Offshore Oil Offloading
- Transfer Arms -

November 2012

Rule Note
NR 588 DT R00 E

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BUREAU VERITAS

MARINE DIVISION
GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine Division (the "Society") is the classification (" Classification ") of any ship or vessel or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- prepares and publishes Rules for classification, Guidance Notes and other documents ("Rules");
- issues Certificates, Attestations and Reports following its interventions ("Certificates");
- publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as " Certification ".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as " Services ". The party and/or its representative requesting the services is hereinafter referred to as the " Client ". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisement given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisement is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisement or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

ARTICLE 3

3.1. - **The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.**

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- conducts surveys at the place of their construction;
- classes Units and enters their class in its Register;
- surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.

5.2. - The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder, respectively.

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - If the Services of the Society cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee.

The Society bears no liability for indirect or consequential loss such as e.g. loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on of were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. Overdue amounts are increased as of right by interest in accordance with the applicable legislation.

8.3. - The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the **classification file** consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit;
- copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, are passed on to IACS (International Association of Classification Societies) according to the association working rules;
- the certificates, documents and information relative to the Units classed with the Society may be reviewed during certificating bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France.

12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

ARTICLE 13

13.1. - **These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement.**

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.

RULE NOTE NR 588

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Section 1 General

Section 2 Design Requirements, Inspection and Testing

SECTION 1 GENERAL

1 Introduction

1.1 Application

1.1.1 The present note provides procedures and technical requirements for classification and approval of transfer arms used in offshore environment for oil products.

1.1.2 Provisions of the present note are applicable for all types of floating offshore units covered by Pt A of the Offshore Rules fitted with oil transfer arms and intended to perform oil loading/offloading in offshore conditions.

1.2 Classification, class notations

1.2.1 The requirements of the present note are applicable for floating offshore units intended to be granted the additional class notation **oil offloading (transfer arms)**, as defined in [1.3].

General principles of classification process are defined in Pt A of the Offshore Rules.

1.3 Additional notation oil offloading

1.3.1 General

The additional class notation **oil offloading (transfer arms)** may be granted to units having a transfer system for oil loading/offloading installed onboard. As a rule, the scope of classification covers items defined in [1.3.2]. The presentation flange is to be considered as the limit of classification scope.

1.3.2 Scope

The additional class notation **oil offloading (transfer arms)** covers classification of the following types of oil transfer system installed onboard offshore units defined in Pt A of the Offshore Rules:

- transfer arms applied in a side-by-side configuration
- transfer arms applied in a tandem configuration.

The detailed scope of classification will be established by the Society on a case-by-case basis, taking into account the specificities and configuration of each transfer system. As a rule, classification covers the following items:

- foundations and connexions of the transfer system with unit's hull
- supporting structures
- transfer line and associated equipment, including swivels and bearings, when relevant
- emergency release system
- control/detection systems
- equipment for energy supply
- mooring and fendering equipment.

1.3.3 Units intended for oil offloading (transfer arms) notation

For units intended to be granted the additional class notation **oil offloading (transfer arms)**, the scope of classification is defined in [1.3.2].

Manifolds, connecting devices and other related equipment fitted onboard the shuttle tanker are not included in the scope of **oil offloading (transfer arms)** notation. However, documentation including a general description of, and operational procedures relating to these items, are to be submitted to the Society for information.

Note 1: Equipment and devices fitted onboard the shuttle tanker may be considered for the purpose of concept approval and covered by the related Concept Approval Certificate.

1.3.4 Units without oil offloading (transfer arms) notation

When the additional class notation **oil offloading (transfer arms)** is not requested by the applying party, classification is limited to transfer system foundations and attachments of all related equipment to the hull structure. Depending on the configuration of the transfer system, the Society may extend the scope of classification to other items which influence the global safety of the offshore unit, on a case-by-case basis.

Documentation of estimated loads on foundations and attachments to the hull is to be submitted to the Society for information.

1.4 Available certificates

1.4.1 The Society may accept, for the purpose of classification, previous certificates relating to the transfer system and/or its components, upon the request of the party applying for classification. These certificates are to be submitted to the Society for examination. Additional documentation and gap analysis may be requested for acceptance. The following types of certificates are generally concerned:

- Concept Approval Certificates, or equivalent
- Type Approval Certificates of parts and components of the transfer system.

1.5 OCIMF specification

1.5.1 The applicable requirements of OCIMF specification for marine loading arms are referenced for the purpose of classification. When deemed necessary, the Society may refer to the document referenced in [1.5.2].

