fire division, and destruction by fire of plastic pipes may cause inflow of liquid from tank, a metallic shutoff valve operable from above the bulkhead deck is to be fitted at the bulkhead or deck.

13 Application of Fire Protection Coatings

Where required by fire endurance criteria in A1-2/11, fire protection coatings are to be applied on the joints after performing hydrostatic pressure tests of the piping system (see Appendix 1, Section 10). The fire protection coatings are to be applied in accordance with the manufacturer's recommendations, using a procedure approved in each particular case.

APPENDIX 1 Plastic Pipe Installations

SECTION 4 Manufacturing of Plastic Pipes

Preferably, the manufacturer is to have a quality system and be certified in accordance with 4-1-1/3.5.2 of the *Steel Vessel Rules* or ISO 9001. The quality system is to consist of elements necessary to ensure that pipes and components are produced with consistent and uniform mechanical and physical properties in accordance with recognized standards, and is to include the following tests:

i) Samples of pipe are to be tested to determine the short-term and long-term hydrostatic design strength. These samples are to be selected randomly from the production facilities.

ii) For piping that is required to be electrically conductive, representative samples of pipe are to be tested to determine electrical resistance per unit length.

iii) Random samples of pipe are to be tested to determine the adhesion qualities of its coating.

If the manufacturer does not have a certified quality system, the tests listed above will be required using samples from each batch of pipes being supplied for use aboard the facility.

Regardless of whether the manufacturer has a certified quality system, each length of pipe is to be tested at the manufacturer's production facility (shop test) to a hydrostatic pressure not less than 1.5 times the maximum allowable internal pressure of the pipe (see A1-2/1).

APPENDIX 1 Plastic Pipe Installations

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APPENDIX 1 Plastic Pipe Installations

SECTION 5 Plastic Pipe Bonding Procedure Qualification

1 Procedure Qualification Requirements

1.1 Joint Bonding Parameters

To qualify joint bonding procedures, the tests and examinations specified herein are to be successfully completed. The procedure for making bonds is to include the following:

i) materials used

ii) tools and fixtures

iii) environmental requirements

iv) joint preparation requirements

v) cure temperature

vi) dimensional requirements and tolerances

vii) test acceptance criteria for the completed assembly

1.3 Re-qualification

Any change in the bonding procedure that will affect the physical and mechanical properties of the joint will require the procedure to be re-qualified.

3 Procedure Qualification Testing

3.1 Test Assembly

A test assembly is to be fabricated in accordance with the procedure to be qualified, and is to consist of at least one pipe-to-pipe joint and one pipe-to-fitting joint. When the test assembly has been cured, it is to be subjected to a hydrostatic test pressure at a safety factor of 2.5 times the design pressure of the test assembly, for not less than one hour. No leakage or separation of joints is to be allowed. The test is to be conducted so that the joint is loaded in both longitudinal and circumferential direction.

3.3 Pipe Size

Selection of the pipes used for test assembly is to be in accordance with the following:

i) When the largest size to be joined is 200 mm (8 in.) in nominal outside diameter or smaller, the test assembly is to be the largest pipe size to be joined.

ii) When the largest size to be joined is greater than 200 mm (8 in.) in nominal outside diameter, the size of the test assembly is to be either 200 mm (8 in.) or 25% of the largest piping size to be joined, whichever is greater.

3.5 Bonding Operator Qualification

When conducting performance qualifications, each bonder and each bonding operator are to make up test assemblies, the size and number of which are to be as required above.

APPENDIX 1 Plastic Pipe Installations

SECTION 6 Tests by the Manufacturer – Fire Endurance Testing of Plastic Piping in Dry Condition (For Level 1 and Level 2)

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APPENDIX 1 Plastic Pipe Installations

SECTION 6 Tests by the Manufacturer – Fire Endurance Testing of Plastic Piping in Dry Condition (For Level 1 and Level 2)

1 Test Method

1.1 Furnace Test Temperature

The specimen is to be subjected to a furnace test with fast temperature increase similar to that likely to occur in a fully-developed liquid hydrocarbon fire. The time/temperature is to be as follows:

i)	at the end of 5 minutes	945°C (1733°F)
ii)	at the end of 10 minutes	1033°C (1891°F)
iii)	at the end of 15 minutes	1071°C (1960°F)
iv)	at the end of 30 minutes	1098°C (2008°F)
v)	at the end of 60 minutes	1100°C (2012°F)

1.3 Furnace Temperature Control

The accuracy of the furnace control is to be as follows:

i) During the first 10 minutes of the test, variation in the area under the curve of mean furnace temperature is to be within ±15% of the area under the standard curve.

ii) During the first 30 minutes of the test, variation in the area under the curve of mean furnace temperature is to be within ±10% of the area under the standard curve.

iii) For any period after the first 30 minutes of the test, variation in the area under the curve of mean furnace temperature is to be within ±5% of the area under the standard curve.

iv) At any time after the first 10 minutes of the test, the difference in the mean furnace temperature from the standard curve is to be within ±100°C (±180°F).

1.5 Furnace Temperature Measurement

The locations where the temperatures are measured, the number of temperature measurements, and the measurement techniques are to be approved by ABS.

3 Test Specimen

3.1 Pipe Joints and Fittings

The test specimen is to be prepared with the joints and fittings intended for use in the proposed application.

3.3 Number of Specimens

The number of specimens is to be sufficient to test typical joints and fittings, including joints between non-metal and metal pipes and metal fittings to be used.

3.5 End Closure

The ends of the specimen are to be closed. One of the ends is to allow pressurized nitrogen to be connected. The pipe ends and closures may be outside the furnace.

3.7 Orientation

The general orientation of the specimen is to be horizontal, and it is to be supported by one fixed support, with the remaining supports allowing free movement. The free length between supports is not to be less than 8 times the pipe diameter.

3.9 Insulation

Most materials will require a thermal insulation to pass this test. The test procedure is to include the insulation and its covering.

3.11 Moisture Condition of Insulation

If the insulation contains or is liable to absorb moisture, the specimen is not to be tested until the insulation has reached an air dry condition, defined as equilibrium with an ambient atmosphere of 50% relative humidity at 20 ± 5°C (68 ± 9°F). Accelerated conditioning is permissible, provided the method does not alter the properties of the component material. Special samples are to be used for moisture content determination, and conditioned with the test specimen.

These samples are to be so constructed as to represent the loss of water vapor from the specimen having similar thickness and exposed faces.

5 Test Condition

A nitrogen pressure inside the test specimen is to be maintained automatically at 0.7 ± 0.1 bar (0.7 ± 0.1 kgf/cm^2, 10 ± 1.5 psi) during the test. Means are to be provided to record the pressure inside the pipe and the nitrogen flow into and out of the specimen, in order to indicate leakage.

7 Acceptance Criteria

7.1 During the Test

During the test, no nitrogen leakage from the sample is to occur.

7.3 After the Test

After termination of the furnace test, the test specimen and its fire protective coating, if any, are to be allowed to cool to ambient temperature in still air, then tested to the maximum allowable pressure of the pipes as defined in A1-2/1 and A1-2/3. The pressure is to be held for a minimum of 15 minutes without leakage. Where practicable, the hydrostatic test is to be conducted on bare pipe (i.e., coverings and insulation removed) so that any leakage will be visible.

7.5 Alternative Tests

Alternative test methods and/or test procedures considered to be at least equivalent, including open pit testing method, may be accepted in cases where the pipes are too large for the test furnace.

APPENDIX 1 Plastic Pipe Installations

SECTION 7 Tests by the Manufacturer – Fire Endurance Testing of Water-filled Plastic Piping (For Level 3)

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APPENDIX 1 Plastic Pipe Installations

SECTION 7 Tests by the Manufacturer – Fire Endurance Testing of Water-filled Plastic Piping (For Level 3)

1 Test Method

1.1 Burner

A propane multiple burner test with a fast temperature increase is to be used.

