



Offshore Classification – Structural Strength

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DNV Energy

Offshore Classification - Capability & Track Record

For four decades DNV has been engaged in classification and certification of mobile offshore drilling and production units built and operated world wide. With nearly half the fleet of drilling units built during the last decade to DNV class, the Society is widely recognised by the drilling industry as the provider of cost effective and highly beneficial classification services, supported by state of the art technology.

DNV has also been involved in verification of fixed and floating production units (FPUs) for more than 30 years. Currently 35 FPUs classified/certified/verified by DNV are in operation and additional 9 FPUs are under design or construction.

Today more than 150 offshore units, about 30 percent of the world's total tonnage, are classified with DNV.

This fleet is spread around the world, and DNV utilises its own global network of resource and service centres to accommodate the customers' needs. Wherever the business is, DNV's local offices have a common understanding of the classification systematics and an understanding of the specific region, its conditions and governing regulations. DNV Offshore Classification has dedicated service centres in e.g. Rio/Brazil, Houston/US, Oslo/Norway, Singapore, China, South-Korea and Japan covering all aspects from design, construction to the in-service phase. In addition DNV has more than 300 offices in 100 countries around the world. Specially worth mentioning are our site offices in Tema/Ghana, Luanda/Angola and Lagos/Nigeria.



Offshore Classification – Structural Strength

The purpose of this document is to provide an introduction to offshore classification service related to structural strength. This document includes a brief description of early phase services as well as full classification services related to structural strength.

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1 Offshore Classification Services related to Structural Strength.

1.1 Introduction

Classification is a comprehensive verification service providing assurance that a set of requirements laid down in rules and standards established by the classification society are met during design and construction, and maintained during operation of an offshore unit. The structural rules and standards are aimed at ensuring structural safety against hazards to the unit, personnel, and against hazards to the environment.

Classification implies an activity, in which a ship or an offshore unit is surveyed during construction on the basis of design approval, tested before being taken into service, and surveyed regularly during its whole operational life. The aim is to verify that the required safety standard is built in, observed and maintained.

Classification has gained world-wide recognition as representing an adequate level of safety and quality, by way of applying experience and peak technical competence in developing rules and performing approval and surveys.

DNV's objective for Offshore Classification Services is also to reduce our customer's project risk through services creating consistency and confidence for complex offshore projects. Through a proactive approach and use of extensive experience DNV Offshore Classification aims to reduce financial and schedule risk by creating confidence and predictability relating to safe construction and design.

Prior to full classification, early phase services can be offered to a detail level found adequate based on a cost benefit evaluation. Such early phase products can to a large extent be tailor made based on the customer expectations. Typical levels of early phase services are described in brief detail in this document.

1.2 Classification Rules and Supporting Documents.



Class Rules and supporting documents give criteria for design, construction and maintenance of offshore assets. DNV Rules incorporate knowledge and experience acquired over time and provides a consistent set of standards designed to ensure fail safe design and redundancy to prevent a failure from becoming a critical accident. The Rules and supporting documents are subject to regular updating to reflect operational experience and advances in technology.

Documents for Offshore Class consist of a three level document hierarchy:

- Rules for Classification (Offshore Service Specifications); providing principles and procedures of DNV classification services
- Offshore Standards; providing technical requirements and acceptance criteria
- Recommended Practices and Class Notes; providing DNV best practices as well as guidance related to the higher level documents

Current Rules for Offshore Classification are:

- DNV-OSS-101: Rules for Classification of Offshore Drilling and Support Units
- DNV-OSS-102: Rules for Classification of Floating Production and Storage Units
- DNV-OSS-103: Rules for Classification of LNG/LPG Production and Storage Units

Current Offshore Standards applicable for Offshore Class are:

- DNV-OS-A101 Safety Principles and Arrangement
- DNV-OS-B101 Metallic Materials
- DNV-OS-C101 Design of Offshore Steel Structures, General (LRFD-method)
- DNV-OS-C102 Structural Design of Offshore Ships
- DNV-OS-C103 Structural Design of Column-stabilised Units (LRFD-method)

- DNV-OS-C104 Structural Design of Self-elevating Units (LRFD-method)
- DNV-OS-C105 Structural Design of Tension-leg Platforms (LRFD-method)
- DNV-OS-C106 Structural Design of Deep Draught Floating Units (LRFD-method)
- DNV-OS-C201 Structural Design of Offshore Units (WSD Method)
- DNV-OS-C301 Stability and Watertight Integrity
- DNV-OS-C401 Fabrication and Testing of Offshore Structures
- DNV-OS-E301 Position Mooring
- DNV-OS-E401 Helicopter Decks

Current Recommended Practices applicable for Offshore Class are:

- DNV-RP-A201 Standard Documentation Types
- DNV-RP-A202 Documentation of Offshore Projects
- DNV-RP-C102 Ship Shaped Offshore Structures
- DNV-RP-C103 Column Stabilised Units
- DNV-RP-C201 Buckling Strength of Plated Structures
- DNV-RP-C202 Buckling Strength of Shells
- DNV-RP-C203 Fatigue Strength Analysis of Offshore Steel Structures

1.3 Classification and Early Phase Products related to Structural Strength

DNV Classification and early phase evaluations may be divided into the following main products:

- Design Brief Review
- Approval in Principle
- Concept Evaluation
- Main Scantling Approval
- Full Classification

1.3.1 Design Brief Review

The Design Brief will be reviewed for consistency and compliance with applicable Class notations and project specific requirements as relevant.