1.5.2 When OCIMF specification is mentioned in the present note, reference is made to OCIMF Design and Construction Specification for Marine Loading Arms (Third Edition 1999).

1.6 European Standard EN 1474

1.6.1 When deemed necessary, the Society may refer to the requirements of the following documents:

- European Standard EN 1474-1 "Design and testing of marine transfer systems" - Part 1: Design and testing of transfer arms
- European Standard EN 1474-3 "Design and testing of marine transfer systems" - Part 1: Offshore transfer systems.

The present note provides interpretations and clarifications of EN 1474 requirements, from the Society point of view. A large part of EN 1474 requirements are adopted for the purpose of the present Rule Note.

1.7 Other approval services

1.7.1 The provisions of the present note are also applicable, as relevant, for other approval services relating to oil transfer systems, such as:

- concept approval
- basic design approval
- Front End Engineering Design (FEED) approval.

These approval services provide a confirmation of the technical feasibility of the project at each planning stage, taking into account both the current state of art and the applicable rules and standards, previous to classification.

1.8 Modifications of the present Rules

1.8.1 Modifications from the requirements of the present note may be accepted by the Society based on the principle of equivalence formulated in Pt A, Ch 1, Sec 1, [2.3] of the Offshore Rules. For this equivalence, a gap analysis of transfer system design compared to the present Rules will be performed and submitted to the Society.

1.9 Design studies and model tests

1.9.1 General

The party applying for classification is to perform and document technical studies and model tests requested by the present Rules.The following types of studies and tests are concerned:

- studies and model tests requested by the design requirements stated in Sec 2
- studies and model tests requested for the qualification of new technology, when relevant.

A detailed documentation is to be submitted to the Society for information.

1.10 Identification and qualification of new technology

1.10.1 Identification of new technology

Transfer systems covered by the notation **oil offloading (transfer arms)** and using new or unproven technology are to be subject to a qualification process.

The identification of new technology is to be carried based on the provisions of NI 525 "Risk Based Qualification of New Technology". Documentation containing a list of components of the transfer system categorized as new technology and requiring a qualification process is to be submitted.

1.10.2 Qualification program of new technology

Methodological guidelines for qualification of new technology are provided by the Society in NI 525 "Risk Based Qualification of New Technology".

The party applying for classification is to establish and submit a qualification programme of new technology, when relevant.

Based on the qualification program, the Society will set-up a list of approval activities for classification purpose.

The main tasks of the qualification program are to be clearly identified and documented.

The documentation of the qualification program is to include:

- design description and proposed criteria
- test procedures and reports
- calculation procedures and reports
- correlation analyses reports.

2 Definitions

2.1 General

2.1.1 Offshore Rules

When "Offshore Rules" are mentioned in the present note, reference is made to Rule Note NR445 "Rules for the Classification of Offshore Units".

2.1.2 Transfer system

The transfer system is a system allowing the transfer of oil products between the offshore unit and the shuttle tanker. The transfer system comprises the transfer lines and all their supporting structure including the supporting structure on the offshore unit, complete with all accessories, control/detection systems and energy supply.

2.1.3 Transfer line

The transfer line is an articulated piping, transfer hose and swivel if any, or a combination of piping and hose allowing the transfer of oil products between the offshore unit and the shuttle tanker.

2.1.4 Transfer arm

The transfer arm is an articulated piping, including the base riser fixed on its supporting structure, and all its accessories.

2.1.5 Swivel

Swivel is a swing joint contained in the transfer arm allowing the transfer of liquid between the arms parts. Its role is to permit the arm to freely follow the relative motion of offshore unit and shuttle tanker.

2.1.6 Manifold

Manifold is a pipe assembly to which the outboard flanges of the transfer system are connected.

2.1.7 Emergency release coupling (ERC)

ERC is a device to provide a means of quick release of the transfer system when such action is required only as an emergency measure.

2.1.8 Emergency release system (ERS)

ERS is a system that provides a positive means of quick release of transfer system and safe isolation of the shuttle tanker and transfer system. An ERS normally contains one or several ERC.

2.1.9 Emergency shut down (ESD)

ESD is a method that stops in a safely way the transfer of oil products between the offshore unit and the shuttle tanker.

2.1.10 Operating envelope

Operating envelope of a transfer system is the volume in which the presentation flange of the transfer line is required to operate.