1.3 Pipe up to 152 mm (6 in) OD

For piping up to and including 152 mm (6 in.) OD, the fire source is to consist of two rows of 5 burners as shown in A1-7/Figure 1. A constant heat flux averaging 113.6 kW/m^2 (36,000 BTU/hr-ft^2) ± 10% is to be maintained 12.5 ± 1 cm (5 ± 0.4 in.) above the centerline of the burner array. This flux corresponds to a premix flame of propane with a fuel flow rate of 5 kg/hr (11 lb/hr) for a total heat release of 65 kW (3700 BTU/min.). The gas consumption is to be measured with an accuracy of at least ±3% in order to maintain a constant heat flux. Propane with a minimum purity of 95% is to be used.

1.5 Pipes more than 152 mm (6 in.) OD

For piping greater than 152 mm (6 in.) OD, one additional row of burners is to be included for each 51 mm (2 in.) increase in pipe diameter. A constant heat flux averaging 113.6 kW/m^2 (36,000 BTU/hr-ft^2) ± 10% is still to be maintained at the 12.5 ± 1 cm (5 ± 0.4 in.) height above the centerline of the burner array. The fuel flow is to be increased as required to maintain the designated heat flux.

1.7 Burner Type and Arrangement

The burners are to be of type "Sievert No. 2942" or equivalent which produces an air mixed flame. The inner diameter of the burner heads is to be 29 mm (1.14 in.). See A1-7/Figure 1. The burner heads are to be mounted in the same plane and supplied with gas from a manifold. If necessary, each burner is to be equipped with a valve to adjust the flame height.

1.9 Burner Position

The height of the burner stand is also to be adjustable. It is to be mounted centrally below the test pipe, with the rows of burners parallel to the pipe's axis. The distance between the burner heads and the pipe is to be maintained at 12.5 ± 1 cm (5 ± 0.4 in.) during the test. The free length of the pipe between its supports is to be 0.8 ± 0.05 m (31.5 ± 2 in.). See A1-7/Figure 2.

3 Test Specimen

3.1 Pipe Length

Each pipe is to have a length of approximately 1.5 m (5 ft).

3.3 Pipe Joints and Fittings

The test pipe is to be prepared with the permanent joints and fittings intended to be used. Only valves and straight joints, rather than elbows and bends, are to be tested, as the adhesive in the joint is the primary point of failure.

3.5 Number of Specimens

The number of pipe specimens is to be sufficient to test all typical joints and fittings.

3.7 End Closure

The ends of each pipe specimen are to be closed. One of the ends is to allow pressurized water to be connected.

3.9 Moisture of Insulation

If the insulation contains or is liable to absorb moisture, the specimen is not to be tested until the insulation has reached an air dry condition, defined as equilibrium with an ambient atmosphere of 50% relative humidity at 20 ± 5°C (68 ± 9°F). Accelerated conditioning is permissible, provided the method does not alter the properties of the component material. Special samples are to be used for moisture content determination, and conditioned with the test specimen.

These samples are to be so constructed as to represent the loss of water vapor from the specimen having similar thickness and exposed faces.

3.11 Orientation

The pipe samples are to rest freely in a horizontal position on two V-shaped supports. The friction between pipe and supports is to be minimized. The supports may consist of two stands, as shown in A1-7/Figure 2.

3.13 Relief Valve

A relief valve is to be connected to one of the end closures of each specimen.

5 Test Conditions

5.1 Sheltered Test Site

The test is to be carried out in a sheltered test site in order to prevent any draft influencing the test.

5.3 Water-filled

Each pipe specimen is to be completely filled with de-aerated water to exclude air bubbles.

5.5 Water Temperature

The water temperature is not to be less than 15°C (59°F) at the start, and is to be measured continuously during the test. The water is to be stagnant and the pressure maintained at 3 ± 0.5 bar (3.1 ± 0.5 kgf/cm^2, 43.5 ± 7.25 psi) during the test.

7 Acceptance Criteria

7.1 During the Test

During the test, no leakage from the sample(s) is to occur, except that slight weeping through the pipe wall may be accepted.

7.3 After the Test

After termination of the burner test, the test specimen and its fire protective coating, if any, are to be allowed to cool to ambient temperature, then tested to the maximum allowable pressure of the pipes as defined in A1-2/1 and A1-2/3. The pressure is to be held for a minimum of 15 minutes without significant leakage (i.e., not exceeding 0.2 liters/min. (0.05 gpm)). Where practicable, the hydrostatic test is to be conducted on bare pipe (i.e., coverings and insulation removed) so that any leakage will be visible.

FIGURE 1
Fire Endurance Test Burner Assembly

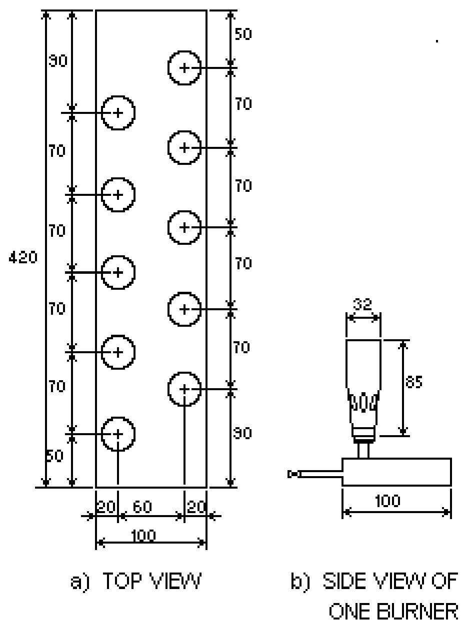
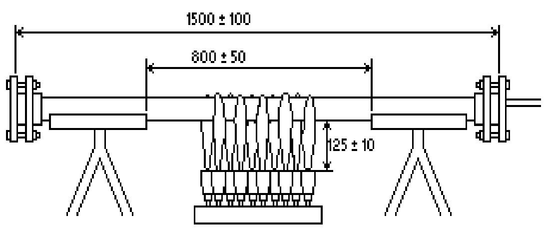


FIGURE 2
Fire Endurance Test Stand with Mounted Sample



APPENDIX **1** **Plastic Pipe Installations**

SECTION 8 Tests by the Manufacturer – Wet/Dry Fire Endurance Testing of Plastic Piping Used in Deluge System (For Level 3 Modified Test – Level 3 WD) (Adopted from USCG PFM 1-98)

The wet/dry fire endurance testing is to consist of conducting the Level 3 fire endurance testing specified in Appendix 1, Section 7, with the following modifications:

i) For the first 5 minutes of the test, the piping is to be maintained in the dry condition at atmospheric pressure in lieu of containing stagnant water.

ii) After completion of the first 5 minutes of the test, the pipe specimen is to be completely filled with flowing water.

iii) Air is to be bled from the opposite end of the piping via a test connection, until a steady flow of water at the specified flow rate and pressure is observed.

iv) The flow rate should not exceed the minimum pressure and flow rate that will be observed at the hydraulically most remote nozzle of the specific deluge system installation. The elapsed time between first introducing water to the test specimen until the specified flow rate and pressure is obtained, is not to exceed one minute. Testing at the specified flow rate and pressure will qualify the piping for all flow rates greater than that specified in the test.

v) The total test time including dry and wet time shall be 30 minutes.

All other requirements of Level 3 testing are to be followed without deviation.