2.1.11 Technology qualification

Technology qualification is a confirmation by examination that a new technology meets the specified requirements for the intended use. The qualification process is carried out through a set of documented activities to prove that the technology fit for service.

2.1.12 Presentation flange

The presentation flange is transfer system's flange for connection to the shuttle tanker manifold or spool piece.

2.1.13 Spool piece

The spool piece is a reducer or enlarger fitted on the shuttle tanker manifold for the purpose of matching the flanges of transfer system and shuttle tanker.

3 Documentation

3.1 General

3.1.1 In addition to the documentation specified in Pt A, Ch 1, Sec 4 of the Offshore Rules, which is required for the offshore unit, documents listed in the present article [3] are to be submitted to the Society.

3.1.2 Depending on the specificities of the investigated transfer system, the Society may require additional documentation for classification purpose, on a case-by-case basis.

3.2 Structural and mechanical documentation

3.2.1 The following documents are to be submitted:

- transfer system general arrangement drawings
- drawings showing operational envelopes
- transfer system component drawings
- ERC/ERS arrangement drawings
- cross section drawings
- weight and center of gravity data
- accessories drawings
- weld summary list
- welding procedures and specifications
- painting and coating specifications
- material list.

3.3 Electrical control

3.3.1 The following documents are to be submitted:

- list of electrical equipment
- electrical interconnection diagram
- electrical circuit diagrams
- control logic diagrams
- overload protection devices data.

3.4 Hydraulic control

3.4.1 The following documents are to be submitted:

- list of hydraulic equipment
- hydraulic circuit diagrams
- control logic diagrams
- hydraulic components data.

3.5 Testing

3.5.1 The following documents are to be submitted:

- pressure tests procedures
- NDE tests procedure
- radiographs procedures and equipment description
- factory acceptance
- site tests procedures
- test acceptance criteria.

SECTION 2 DESIGN REQUIREMENTS, INSPECTION AND TESTING

1 Introduction

1.1 Application

1.1.1 The requirements of the present section are applicable for transfer systems covered by the additional class notation **oil offloading (transfer arms)**, as defined in Sec 1.

2 Classification procedure

2.1 General

2.1.1 Classification steps

The classification process related to the additional class notation **oil offloading (transfer arms)** is to be performed through a risk assessment approach based on the requirements of EN 1474-3, [4]. The steps of the procedure are given in Tab 1.

2.2 Definition of the transfer system

2.2.1 General

The party applying for classification is to provide a description of the transfer system covering the design, arrangement and operating procedures. Previous applications of the technology, if relevant, are also to be specified.

2.3 Definition of Owner's acceptance criteria and performance standards

2.3.1 Acceptance criteria for risk analysis

The Owner is to define acceptance criteria which will establish the basis for identification of safety critical elements of the transfer system. The criteria are to take into account the probability (or frequency) and consequences of significant major hazards.

Acceptance criteria are to be stated in the Design Criteria Statement.

2.3.2 Owner's performance standards

The Owner is to define performance standards relating to the transfer system, taking into account the following items:

- applicable legislation, regulations
- industry standards intended to be considered for the classification of transfer system
- overall functional targets and requirements covering different operational phases (see EN 1474-3, [4.3]).

The performance statements may be expressed in both qualitative and quantitative terms.

2.4 Definition of limiting loading conditions for offloading operations

2.4.1 Limiting conditions for loading/offloading operations

The party applying for classification is to specify the list of limiting conditions for loading/offloading operations, based on the following items:

- Owner requirements
- Technological limits defined by the designer and manufacturer of the offloading system
- Issues of the risk analysis (see [2.5])

The following parameters are to be defined as a minimum:

- maximum allowable significant wave heights
- limiting specific metocean conditions (wind, current, ice and snow)
- limiting air temperatures for offloading operations
- limiting configurations of gas carrier (manifold position is to be taken into account)
- limiting draughts of the unit for loading/offloading operations
- operating envelopes of the transfer system

The parameters defining the limiting conditions for loading/offloading operations are to be stated in the Design Criteria Statement.

2.5 Risk assessment

2.5.1 General

A risk assessment study is to be carried out, as a part of overall assessment of the transfer system. The risk assessment report, complying with the requirements of [2.5.2], is to be submitted to the Society.

Generally, the risk assessment study has the following objectives:

- evaluation of the design, taking into account the operational procedures
- determination of limiting conditions for offloading operations
- assessment of safety and operability of the transfer system via risk assessment techniques.