APPENDIX 1 Plastic Pipe Installations

SECTION 9 Tests by the Manufacturer – Flame Spread

1 Test Method

Flame spread of plastic piping is to be determined by IMO Resolution A.653 (16) entitled "Recommendation on Improved Fire Test Procedures for Surface Flammability of Bulkhead, Ceiling, and Deck Finish Materials", with the following modifications:

i) Tests are to be performed on each pipe material and size.

ii) The test sample is to be fabricated by cutting pipes lengthwise into individual sections, and assembling the sections into a test sample as representative as possible of a flat surface. A test sample is to consist of at least two sections. The test sample is to be at least 800 ± 5 mm (31.5 ± 0.2 in.) long. All cuts are to be made normal to the pipe wall.

iii) The number of sections that must be assembled to form a test sample is to correspond to the nearest integer number of sections which makes up a test sample with an equivalent linearized surface width between 155 mm (6 in.) and 180 mm (7 in.). The surface width is defined as the measured sum of the outer circumference of the assembled pipe sections that are exposed to the flux from the radiant panel.

iv) The assembled test sample is to have no gaps between individual sections.

v) The assembled test sample is to be constructed in such a way that the edges of two adjacent sections coincide with the centerline of the test holder.

vi) The individual test sections are to be attached to the calcium silicate backing board using wire (No. 18 recommended) inserted at 50 mm (2 in.) intervals through the board, and tightened by twisting at the back.

vii) The individual pipe sections are to be mounted so that the highest point of the exposed surface is in the same plane as the exposed flat surface of a normal surface.

viii) The space between the concave unexposed surface of the test sample and the surface of the calcium silicate backing board is to be left void.

ix) The void space between the top of the exposed test surface and the bottom edge of the sample holder frame is to be filled with a high temperature insulating wool if the width of the pipe segments extend under the side edges of the frame holding the sample.

APPENDIX 1 **Plastic Pipe Installations**

SECTION 10 Testing on Board After Installation

Piping systems are to be subjected to a hydrostatic test pressure of not less than 1.5 times the design pressure to the satisfaction of the Surveyor. For piping required to be electrically conductive, grounding (earthing) is to be checked and random resistance testing is to be conducted to the satisfaction of the Surveyor.

APPENDIX 2 API and UK DOT Fire Tests for Non-metallic Hoses

API Spec. 16 C "Specifications for Choke and Kill Systems" 1st Edition 1993

10.5.1 Flexible Line Fire Test

1. Flexible Choke and Kill Lines shall withstand a 5 to 30 minute fire test as described in paragraphs 2 through 6. The lines shall not have visible leakage under nominal working pressure as a result of the Fire Test during the test period.

2. The fire test shall consist of direct exposure to flame or to radiation within a furnace. The temperature indicated by thermocouples at the end of the time period, shall be equal to or higher than 704°C (1300°F).

3 Thermocouples are to be positioned around the flexible line within 25.4 mm (1 in.) of the outer surface of the line or end fittings. At least one thermocouple near the flexible line, and one thermocouple near the surface of the end fitting shall reach 704°C (1300°F).

4 The flexible line must be pressurized full of water. The line may be tested horizontally, or vertically, according to the choice of the manufacturer.

5. The test sample shall be a minimum of 2.5 m (10 feet) in length. At least 1.25 m of the flexible line and one end fitting shall be exposed to fire or radiation.

6 After exposure to the fire, the line must remain pressurized either until a cool down, or if a leak occurs after the test period, until the pressure is reduced to one atmosphere. The line must not burst during this period.

API Spec. 16 D "Specifications for Control Systems for Drilling Well Control Equipment" 1st Edition 1993

Flame Tests

The control lines, and any component of the control lines to a surface mounted BOP stack or diverter located in a division1 area, as defined by API 500 (Area Classification) shall be capable of containing the normal operating pressure in a flame temperature of 1093°C (2000°F) for a period of three minutes without leakage (includes end connections).

Where hoses are used to connect the control system to the well control equipment, flame resistance test shall be conducted on a typical specimen in the following manner:

1. The test specimen shall be fitted with pressure end coupling and installed in a test facility capable of maintaining a 2000°F (±100) flame temperature over at least 180 angle degrees of the test specimen inclusive of approximately 305 mm (12 in.) of the specimen length, including one end connection.
2 The specimen is to be connected to a regulated water pressure source equal to normal operating pressure.
3. Thermocouples shall be located within the flame area to ensure that the test temperature is maintained at the end coupling, the coupling to hose transition and at a point along the hose at least 152 mm (6 in.) from the hose-to-coupling transition.
4. Deliverable hoses typical of successful test specimens shall be permanently identified in a manner to permit tracing of the test specimen and test facility. The control system manufacturers shall be responsible for maintaining hose compliance certifications on hoses which they supply in accordance with this specification.

UK DOT Appendix D

Fire Test Requirements for Fire Mains and Fittings

The valve, hydrant, cock, fitting or joint should be placed in a suitable furnace or oven where a temperature of 540°C (1000°F) should be maintained for 20 minutes, during which time an internal water pressure, without flow, of 8.3bars (120 psi) should be maintained on the item under test. At the end of the test, the maximum permissible leakage should not exceed 22.7 liters (5 gallons) per minute.

Table B.1
Non-Metallic Hose Requirements

Floating Installation			
Systems	**Service**	**Burst Pressure**	**Fire Test**
Marine Support	Non flammable fluids, compressed air and gas	4 x MAWP	None
	Flammable fluids, FO, LO, Hydraulic oil		SV or MODU Rules
	Fire water and deluge		UK DOT Appendix D
Process and Process Support	Non-flammable fluids, compressed air and gas	3 x MAWP	None
	Flammable fluids, FO, LO, Hydraulic oil, Hydrocarbon and gas		API Spec 16C
	Choke and kill	2.5 x MAWP	
	Hydraulic oil for BOP controls	3 x MAWP	API Spec 16D
Fixed Installation			
Systems	**Service**	**Burst Pressure**	**Fire Test**
Process, Process and Platform Support	Non-flammable fluids, compressed air and gas	3 x MAWP	None
	Flammable fluids, FO, LO, Hydraulic oil, Hydrocarbon and gas		API Spec 16C
	Fire water and deluge		UK DOT Appendix D
	Choke and kill	2.5 x MAWP	API Spec 16C
	Hydraulic oil for BOP control	3 x MAWP	API Spec 16D

Note:

MAWP: Maximum Allowable Working Pressure

APPENDIX 3 **Fiber Reinforced Plastic (FRP) Gratings**

Based on U.S.C.G. Policy File Memorandum (PFM 2-98) dated 19 June 1998

A General

(1) FRP gratings are not specifically addressed in the individual vessel regulations. However, the resins typically used in the manufacture of these gratings are combustible and heat sensitive; therefore, FRP gratings use must be limited based on the requirements discussed below.

(2) These requirements are not intended to eliminate any other design criteria or requirement pertaining to the material, construction, or performance of the FRP gratings in the non-fire condition.

B FRP Grating Material Systems

(1) All fire integrity, flame spread, smoke, and toxicity testing, where required, shall be conducted on each material system.

(2) Changes in either the type, amount, and/or architecture, of either the reinforcement materials, resin matrix, coatings, or manufacturing processes shall require separate testing in accordance with the procedures below. Manufacturers should provide evidence, such as enrollment in a follow-up program, that the FRP gratings being installed are the same as those which were tested and approved.

C Fire Test Requirements

(1) Structural Fire Integrity* – The structural fire integrity matrix in Section E establishes the structural fire integrity characteristics that FRP gratings should possess, based on location and service. Where a specific application satisfies more than one block in the matrix, the highest level of fire integrity shall be required. The test procedures required to qualify FRP gratings to one of three levels are described in Section D. The ABS Surveyor shall determine the location and service of the FRP gratings, keeping in mind the following considerations for each of the three performance levels:

- (a) Level 1 (L1): FRP gratings meeting the L1 performance criteria are intended to be satisfactory for use in escape routes or access for firefighting, emergency operation or rescue, after having been exposed to a significant hydrocarbon or cellulosic fire incident. In addition, they are also acceptable for the services and functions described for levels L2 and L3.
- (b) Level 2 (L2): FRP gratings meeting the L2 performance criteria are intended to be satisfactory for use in open deck areas where groups of people are likely to assemble, such as temporary safe refuge or lifeboat embarkation areas. In addition, they are also acceptable for the services and functions described for level L3.

(c) Level 3 (L3): FRP gratings meeting the L3 performance criteria are intended to be satisfactory for use in egress routes and any areas that may require access for firefighting, rescue or emergency operations during exposure to or shortly after exposure to a transitory hydrocarbon or cellulosic fire.

* The structural fire integrity requirements are intended for self-supporting personnel platforms or walkways, and are not intended for grating overlayed on steel decking or used in other applications such as pipe guards, seachest screenings, safety guards, etc.

(2) Fire Retardance – All FRP gratings should be fire retardant; this can be demonstrated by testing to ASTM E-84, Standard Test Method for the Surface Burning Characteristics of Building Materials with a flame spread rating not to exceed 25, or by meeting the requirements in Section C(3)(a) or C(3)(b) below.

(3) Flame Spread – All FRP gratings, except those fitted on open decks and within tanks, cofferdams, void spaces, pipe tunnels and ducts, should have low flame spread characteristics as determined by one of the following test procedures:

(a) tested to ASTM E-84 with a flame spread rating not to exceed 20; or

(b) tested to IMO Resolution A.653(16), Recommendation on Improved Fire Test Procedures for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials and meeting the criteria for bulkheads, linings, or ceilings.

(4) Smoke Generation – FRP gratings within accommodation, service and control spaces, should have low smoke characteristics as determined by one of the following test procedures:

(a) tested to ASTM E-84 with a smoke developed rating not to exceed 10; or

(b) tested in accordance with the IMO Fire Test Procedures Code (FTPC), Resolution MSC.61(67), Part 2 – Smoke and Toxicity Test, and meeting the criteria established for materials used as bulkheads, linings, or ceilings.

D Structural Fire Integrity Test Procedures

(1) Level 1–To be qualified as level 1 (L1), the FRP gratings shall meet the requirements for qualification as level 3 and level 2, and in addition shall be subjected to the following test procedures:

(a) Three (3) FRP grating specimens, after being subjected to the level 2 testing, shall be unloaded and prepared for impact testing in the manner specified for horizontal specimens in ASTM E-695, Standard Method of Measuring Resistance of Wall, Floor, and Roof Construction to Impact Loading. The test specimens shall be secured as required in section 8.3 of ASTM E-695 except that the span shall be 200 mm less than the specimen length. A lead shot bag of 40 kg mass shall be dropped once from a height of 2 m such that the point of impact is in the center of the span. The specimens shall then be uniformly loaded as required by the level 2 test procedures.

(b) The test will be considered successful if all three (3) specimens remain intact after being subjected to the impact test and the level 2 loading test. Failure will be indicated by collapse of one or more of the gratings.

(2) Level 2–To be qualified as level 2 (L2), the FRP gratings shall meet the requirements for qualification as level 3, and in addition shall be subjected to the following test procedures:

(a) On the FRP grating specimen and the steel grating specimen subjected to the level 3 post-loaded testing, the specimen shall be gradually loaded in increments not to exceed 20 kg, placed in such a manner as to represent a uniformly distributed load across the span.

(b) The test will be considered successful if the FRP grating remains intact at a load greater than or equal to a uniform 4.5 kN/m^2 (94 lbf/ft^2), or greater than or equal to the steel grating failure loading, whichever is less. Failure will be indicated by collapse of the grate.

(3) Level 3–To be qualified as level 3 (L3), the FRP gratings should be subjected to the following fire test procedures for both the post-loaded and pre-loaded tests and conditions:

(a) A fire test will be conducted in accordance with ASTM E-119, Standard Test Method for Tests of Building Construction and Materials. Two tests shall be conducted in the ASTM E-119 furnace for each FRP grating design. The first fire test shall be conducted with the specimens under the specified load (pre-loaded) and the second fire test will be conducted on unloaded specimens (post-loaded). The time-temperature curve shall be the standard for E-119 or the ISO equivalent. The duration of the tests shall be as specified below.

(b) Each test specimen shall be 300-350 mm wide to allow for the differences in the spacing of longitudinal supporting members. The length of each test specimen shall be the length of the maximum span to be seen in service, plus 200 mm. Four test specimens shall be prepared as described above: two of the proposed FRP gratings and two of a similar steel grating that would be used in the same location constructed to the applicable regulations and standards (steel gratings rated at a minimum of 4.5 kN/m^2 (94 lbf/ft^2) uniform loading with a 1.67 factor of safety are acceptable).

(c) The pre-loaded test shall consist of the following:

(i) one steel grating specimen and one FRP grating specimen shall be placed adjacent to one another in the furnace, simply supported on two I-beams with a minimum flange width of 100 mm at an elevation of at least one half of the furnace height, or a minimum of 300 mm above the burners;

(ii) the specimens shall be placed on the I-beams such that 100 mm of each side of the specimen rests on each of the two I-beams;

(iii) a static load represented by a 40 kg mass shall be placed in the center span of the test specimens;

(iv) the 40 kg mass load shall consist of a steel container filled with sand, the base of which shall be square with an area of 0.9 m^2;

(v) arrangements shall be made to measure the deflection at the center of the span of each of the loaded specimens during the test, with a degree of accuracy of ±5 mm.

(vi) the two specimens shall be subjected to the time-temperature curve specified in the ASTM E-119;

(vii) deflection of the two loaded test specimens shall be measured throughout the duration of the fire test, and the average furnace temperature shall be recorded when each of the two specimens has deflected a distance of L/10 (failure point) from the horizontal, where L is equal to the maximum unsupported span of the specimens; and

(viii) the test will be considered successful if the difference between the average furnace temperature at the time of failure of the steel grating and the average furnace temperature at the time of failure of the FRP grating is less than 100ºC (180ºF).

(e) The post-loaded test shall consist of the following:

(i) one steel grating specimen and one FRP grating specimen shall be placed adjacent to one another in the furnace, simply supported on two I-beams with a minimum flange width of 100 mm at an elevation of at least one half of the furnace height;

(ii) the specimens shall be placed on the I-beams such that 100 mm of each side of the specimen rests on each of the two I-beams;

(iii) the two specimens shall be subjected to the time-temperature curve specified in the ASTM E-119 for a duration of 60 minutes;

(iv) at the end of the 60 minutes, the specimens will be allowed to cool and shall then be subjected to a static load represented by the 40 kg mass specified in the pre-loaded test above, placed in the center span of the test specimens; and

(v) the test will be considered successful if the FRP grating specimen is intact at the end of the test and does not collapse under the 40 kg mass load.

E Structural Fire Integrity Matrix

Location	Service	Fire Integrity
Machinery Spaces	Walkways or areas which may be used for escape, or access for firefighting, emergency operation or rescue	L1[1]
	Personnel walkways, catwalks, ladders, platforms or access areas other than those described above	L3
Cargo Pump Rooms	All personnel walkways, catwalks, ladders, platforms or access areas	L1
Cargo Holds	Walkways or areas which may be used for escape, or access for firefighting, emergency operation or rescue	L1
	Personnel walkways, catwalks, ladders, platforms or access areas other than those described above	None required
Cargo Tanks	All personnel walkways, catwalks, ladders, platforms or access areas	None required[2]
Fuel Oil Tanks	All personnel walkways, catwalks, ladders, platforms or access areas	None required[2]
Ballast Water Tanks	All personnel walkways, catwalks, ladders, platforms or access areas	None required[3]
Cofferdams, void spaces, double bottoms, pipe tunnels, etc.	All personnel walkways, catwalks, ladders, platforms or access areas	None required[3]
Accommodation, service, and control spaces	All personnel walkways, catwalks, ladders, platforms or access areas	L1
Lifeboat embarkation or temporary safe refuge stations in open deck areas	All personnel walkways, catwalks, ladders, platforms or access areas	L2
Open Decks or semi-enclosed areas	Walkways or areas which may be used for escape, or access for firefighting, emergency operation or rescue	L3[4]
	Personnel walkways, catwalks, ladders, platforms or access areas other than those described above	None required

Footnotes:

1 If the machinery space does not contain any internal combustion machinery, other oil-burning, oil-heating, or oil-pumping units, fuel oil filling stations, or other potential hydrocarbon fire sources, and has not more than 2.5 kg/m^2 of combustible storage, gratings of L3 integrity may be used in lieu of L1.