Table 1 : Definition of acceptance criteria for risk analysis and performance standards

	Classification step	Performed by	Comment
1	Definition of the transfer system	Party applying for classification	See [2.2]
2	Definition of Owner's acceptance criteria and performance standards	Owner	See [2.3]
3	Definition of limiting conditions for offloading operations	Owner Party applying for classification	See [2.4]
4	Risk assessment	Party applying for classification	See [2.5]
5	Identification of new technology Qualification programme of new technology	Party applying for classification	See Sec 1, [1.10]
6	Design studies and/or model tests	Party applying for classification	See [2.6]
7	Elaboration of the approval scheme for classification	The Society	See [2.7]
8	Verification of all approval tasks from the approval scheme	The Society	See [2.8]
9	Issuance of certificate for the additional class notation **oil offloading (transfer arms)**	The Society	–

2.5.2 Risk assessment report

The risk assessment report is to cover at least the following items:

- hazard identification with documentation of techniques
- critical failure modes identification, major hazard accidents
- risk ranking of identified hazards
- identification and categorization of safety critical elements
- definition of performance standards for safety critical elements; Owner's performance standards as per [2.3.2] are to be taken into account
- listing of measures for risk control and mitigation
- risk calculation methodology and assumptions
- record of limiting conditions for offloading operations which will complete the list of [2.4.1].

2.5.3 Risk assessment methodology

Risk assessment methodology is to be based on the provisions of EN 1474-3, [4.6]. The Society accepts risk analysis based on other recognized standards, such as EN ISO 17776 "Guidelines on tools and techniques for hazard identification and risk assessment.

2.6 Design studies and/or model tests

2.6.1 General

The party applying for classification is to perform and document the technical studies and model tests requested for the approval scheme. The following type of studies and tests are concerned:

- Studies and model tests requested by the qualification plan of new technologies
- Studies and model tests requested by the design requirements in [3]
- Studies and model test requested for the evaluation of performance standards defined for risk analysis.

A detailed documentation is to be submitted to the Society for information.

2.7 Elaboration of approval scheme for classification

2.7.1 General

The approval scheme for classification is to be established by the Society, based on the documentation provided by the party applying for classification.

The approval scheme is to include the following items:

- approval tasks identified through the risk analysis, in order to check that the performance standards are achieved for each safety critical element
- approval tasks from the design requirements in [3]
- tasks relating to the construction survey, inspections and testing (see [4])
- on-site requested inspections, at installations and in service.

2.8 Verification of approval scheme for classification

2.8.1 General

The Society will perform the tasks defined through the approval scheme, including the examination of documents, inspections, attendance to tests. The additional class notation **oil offloading (transfer arms)** is granted to the unit when all approval tasks are satisfactory fulfilled. Any exception and limitation is to be stated in the Certificate of Classification.

3 Design requirements

3.1 Dimensions and clearance

3.1.1 Stowed position of side-by-side loading arms

In stowed position, side-by-side loading arms are to be arranged such as no part of the arm extends transversely beyond unit's deck at side.

3.1.2 Clearance study report

The party applying for Classification is to provide a clearance study report, indication the investigated checkpoints. The checkpoints are to be chosen taking into account the deck and topsides layout. The Society may require clearance check in additional checkpoints, based on the examination of general arrangement drawings.

The clearance study is to take into account the fabrication and erection tolerances specified by the party applying for Classification. The values of these tolerances are to be stated in the Design Criteria Statement.

The clearance study is also to take into account maximal deformation of structural elements (see [3.5.10]).

3.1.3 Minimum clearance

The minimum acceptable clearances applicable for transfer arms are indicated in Tab 2.

Table 2 : Minimum acceptable clearances

Minimum clearance, in mm	Description
150	• between counterweights of operating arms • between any part of an operating arm and a stowed arm
300	between any part of an operating arm and any adjacent structure, piping, equipment or part of adjacent operating arm

Minimum clearances different than Tab 2 may be accepted by the Society, provided that a detailed documentation of these values covering different operating conditions of the transfer system, is submitted to the Society and agreed by the Owner.

For transfer systems other than transfer arms, the Society will establish the minimum acceptable clearances on a case-by-case basis, depending on system configuration.

3.2 Materials

3.2.1 Design temperature

Design temperature of transfer system's elements is to be calculated based on the local environmental conditions (air temperature ranges) and cargo temperature.

A calculation report is to be submitted to the Society. The methods, software, assumptions used for design temperature calculation are to be documented.