2 If these spaces are normally entered when underway, gratings of L1 integrity shall be required.

3 If these spaces are normally entered when underway, gratings of L3 integrity shall be required.

4 Vessels fitted with deck foam firefighting systems require gratings of L1 integrity for foam system operational areas and access routes.

F Other Authorized Uses

(1) The ABS Surveyor may authorize the use of FRP gratings without Main Office approval in applications where structural fire integrity of the FRP gratings is not a concern, provided they meet the applicable fire retardance, flame spread and smoke generation requirements set forth in Sections C(2), (3), & (4). Applications where the use of FRP gratings have been authorized in the past, without any structural fire integrity requirements, include the following:

- (a) sea chest coverings;
- (b) small sundeck awnings and supports;
- (c) lifeboat bilge flooring;
- (d) electrical control flooring;
- (e) pipe guards on deck, in cargo holds, and in engine rooms;
- (f) removable guards over hawse holes, anchor hawse pipes, and scuppers;
- (g) personnel barriers, such as protection for electrical panels; and
- (h) ship staging and work platforms (Occupational Safety and Health Administration (OSHA) requirements may also apply).

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APPENDIX 4 Comparison of Numbering System of 1991 vs. 2000 Guide

FOI 1991	*Title*	*FOI 2000*
19.1	Definitions	Ch 2, Sec 1
19.1.1	Abnormal Conditions	2-1/3
19.1.2	Buoyant Structure	deleted
19.1.3	Classified Area	2-1/19
19.1.4	Closed Drains	2-1/21
19.1.5	Completed Wells	2-1/23
19.1.6	Direct Fired Heater	deleted
19.1.7	Escape Route	2-1/31
19.1.8	Explosive Mixture	2-1/33
19.1.9	Fired Heaters	deleted
19.1.10	Fire Wall	2-1/35
19.1.11	Fixed Platform	deleted
19.1.12	Flammable Liquid	deleted
19.1.13	Flash Point	2-1/43
19.1.14	Hazardous Areas	2-1/49
19.1.15	Indirect Fired Heater	deleted
19.1.16	Inert Gas	2-1/55
19.1.17	Interim Class Certificate	2-1/57
19.1.18	Ignition Temperature	2-1/53
19.1.19	L.E.L. (Lower Expl. Limit)	2-1/63
19.1.20	MODU	deleted
19.1.21	Manned Facility	2-1/67
19.1.22	Offshore Installation	deleted
19.1.23	Open Drains	2-1/75
19.1.24	Operating Conditions	2-1/77
19.1.25	Process Design Conditions	2-1/85
19.1.26	Pad Gas	2-1/81
19.1.27	Produced Fluids	2-1/89
19.1.28	Production Facilities	2-1/91
19.1.29	Severe Environment	2-1/99
19.1.30	Shut-in Condition	2-1/101
19.1.31	Transient Conditions	2-1/109
19.1.32	Upset Condition	2-1/111
19.1.33	Unclassified Areas	deleted
19.1.34	Vessel Service Functions	deleted
19.1.35	Ventilation, Adequate	2-1/113
19.1.36	Well Characteristics	2-1/115
19.1.37	Well Fluid Properties	2-1/117
19.3	Design Documentation Requirements	3-2/1 4-2/1
19.3.1	Hydrocarbon Production and Processing Systems	3-2/5 4-2/5
19.3.2	Process Support Systems	3-2/7 4-2/7
19.3.3	Electrical Installations	3-2/11 4-2/9
19.3.4	Instrumentation and Control Systems	3-2/13 4-2/11
19.3.5	Fire Protection and Personnel Safety	3-2/15 4-2/13

FOI 1991	*Title*	*FOI 2000*
19.3.6	Requirements for Oil Production and Storage Units	deleted
19.3.7	Surveys During Construction and Commissioning	deleted
19.3.8	Surveys for Maintenance of Class	3-2/23 4-2/21
20.1	General	3-3/1 4-3/1
20.1.1	Scope	3-3/1.1
20.1.2	Process Safety Criterion	3-3/1.3
20.1.3	Governmental Regulations	3-3/1.5
20.3	Process Design	3-3/3
20.3.1	Design Basis	3-3/3.1
20.3.2	Process Design Conditions	3-3/3.3
20.3.3	Process Flow Sheets	3-3/3.5
20.5	Facility Layout	3-3/5
20.5.1	General Arrangement	3-3/5.1
20.5.2	Living Quarters	3-3/5.3
20.5.3	Wellhead Areas	3-3/5.5
20.5.4	Storage Tanks	3-3/5.7
20.5.5	Fired Heaters	3-3/5.9
20.7	Area Classification	3-6/15
20.9	Ventilation	3-6/17
20.9.1	General	3-6/17.1
20.9.2	Ventilation of Enclosed Classified Spaces	3-6/17.3
20.9.3	Ventilation of Non-classified Spaces	3-6/17.5
20.9.4	Emergency Shutdown	3-6/17.7
20.11	Piping and Instrumentation Design	3-3/7
20.11.1	Process Control System	3-3/7.1
20.11.2	Safety System	3-3/7.3
20.12	Emergency Shutdown (ESD) Stations	3-3/9
20.13	Pressure Relieving and Hydrocarbon Disposal Systems	3-3/11
20.13.1	Pressure Relief Systems	3-3/11.1
20.13.2	Pressure/Vacuum Venting System	3-3/11.3
20.13.3	Flares and Vents	3-3/11.5
20.15	Spill Containment, Open and Closed Drain Systems	3-3/13
20.15.1	Spill Containment	3-3/13.1
20.15.2	Open Drain Piping	3-3/13.3
20.15.3	Sealing of Open Drains	3-3/13.5
20.15.4	Segregation of Open Drain Systems	3-3/13.7
20.15.5	Closed Drain Systems	3-3/13.9
20.17	Protection from Ignition by Static Charges	3-3/15
20.19	Major Equipment Requirements	3-3/17
20.19.1	Process Vessels	3-3/17.1
20.19.2	Atmospheric Storage Tanks	3-3/17.9
20.19.3	Process Heal Exchangers	3-3/17.3
20.19.4	Process Electric Heater	3-3/17.5
20.19.5	Fired Heaters	3-3/17.7
20.19.6	Compressors	3-3/17.11
20.19.7	Pumps	3-3/17.13
20.19.8	Flowlines and Manifolds	3-3/17.15
20.19.9	Scraper Launchers/Receivers	3-3/17.17
20.19.10	Wellheads	3-3/17.19
20.19.11	Flare Structures	3-3/17.21
20.19.12	Sub-sea Production Systems	3-3/17.19
20.21	Process Piping Systems	3-3/19
20.23	Packaged Process Units	3-3/23
21.1	General	3-4/1 3-5/1 4-4/1
21.3	Component Requirements	3-4/3 3-5/3 4-4/3