3.2.2 Supporting structures

Steel grades of supporting structure are to comply with the requirements of Pt B, Ch 3, Sec 2 of the Offshore Rules.

3.3 Model tests and hydrodynamic analysis

3.3.1 General

Combined motions of the offshore unit and shuttle tanker are to be assessed through hydrodynamic analysis. This assessment is to be based on the offloading procedure, which is to be submitted to the Society for review.

Generally, model tests are to be performed. The model is to include the offshore unit and the shuttle tanker, as well as the mooring and fendering system and the anchoring system.

For side-by side configuration, model tests are requested to determine shielding effect for wind and current coefficients and the damping due to the close proximity of the vessels.

Direct calculations through numerical methods may be accepted by the Society provided that the following items are at the satisfaction of the Society:

- model of area between the unit and shuttle tanker
- model of mooring lines, anchoring and fenders
- choice of heave damping and roll damping parameters.

3.3.2 Reporting

A detailed report is to be submitted to the Society for review. Testing procedures and methods used for the extrapolation to full scale data are to be documented. When numerical calculations are used, the software, methodology and choice of parameters are to be documented.

3.3.3 Design conditions

The design conditions for model tests and/or hydrodynamic analysis are to consider the maximum allowable significant wave heights and specific metocean conditions beyond which any transfer of the oil product is to be stopped.

Design conditions are to be established based on the limiting conditions for offloading operations specified by the Owner.

All mooring configurations are to be investigated.

At least three loading configurations are to be investigated, as given in Tab 3.

Table 3 : Minimum loading configurations

Offshore unit	Shuttle tanker
Full loaded	Ballasted
Ballasted	Full loaded
Relevant intermediate filling	Relevant intermediate filling

3.3.4 Design parameters

Model tests and/or hydrodynamic analysis are to result in the following parameters, relevant for the assessment of transfer system and mooring and anchoring system:

- relative motions between offshore unit and gas carrier
- absolute accelerations in three directions
- tension in mooring lines
- tension in anchoring lines
- general motions of coupled system (offshore unit and shuttle tanker).

3.4 Design loads for structural elements

3.4.1 Lightweight

The lightweight is to include the weight of components with all permanently attached equipment.

The lightweight of all components of the transfer system is to be calculated based on the material densities specified by the Designer.

3.4.2 Cargo load

Cargo load is the weight of cargo conveying the transfer system in operating conditions. Cargo load is to be calculated based on the density of cargo specified by the Designer.

3.4.3 Design pressure

The design pressure for each component conveying cargo of cargo vapour is to be specified by the Designer. When the design pressure is obtained through calculations or model test, a calculation or test report is to be submitted to the Society for information.

3.4.4 Ice accumulation

Ice accumulation on components of the transfer system are to be taken into account for the calculation of weight and wind loads. Ice accumulation will be taken into account for units operating in cold regions. Values of ice accumulations are to be taken on a case by case basis, considering the effects of rain and sea spray for the relevant region, but in no case less than 6 mm.

3.4.5 Wind loads

Wind loads acting on the transfer system are to be calculated for the worst directions.

Wind velocity is to be taken as the design wind speed at 10 m above the sea level, as a 3 seconds gust speed.

For stowed condition, 100 years and 10 years return period wind velocity are to be considered for calculation, in combination with wave loads (see Tab 4).

For operating conditions, the wind velocity is to correspond to the probability level of limiting conditions for offloading operations (see [2.4].

Wind force may be determined through wind tunnel tests on a representative model of the transfer system. When tunnel tests are not available, the wind force is to be calculated using the methodology given in EN 1474-1, [4.2].

3.4.6 Thermal loads

Thermal loads caused by material temperature differences are to be taken into account for the assessment of structural elements. Temperature differences for each structural element are to be established by the Designer and approved by the Society. The following items are to be taken into account:

- design temperature, as defined in [3.2.1]
- ambient air temperature
- cargo liquid or vapour temperature, when relevant
- ice accumulation, when relevant
- solar radiation.

These temperatures are to be applied in the most extreme combination.

3.4.7 Accelerations and relative motions

Accelerations and relative motions between the unit and the shuttle tanker during offloading operations are to be applied on structural elements of the transfer system in the most severe combination.

The values of accelerations and relative motions are to be obtained through model tests and/or hydrodynamic analysis, as required in [3.3].

3.4.8 Test pressure loads

Structural elements conveying cargoes or cargo vapour are to be subject to hydrostatic testing. The test pressure is to be taken 1.5 times the design pressure defined as in [3.4.3].

3.5 Structural design assessment

3.5.1 Loading conditions

The following types of loading conditions are to be investigated through structural analysis:

- stowed conditions
- operating conditions (see [3.5.2])
- maintenance conditions
- hydrostatic test
- accidental conditions.

Additional loading conditions may be requested by the Society, based on the issues of risk analysis report.

3.5.2 Operating conditions

For transfer systems using transfer arms, the operation conditions include:

- luffing and slewing for normal operations and manoeuvring into the maintenance position
- free wheel mode
- control mode during connection
- control mode after connection
- connection and disconnection of quick connect/disconnect coupler (QCDC)
- operation of the ERS including automatic raise and retract of the arms behind the berthing line
- manoeuvring following ERS operation taking into account:
  - full outboard arm to just above horizontal position, for draining
  - full and empty transfer arm in stowed position
  - full and empty transfer arm to the connected position, for ERC reconnection.

3.5.3 Accidental loading conditions

Accidental loading conditions are to be identified based on the issues of risk analysis report and taking into account the major hazard accidents relating to the transfer system and the risk assessment of each hazard.

3.5.4 Load combinations

For transfer systems using transfer arms, the load cases and combinations to be considered, as a minimum, through the structural analysis are given in Tab 4. The Society may require the analysis of additional load cases, taking into account the specificities of design and operation of the off-loading system under investigation.

For transfer systems other than those based on transfer arms, the load cases will be established on a case-by-case basis, taking into account the operational procedure.

3.5.5 Structural criteria

The assessment of structural members of the transfer system is to be carried out as follows:

- calculation of equivalent stresses using linear elastic material behaviour, for all load cases defined in [3.5.4]; the equivalent stress, is defined in Pt B, Ch 3, Sec 3, [5.3] of the Offshore Rules.

  Calculation methods are to be at the satisfaction of the Society.
- the equivalent stress is to satisfy:

  $\sigma_c \leq KR_f$

  where:

  σ_c : Equivalent stress, in N/mm²

  K : Factor of allowable stress, as defined in Tab 4

  R_f : Reference allowable stress, in N/mm², as defined in [3.5.6].

Table 4 : Load cases

Load case N°	Loading condition	Load combination	Factor K of allowable stress
1	Stowed condition	• Lightweight • Wind load in stowed position (10 years) • Maximum accelerations from unit's motions at 100 years return period, in worst directions • Ice accumulation for cold regions, stowed position	1,2 **(1)**
2	Stowed condition	• Lightweight • Wind load in stowed position (100 years) • Maximum accelerations from unit's motions at 10 years return period, in worst directions • Ice accumulation for cold regions, stowed position	1,2 **(1)**
3	Operations - Manoeuvring **(2)**	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Ice accumulation for cold regions, operating conditions	0,9
4	Operations - Connected, empty	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Ice accumulation for cold regions, operating conditions	0,8
5	Operation - Connected, with cargo transfer	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Cargo load, as stated in [3.4.2] • Design pressure on elements conveying cargo and cargo vapours • Ice accumulation for cold regions, in operating conditions	0,8

(1) The Society may accept, on a case-by-case basis, different return periods for the combination of wind and wave loads, based on the examination of metocean data relating to unit's site.

(2) This load case is to be applied for all relevant positions (attitudes) of the transfer system during manoeuvring.

(3) All positions (attitudes) for emergency release are to be considered.

(4) This load case is to be considered only when the full outboard position just above horizontal, for draining, is stated in the emergency release procedure.

(5) When the hydrostatic test is performed using a testing fluid different than cargo, the testing fluid density is to be used for the calculation of the load.