FOI 1991	*Title*	*FOI 2000*
21.3.1	Pressure Vessels	3-4/3.1 3-5/3.1 4-4/3.1
21.3.2	Heat Exchangers	3-4/3.3 3-5/3.3 4-4/3.3
21.3.3	Pumps	3-4/3.5
21.3.4	Compressors	3-4/3.7
21.3.5	Prime Movers (Engines and Turbines)	3-4/3.9
21.5	System Requirements	3-4/5 3-5/5 4-4/5
21.5.1	Utility/Instrument Air Systems	3-4/5.1
21.5.2	Fuel/Instrument Gas Systems	3-4/5.3
21.5.3	Purging and Tank Blanketing Systems	3-4/5.9 4-4/7.3
21.5.4	Inert Gas Supply	4-4/7.5
21.5.5	Oil Fired Inert Gas Generators	4-4/7.7
21.5.6	Fuel Oil Systems	3-4/5.11
21.5.7	Hydraulic Systems	3-4/5.13
21.5.8	Potable Water Systems	deleted
21.5.9	Sewage Treatment Systems	4-4/5.27
21.5.10	Chemical Injection Systems	3-4/5.17
21.5.11	Fuel Storage for Helicopter Facilities	4-4/5.25
21.5.12	Material Handling Systems	3-4/3.11
21.6	Platform Drilling Systems	3-4/7 4-4/9
21.6.1	General Arrangement	4-4/9.1
21.6.2	Equipment and Systems	4-4/9.3
21.6.3	Area Classification	4-4/9.5
21.6.4	Piping Systems	4-4/9.7
21.6.5	Electrical Systems	4-4/9.9
21.6.5	Safety Features	4-4/9.11
22.1	Applicability	3-6/1 4-6/1
22.3	General	3-6/3
22.5	Design Considerations	3-6/5
22.5.1	Equipment and Enclosures	3-6/5.1
22.5.2	Corrosion-Resistant Parts	deleted
22.5.3	Equipment Grounding (Earthing) Arrangements	3-6/5.5
22.5.4	System Grounding	3-6/5.7
22.5.5	Distribution and Circuit Protection	3-6/5.9
22.7	Rotating Electrical Machinery	3-6/7
22.7.1	General	3-6/7.1
22.7.2	Rating	3-6/7.3
22.7.3	Moisture Condensation Protection	3-6/7.5
22.7.4	Temperature Detection	3-6/7.7
22.7.5	Enclosures	deleted
22.9	Transformers	3-6/9 4-6/9
22.9.1	General	3-6/9.1
22.9.2	Transformer Protection	3-6/9.3
22.11	Switchboards	deleted
22.11.1	General	deleted
22.11.2	Generator Protective Devices	deleted
22.11.3	Switchboard Assemblies	deleted
22.11.4	Ground Fault Detection	deleted
22.11.5	Bus Bars	deleted
22.11.6	Installation	deleted
22.13	Wire and Cable Construction	3-6/13
22.13.1	General	3-6/13.1
22.13.2	Conductor Type	3-6/13.3
22.13.3	Insulation	3-6/13.5
22.13.4	Cable Flame Retardancy	3-6/13.7

FOI 1991	*Title*	*FOI 2000*
22.15	Installations in Classified Areas	3-6/15.3
22.15.1	Equipment	deleted
22.15.2	Exposed Surface Temperature	deleted
22.15.3	Wiring Methods in Classified Areas	3-6/157
22.17	Cable Support and Installation	3-6/19 4-6/17
22.17.1	Cable Tray	deleted
22.17.2	Grounding of Metallic Cable Covering	deleted
22.17.3	Bend Radius	deleted
22.17.4	Mechanical Protection	3-6/19.1
22.17.5	Splicing	3-6/19.3
22.19	Power Source Requirements	3-6/21 4-6/21
22.19.1	Unmanned Facilities	3-6/21.1 4-6/21.1
22.19.2	Manned Facilities on Fixed Platforms	3-6/21.3 4-6/21.3
22.19.3	Manned Facilities on Fixed Platforms in Severe Environments	4-6/21.5
22.19.4	Manned Facilities Onboard Non-fixed Offshore Installations	deleted
22.19.5	Vessels or Units not Classed as Offshore Installations	deleted
22.21	Emergency Source of Power	3-6/23 4-6/23
22.21.1	General	4-6/23.1
22.21.2	Location	4-6/23.3
22.21.3	Operability	4-6/23.5
22.21.4	Isolation from Main Power Source	deleted
22.23	Emergency Generator Systems	deleted
22.23.1	Switchboard Arrangements	deleted
22.23.2	Prime Mover Arrangements	deleted
22.25	Emergency Battery Systems	deleted
22.25.1	Arrangements	deleted
22.25.2	Ventilation	deleted
22.27	Short-circuit Current Calculations and Coordination Study	3-6/27
22.27.1	General	3-6/27.1
22.27.2	Short-circuit Capacity	3-6/27.3
22.27.3	Coordination	3-6/27.5
23.1	Applicability	3-7/1
23.1.1	General	3-7/1.1
23.3	Components	3-7/3
23.5	System Requirements	deleted
23.5.1	Loss of Power	3-7/3.7
23.5.2	Loss of Signal	3-7/9.3
23.7	Redundant Protection Requirements	deleted
23.7.1	Single Component Failure	deleted
23.7.2	Primary and Secondary Protection	3-3/7.3.1
23.9	Audible and Visual Alarm Indicators	deleted
23.9.1	Audible and Visual Alarms	deleted
23.9.2	Visual Displays	deleted
23.9.3	Test Features	deleted
23.11	Alarm and Shutdown Reset Logic	deleted
23.11.1	Trouble Indication	deleted
23.11.2	Alarm Silence	deleted
23.11.3	Manual Reset	deleted
23.13	Overrides	3-7/9.9
23.13.1	Calibration	3-7/9.9.1
23.13.2	Out of Service	3-7/9.9.2
23.13.3	Start-up	3-7/9.9.3
23.15	Sequential Start-up Logic	deleted
23.15.1	Feedback	deleted
23.15.2	Valves	deleted
23.17	Safety Shutdown Systems	3-7/13
23.17.1	Safety Analysis	3-7/13.3
23.17.2	Shutdown Response	3-7/13.5.1
23.19	Installation	3-7/1.3

FOI 1991	*Title*	*FOI 2000*
23.19.1	Electrical Installations	3-7/1.3.1
23.19.2	Hydraulic and Pneumatic Control Systems	3-7/1.3.2
23.21	Relief Valves	3-7/17
23.21.1	Provisions for Testing	3-7/17.3
23.21.2	Block Valve Locking Devices	3-7/17.5
23.23	Shutdown Valves, Blowdown Valves and Diverter Valves	3-7/19
23.25	Instruments	3-7/25
23.25.1	Temperature	3-7/25.1
23.25.2	Pressure	3-7/25.3
23.25.3	Level	3-7/25.5
24.1	Applicability	3-8/3 4-8/1.5
24.3	General	3-8/1 4-8/1
24.3.1	Scope	3-8/1.1 4-8/1.1
24.3.2	Governmental Authority	3-8/1.3 4-8/1.5
24.5	Structural Fire Protection	3-8/9 4-8/9
24.5.1	Accommodation Spaces and Central Process Control Rooms	deleted
24.5.2	Wellhead Areas	3-8/9.5 4-8/9.5
24.5.3	Direct Fired Heaters	3-8/9.7 4-8/9.7
24.7	Requirements for Fire Fighting Systems	3-8/5 4-8/3
24.7.1	Unmanned Platforms	4-8/3.1
24.7.2	Manned Production Facilities	4-8/3.3
24.9	Fire Water System	3-8/5.1 4-8/5.1
24.9.1	Piping	3-8/5.1.1 4-8/5.1.1
24.9.2	Fire Pumps	3-8/5.1.2 4-8/5.1.2
24.9.3	Fire Water Stations	3-8/5.1.3 4-8/5.1.3
24.9.4	Water Spray Systems	3-8/5.1.4 4-8/5.1.4
24.11	Fixed Fire Extinguishing Systems	3-8/5.5 4-8/5.5
24.11.1	Accommodation Sprinkler Systems	4-8/5.1.5
24.11.2	Dry Chemical Systems	3-8/5.3 4-8/5.3
24.11.3	Gaseous Systems	3-8/5.5.1 4-8/5.5.1
24.11.4	Galley Range Hoods	4-8/5.7.2
24.13	Fire and Gas Detection and Alarm Systems	3-8/7 4-8/7
24.13.1	Fire Detectors	3-8/7.1 4-8/7.1
24.13.2	Gas Detectors	3-8/7.3 4-8/7.3
24.13.3	Smoke Detectors	3-8/7.5 4-8/7.5
24.13.4	Alarm Panel	3-8/7.7 4-8/7.7
24.13.5	Fire and Gas Detection Wiring	3-8/7.9 4-8/7.9
24.13.6	General Alarm	3-8/7.11 4-8/7.11
24.15	Emergency Control Station	3-8/5.11 4-8/5.9
24.17	Fire-Fighting Equipment for Helicopter Facilities	3-8/5.9 4-8/5.7.3

FOI 1991	Title	FOI 2000
24.17.1	Helicopter Decks with No Refueling Capabilities	4-8/5.7.3(a)
24.17.2	Helicopter Decks with Refueling Capabilities	4-8/5.7.3(b)
24.19	Portable and Semi-Portable Extinguishers	3-8/5.13 4-8/5.13
24.21	Personnel Safety	deleted
24.21.1	Guard Rails	3-8/17.3 4-8/17.3
24.21.2	Means of Escape	3-8/13 4-8/13
24.21.3	Lifesaving Appliances and Equipment	3-8/15.5 4-8/15.5
24.21.4	Means of Embarkation	3-8/15.7 4-8/15.7
24.23	Fireman's Outfit	3-8/17.1 4-8/17.1
24.25	Insulation of Hot Surfaces	3-8/17.5 4-8/17.5
25.1	Applicability	deleted
25.1.1	Offshore Installations	deleted
25.1.2	Vessels or Units not Classed as an Offshore Installation	deleted
25.3	General Arrangements	3-3/5.1
25.3.1	Accommodation Spaces	3-3/5.3
25.3.2	Crude Oil Storage and Slop Tanks	3-5/1
25.3.3	Mooring System	3-5/1
25.5	Area Classifications and Electrical Installations	3-6/15.5
25.5.1	General	3-6/15.5.1
25.5.2	Area Classification	3-6/15.5.2
25.5.3	Cables and Types of Electrical Equipment Permitted in Hazardous Areas	3-6/15.5.4
25.5.4	Electrical Interconnections	3-6/15.5.3
25.7	Piping Systems	3-5/1
25.7.1	General Components and Systems	3-5/1
25.7.2	Interconnections	3-5/5.1
25.9	Oil Storage Tank Venting and Blanketing	3-5/5.3 4-4/7
25.9.1	Tank Venting	3-5/5.5 4-4/7.1
25.9.2	Tank Blanketing	3-5/5.3 4-4/7.3
25.11	Use of Produced Gas as Fuel	3-5/5.7 4-4/5.5
25.13	Fire Protection	deleted
25.13.1	Capacity	deleted
25.13.2	Fire Protection for Tanker Deck	3-8/5.1.5 4-8/5.7.4
25.13.3	Fire Protection for Crude Oil Pump Room	deleted
26.1	General	5-1/1
26.3	Construction Surveys	5-1/3
26.3.1	General	5-1/3.1
26.3.2	Survey at Vendor's Shop	5-1/3.3
26.3.3	Module Fabrication	5-1/3.5
26.3.4	Module Installation	5-1/3.7
26.5	Commissioning & Start-up Surveys	5-1/5
26.5.1	General	deleted
26.5.2	Comp’t & System Checks	deleted
26.5.3	Functional Testing	5-1/7.1
26.5.4	Start-up	5-1/7.3
27.1	General	5-2/1
27.3	Commissioning	5-2/3
27.5	Surveys	5-2/5
27.5.1	Annual Survey	5-2/5.1
27.5.2	Special Survey	5-2/5.3
27.5.3	Timing of Surveys	5-2/5.5

FOI 1991	*Title*	*FOI 2000*
27.5.4	Continuous Survey Program	5-2/5.7
27.7	Maintenance Records	5-2/7
27.7.1	Annual Survey	5-2/7.1
27.7.2	Special Survey	5-2/7.3
27.7.3	Inspection Plan	5-2/7.5
27.9	Modifications	5-2/9
27.11	Damage and Repairs	5-2/11
27.13	Certification on Behalf of Coastal States	5-2/13

APPENDIX 5 Reference by Industry Organization

Document	Title	Referenced in Guide
ANSI C-37	IEEE standards collection, Circuit Breakers, Switchgear, Substations and fuses	3-6/11.3.3
ANSI C-57	IEEE Standards Collection Distribution, Power, and Regulating Transformers	3-6/9.1
API RP 2A		3-3/17.21
API RP 2D	Operation and Maintenance of Offshore Cranes	3-4/3.11
API RP 14 C	Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms	3-3/7.3, 3-7/1, 3-8/7.1, 3-8/7.3.1, 4-8/7.1, 4-8/7.3.1
API RP 14 E	Design and Installation of Offshore Production Platform Piping Systems	3-3/17.15, 3-3/19.1, 3-4/5, 4-4/5, 5-1/Table 1
API RP 14 F	Design and Installation of Electrical Systems for fuel and floating offshore Petroleum Facilities for unclassed and class 1, division 1 and division 2 locations.	3-6/3, 3-6/5.1, 3-6/5.5, 3-6/5.7, 3-6/5.9, 3-6/9.1, 3-6/11.5.1, 3-6/11.7.1, 3-6/13.3, 3-6/15.3, 3-6/15.7, 3-6/23, 3-6/25, 3-8/7.1, 3-8/7.3.1, 4-8/7.3.1, 5-1/Table 1
API RP 14 FZ	Design and Installation of Electrical Systems for fixed and floating offshore petroleum Facilities for unclassed and Zone 0, Zone 1 nd Zone 2 locations	3-6/3
API RP 14 G	Fire Prevention and Control on Open Type Offshore Production Platforms	3-8/5.1.2, 3-8/7.1, 4-8/1.1, 4-8/5.1.2, 4-8/7.1
API RP 14 J	Design and Hazards Analysis for Offshore Production Facilities	3-2/13.9, 3-3/5.1, 4-4/1.1
API RP 17 A	Design and Operation of Subsea Production Systems	3-3/17.19
API RP 55	Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide	3-8/7.3.2, 4-8/7.3.2
API RP 500	Classification of Location for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2	2-1/19, 3-4/5.3, 3-6/15.1, 3-6/17.3, 3-6/25, 4-4/9.5
API RP 505	Classification of Location for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2	2-1/19, 3-4/5.3, 3-6/15.1, 4-4/9.5
API RP 520	Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries	3-3/11.1
API RP 521	Guide for Pressure-Relieving and Depressuring Systems	3-3/11.1, 3-3/11.5
API RP 554	Process Instrument and Control	5-1/Table 1
API Spec 2C	Offshore Cranes	3-4/3.11
API Spec 6A	Wellhead and Christmas Tree Equipment	3-3/17.15, 3-3/17.19
API Spec 6FA	Fire Test for Valves	3-3/17.15
API Spec 12K	Indirect Type Oil Field Heaters	3-3/17.7
API Spec 12L	Vertical and Horizontal Emulsion Treaters	3-3/17.7
API Spec 14D		3-3/17.19
API Spec 16C	Choke and Kill Systems	3-3/19.7, 3-3/21, 3-4/5.11, 3-4/5.13, Appendix 2