Load case N°	Loading condition	Load combination	Factor K of allowable stress
6	Operation - Connected, with cargo transfer	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Cargo load, as stated in [3.4.2] • Design pressure on elements conveying cargo and cargo vapours • Ice accumulation for cold regions, in operating conditions • Thermal loads, as stated in [3.4.6]	1,5
7	Operation - Emergency release, empty **(3)**	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Ice accumulation for cold regions, in operating conditions	1,1
8	Operation - Emergency release, full **(3)**	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Cargo load, as stated in [3.4.2] • Design pressure on elements conveying cargo and cargo vapours • Ice accumulation for cold regions, in operating conditions	1,1
9	Operation - Manoeuvring after emergency release, full outboard arm just above horizontal for draining **(4)**	• Lightweight • Wind loads in operating positions, as requested in [3.4.5] • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Cargo load, as stated in [3.4.2] • Ice accumulation for cold regions, in operating conditions	1,1
10	Operation - Manoeuvring after emergency release, full transfer arm in stowed position	• Lightweight • Wind load calculated for limiting operating condition, for stowed position of the transfer system • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Cargo load, as stated in [3.4.2] • Design pressure on elements conveying cargo and cargo vapours • Ice accumulation for cold regions, in operating conditions	1,1
11	Maintenance	• Lightweight • Wind loads for maintenance conditions • Maximum accelerations from unit's motions for limiting maintenance conditions, in worst directions	0,9
12	Hydrostatic test	• Lightweight • Wind loads for testing position, for limiting operation conditions • Maximum accelerations from unit's motions for limiting operation conditions, in worst directions • Cargo load, as stated in [3.4.2] **(5)** • Test pressure load, as stated in [3.4.8] • Ice accumulation, if relevant	1,3

(1) The Society may accept, on a case-by-case basis, different return periods for the combination of wind and wave loads, based on the examination of metocean data relating to unit's site.

(2) This load case is to be applied for all relevant positions (attitudes) of the transfer system during manoeuvring.

(3) All positions (attitudes) for emergency release are to be considered.

(4) This load case is to be considered only when the full outboard position just above horizontal, for draining, is stated in the emergency release procedure.

(5) When the hydrostatic test is performed using a testing fluid different than cargo, the testing fluid density is to be used for the calculation of the load.

3.5.6 Reference allowable stress

The reference allowable stress of material, R_f, is defined by:

$$R_f = \min\left(\frac{R_{eG}}{1,5}, \frac{R}{f_m}\right)$$

where:

R_{eG} : Minimum specified yield stress of the material

R : Ultimate tensile strength of the material

f_m : Material factor to be taken as follows:

- 3 for austenitic steels
- 2,5 for ferritic steels.

3.5.7 Local stress

Local stresses obtained through finite element models with very fine mesh or local thermal stresses are to be examinated by the Society on a case-by-case basis. In any case, the local equivalent stress is to comply with the following criteria:

$$\sigma_{c-L} \leq 2R_{eG}$$

where:

σ_{c-L} : Local equivalent stress from stress concentration regions, obtained on very fine meshes or local thermal stresses

R_{eG} : Minimum specified yield stress of the material.

More stringent requirements may be requested by the Society, based on the examination of the related structural detail.

3.5.8 Buckling

Structural elements under predominantly compressive stress are to be checked, as needed, using recognized methods to the satisfaction of the Society. Additional requirements are given in Pt B, Ch 3, Sec 3, [6] of the Offshore Rules.

3.5.9 Fatigue behaviour

Fatigue behaviour of structural elements is to be verified as requested in EN 1474-3, [6.6]. The fatigue analysis is to be performed in compliance with the relevant requirements of Pt B, Ch 3, Sec 3, [7] of the Offshore Rules.

Except when otherwise specified by the party applying for classification, the design fatigue life is to be taken at least equal design service life of the unit.

3.5.10 Maximum deformation

Maximum deformations of structural elements obtained through the structural analysis are to be taken into account for the clearance study, as requested in [3.1.2] and [3.1.3].

3.5.11 Alternative criteria

Structural criteria given in NR526 "Rules for the Classification and the Certification of Cranes onboard Ships and Offshore Units" may be used for the purpose of transfer system assessment, on a case-by-case basis, provided that:

- structural elements of the transfer system are similar with lifting appliances covered by NR526
- patterns are similar with those defined in NR526 for lifting appliances.

3.6 Mooring and fendering equipment

3.6.1 General

Offloading operations are to be checked for mooring and fendering equipment, based on the offloading procedure submitted by the party applying for classification. Time domain mooring analysis is to be performed in order to assess the design of the mooring lines and fendering system. Anchoring system must be a part of the analysis.

The design conditions to be investigated are stated in [3.3.3].

3.6.2 Side-by-side configuration

As stated in [3.3], model tests are to be performed in order to determine shielding effect for wind and current coefficients and the damping due to the close proximity of the vessels. Both intact and damaged condition of mooring system are to be assessed.

During operations, each mooring line is to fullfil the following safety factors:

- 2,1 in intact condition
- 1,5 in damaged condition (with one hawser broken).

3.6.3 Tandem configuration

Mooring system for tandem configuration is to comply with the relevant requirements of NR494 "Rules for the Classification of Offshore loading and Offloading Buoys".

3.7 Transfer line

3.7.1 The transfer line conveying cargo is to be sized for the maximum cargo speed defined by the Designer and accepted by the Owner. Local higher speed may be accepted, provided that the cavitation and vibration effects are acceptable, at the satisfaction of the Society.

3.7.2 Pressure loss curve for cargo line and return vapour line are to be assessed and accepted by the Owner.

3.8 Swivel joints and structural bearings

3.8.1 General

Swivel joints and structural bearings are to comply with the relevant requirements of EN 1474-1. Relative motions between fixed parts of the transfer system, on the offshore unit, and shuttle tanker manifold are to be considered for the assessment of structural bearings.

3.9 Other design requirements

3.9.1 References

As stated in Sec 1, [1.6.1], design requirements stated in EN 1474 are adopted for the purpose of the classification. References to the relevant requirements of EN 1474 are given in Tab 5.

Table 5 : Design requirements

Design aspect	Requirement reference
Connecting/disconnecting devices	EN 1474-3, [6.9]
Communications, evacuation and rescue	EN 1474-3, [6.11]
Safety systems	EN 1474-3, [7] EN 1474-1, [5]
Pipework and fittings	EN 1474-1, [4.6]
Welding	EN 1474-1, [4.7]
Accessories	EN 1474-1, [4.5]
Monitoring, alarm and shut-down systems	EN 1474-3, [7.4] EN 1474-1, [5.3]
Electrical safety	EN 1474-1, [5.5.4]
Hydraulic and electric control system	EN 1474-1, [7]
QCDC system	EN 1474-1, [6] EN 1474-3, [8]
Corrosion protection, fire proofing	EN 1474-1, [4.8] EN 1474-3, [6.12]

4 Inspections and testing

4.1 General

4.1.1 The following type of inspection and testing are requested for the purpose of the classification of transfer systems using transfer arms:

- prototype testings
- manufacturing
- factory acceptance tests
- site acceptance tests.

For each of this type of inspections and testing, the Society will issue relevant inspection certificates of release notes.

4.2 Prototype testing

4.2.1 Prototype testing requested for the classification of transfer systems based on transfer arms are given in Tab 6.

4.3 Manufacturing

4.3.1 Tests relating to manufacturing are given in Tab 7.

4.4 Factory acceptance tests

4.4.1 Factory acceptance requested for the classification of transfer systems based on transfer arms are given in Tab 8.

4.5 Site acceptance tests

4.5.1 Site acceptance tests are to be performed in accordance with the requirements of EN 1474-1, [8.4.8].

4.6 Additional requirements

4.6.1 Additional requirements for inspection and testing of transfer systems are given in EN 1474-3, [10].

Table 6 : Prototype testing

Item	Test and reference for requirements
Swivels	• load capacity - EN 1474-1, [8.2.1.3] • dynamic test - EN 1474-1, [8.2.1.4] • swivel moisture protection test - EN 1474-1, [8.2.1.5]
ERS	• strength test - EN 1474-1, [8.2.2.2] • release performance test - EN 1474-1, [8.2.2.3]
QCDC	• strength test - EN 1474-1, [8.2.3.2] • release performance test (hydraulic QCDC) - EN 1474-1, [8.2.3.3]

Table 7 : Manufacturing tests

Item	Test and reference for requirements
Materials	EN 1474-1, [8.3.1]
Non-destructive testing	• radiographic examination of welds - EN 1474-1, [8.3.2.1] • penetrant inspection of welds - EN 1474-1, [8.3.2.2] • pressure testing - EN 1474-1, [8.3.2.3]
Insulation flange	EN 1474-1, [8.3.3]

Table 8 : Factory acceptance tests

Item	Test and reference for requirements
Swivel	hydrostatic tests - EN 1474-1, [8.4.1]
Structural bearings	EN 1474-1, [8.4.2]
ERS	• strength test - EN 1474-1, [8.4.3.1.2] • release performance test - EN 1474-1, [8.4.3.1.3] • valve set tests - EN 1474-1, [8.4.3.1.4] • performance test - EN 1474-1, [8.4.3.2]
QCDC	• strength test - EN 1474-1, [8.4.4.1] • release performance test - EN 1474-1, [8.4.4.2]
Insulation flange (stray current protector)	EN 1474-1, [8.4.5]
Hydraulic circuit	EN 1474-1, [8.4.6]
Transfer arm assembly test	EN 1474-1, [8.4.7]