Document	Title	Referenced in Guide
API Spec 16D	Control Systems for Drilling Well Control Equipment	4-4/9.7, Appendix 2
API Spec 17 D	Subsea Wellhead and Christmas Tree Equipment	3-3/17.19
API Std 610	Centrifugal Pumps for Petroleum, Chemical and Gas Industry Services	3-3/17.13, 5-1/Table 1
API Std 616	Gas Turbines for Petroleum, Chemical and Gas Industry Services	3-4/3.9, 5-1/Table 1
API Std 617	Centrifugal Compressors for Petroleum, Chemical and Gas Industry Services	3-3/17.11, 5-1/Table 1
API Std 618	Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services	3-3/17.11, 5-1/Table 1
API Std 619	Rotary-Type Positive Displacement Compressors for Petroleum, Chemical and Gas Industry Services	3-3/17.11, 5-1/Table 1
API Std 620	Design and Construction of Large, Welded, Low-Pressure Storage Tanks	5-1/Table 1
API Std 660	Shell and Tube Heat Exchangers for General Refinery Service	3-3/17.3, 3-4/3.3
API Std 661	Air Cooled Heat Exchangers for General Refinery Service	3-3/17.3, 3-4/3.3
API Std 2000	Venting Atmospheric and Low-Pressure Storage Tanks	3-3/11.3, 4-4/5.25
API Pub 2030	Application of Water Spray Systems for Fire Protection in the Petroleum Industry	3-8/5.1.4, 4-8/5.1.4
ASME	American Society of Mechanical Engieers	
ASME B31.3, B31.4, B31.8	Piping Codes	3-3/17.17, 3-4/5, 4-4/5, 4-4/9.7, 5-1/Table 1
ASME Sec VIII, Div 1 & 2	"Boiler and Pressure Vessel Code"	3-3/11.1, 3-3/17.1, 3-3/17.3, 3-3/17.7, 3-3/17.17, 3-4/3.1, 3-4/3.2, 5-1/Table 1
ASME Sec X		3-4/5.17
ASTM	American Society for Testing and Materials	
ASTM D635	Test Method for Rate of Burning and /or Extent and Time of Burning of Self-Supporting Plastics in Horizontal Position	A1-3/13
ASTM D2444	Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tub (Falling Weight)	A1-3/9
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials	Appendix C/C(2), C(3),C(4)
ASTM E 119	Method for Fire Tests of Building Construction and Materials	Appendix C/D(3)
ASTM E140	Harness Conversion Tables for Metals	3-3/17
ASTM E695	Method for Measuring Relative Resistance of Wall, Floor, and Roof Constructions to Impact Loading	Appendix C/D(1)
ICEA		3-6/13.1, 3-6/13.7
IEC	International Electrotechnical Commission	3-6/13.1, 3-6/13.7, 3-6/27.1
IEC 269	Low Voltage Fuses	3-6/11.3.4
IEC 947-2	Low Voltage Switchgear and Controlgear – Part 2 : Circuit Breakers	3-6/11.3.3
IEC 60331	Test for Electric cables under fire conditions	3-6/13.9, 3-7/19.1
IEC 60332-3	Test on Electric Cables under fire conditions –Part 3: Test on bunched wire and cable	3-6/7.1, 3-6/13.7
IEC 60034	Rotating Electrical Machines	3-6/7.1
IEC 60079-2	Electric Apparatus for Explosive Gas Atmosphere	3-6/17.5
IEC 60092	Electrical Installations in Ships	3-6/13.7
IEEE	Institute of Electrical and Electronic Engineers	3-6/13.1, 3-6/13.7
IEEE Std 45	Recommended Practice for Electrical Installations on Shipboard	3-6/13.7

Document	Title	Referenced in Guide
IEEE Std 242	Recommended Practice for Protection and Coordination of Industrial & Commercial Power Systems	3-6/27.1
IMO FTP Code	Fire Test Procedures	2-1/1, Appendix C/C(4)
IMO MODU Code 89	Code for Construction and Equipment of Mobile Offshore Drilling Units	3-6/17.5, 3-8/9.1
IMO MSC Circ 61		Appendix C(4)
IMO MSC Circ 582		3-8/5.5.2, 4-8/5.5.2
IMO MSC Circ 670		3-8/5.5.2, 4-8/5.5.2
IMO MSC Circ 848		3-8/5.5.1, 4-8/5.5.1
IMO Res. 653(16)	Recommendation on Improved Fire Test Procedure s for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials	A1-3/13, A1-10/1
IMO Res. 754(18)	Recommendation on Fire Resistance Tests for “A”, “B” and “F” Class Divisions	2-1/1, A1-4/11
ISO 75		A1-3/7
ISO 9001		Appendix 1, Section 4
MARPOL 73/78-Annex I	Regulations for the Prevention of Pollution by Oil	3-3/13.11
NACE MR-01-75	Sulfide Stress Cracking Resistant Metallic Material for Oilfield Equipment	3-3/3.3
NEMA	National Electrical Manufacturers Association	
NEMA Std AB-1	Circuit Breakers	3-6/11.3.3
NEMA Std MG-1	Rotating Electric Machinery	3-6/7.1
NFPA	National Fire Protection Association	
NFPA 10	Portable Fire Extinguishers	3-8/5.15, 4-8/5.13
NFPA 11	Low-Expansion Foam	3-8/5.5.2, 4-8/5.5.2
NFPA 11A	Medium- and High-Expansion Foam Systems	3-8/5.5.2, 4-8/5.5.2
NFPA 12	Carbon Dioxide Extinguishing Systems	3-8/5.5.1, 4-8/5.5.1
NFPA 13	Installation of Sprinkler Systems	4-8/5.1.5
NFPA 15	Water Spray Fixed Systems	3-8/5.1.4, 3-8/5.5.3, 4-8/5.1.4, 4-8/5.5.3
NFPA 17	Dry Chemical Systems	3-8/5.3, 4-8/5.3
NFPA 20	Installation of Stationary Pumps	4-8/5.1.2
NFPA 30	Flammable and Combustible Liquids Code	2-1/43
NFPA 37	Stationary Combustion Engines and Gas Turbines	3-4/3.9
NFPA 77	Static Electricity	3-6/29
NFPA 96	Ventilation Control and Fire Protection of Commercial Cooking Operations	3-8/5.7.2
NFPA 496	Purged and Pressurized Enclosed for Electrical Equipment	3-6/17.5
NFPA 780	Installation of Lightning Protection Systems	3-6/5.5
NFPA 8501	Single Burner Boiler Operation	3-4/5.7
SOLAS, 1974 Chap II-2	IMO – Consolidated test of the International Convention for the Safety of Life at Sea	3-8/5.5.1, 3-8/5.5.2, 3-8/5.5.3, 4-8/5.1.5, 4-8/5.5.1, 4-8/5.5.2, 4-8/5.5.3, 4-8/5.7.4
TEMA Stds	Tubular Exchanger Manufacturers Association	3-4/3.3
UL 248		3-6/11.3.4
UK DOE/NPD	Interim Hydrocarbon Fire Resistance Test for Elements of Construction for Offshore Installation	2-1/47
UK DOT Appendix D		3-8/5.1.1, 4-8/5.1.1, Appendix 2
USCG PFM 1-98	Policy File Memorandum on the Fire Performance Requirements for Plastic Pipe per IMO Resolution A.753(18)	Appendix 1, Section 8
USCG PFM 2-98		Appendix 3

APPENDIX 6 Systems Requirements for Floating Installations

Shipshaped Hull

Semisubmersible, TLP or DDCV (Spar) based Hull