The Design brief shall as a minimum include the following topics:

- General project description
- General arrangement drawings
- Tank and capacity plan
- List of applicable rules and regulations
- Design fatigue life
- Design temperature for selection of material grade
- Design environmental data including scatter diagram(s)
- Description of required analyses
- Description of analytical procedures
- Description of the structural evaluation process
- Typical operational characteristics (operation, survival, transit)
- Description of accidental conditions, including damage waterlines and redundancy requirements

The Design Brief content is a vital basis in the development of new project. Based on extensive experience from other projects DNV can provide assistance to ensure that the project is developed based on a correct and consistent basis complying with all relevant Rules and Standards.

1.3.2 Approval in Principle

Based on the general arrangement drawings and simplified structural strength calculations, the design is evaluated with respect to overall structural strength. An Approval in Principle is normally carried out an early stage in the project development. The quality of the review will heavily dependent of the amount of design documentation available from the Designer. As far as possible, actual scantlings should be applied as basis for the evaluation.

Typical studies will vary for different objects as follows:



i. Column-Stabilised Units

Characteristic hydrodynamic responses are calculated, and bending moments and shear forces are estimated in the most critical section either by hand calculations or preferably by simple Finite Element model e.g. a 3-D beam model or a coarse shell model. Structural capacity checks and simplified fatigue evaluation are carried out to ensure that the concept is feasible.



ii. Jack-Up

Normally a simple global model of the jack-up is developed, and deterministic response analyses are carried out with simple corrections for dynamic behaviour and second order effects. Critical issues like strength of barge / leg connections, possible global overturning and significant dynamic amplification (resonance) is considered in the evaluation. Further the minimum leg strength is estimated.



iii. Offshore Ship

Section scantlings checks will be carried out at selected positions. The scantling checks will be based on global wave bending moments and shear forces found from simplified methods.

Other concepts of novel design may also be granted "Approval in Principle", provided DNV find the design to be accomplishable without major changes to the overall design parameters.

1.3.3 Concept Evaluation

The main scantling drawings are reviewed with respect to nominal plate thickness, stiffener and girder dimensions, and grade of material. Local scantlings of buckling stiffeners, brackets, lugs and welds are normally not considered.

The verification is based on the design documentation submitted to DNV as part of the design documentation package. Independent analyses are not part of the Concept Evaluation. The level of analysis is normally similar to design analysis carried out for a Main Scantling Approval, see 1.3.4.

The technical level of drawings and design documentation is similar to what is required for a Main Scantling Approval. However, no independent analyses are carried out, and hence the possibility of errors in the analyses is larger than after a Main Scantling Approval. Therefore it is recommended that a Main Scantling Approval or full classification scope of work, which includes independent analyses, is carried out before ordering materials and starting fabrication preparations.

1.3.4 Main Scantling Approval

The main scantling drawings are approved with respect to nominal plate thickness, stiffener and girder dimensions, and grade of material. Local scantlings of buckling stiffeners, brackets, lugs and welds are normally not considered.



Independent analyses of global and local strength are carried out to verify the design calculations submitted to DNV as part of the design documentation package. These analyses are normally made with a level of detailing sufficient for full classification at a later stage. However, local FE models of hot-spots may have to be added in the detail design.

Drawings approved with respect to main scantlings are normally considered sufficient for ordering material, provided comments given to the main scantling approval are sufficiently accounted for in the design.

1.3.5 Full Classification

Offshore Classification is described in more detail in a separate document - Offshore Technical Guidance OTC-01.

As described in section 1.2 the Offshore Class consists of a three level document hierarchy:

- DNV Offshore Service Specification (DNV-OSS-xxx), providing principles and procedures of DNV classification services
- DNV Offshore Standards (DNV-OS-Cxxx), providing technical requirements and acceptance criteria
- DNV Recommended Practices (DNV-RP-Cxxx), providing DNV best practices as well as guidance related to the higher level documents



For full classification the technical requirements are specified by the documents referred to above. Specific requirements are further determined by the class notations specified for the project either by Owner or Designer.

Approval of structural strength may be carried out in several steps, starting with one or more of the early phase services described in this document, and then further developed to the final product. This way to run a design project may be effective to avoid unexpected costs and ensure that any obstacles in the concept are detected as early as possible.

It is important to see the correlation between the early phase product and full classification. The early phase products are not stand-alone products, but should be seen as part of the work necessary to fulfil requirements relevant for full classification.

2 Concluding Remarks

DNV continuously attempts to tune its offshore classification services to serve the industry the best possible way. In doing so, we strive to be the best in terms of offering added value to the customers, by e.g.:

- Keeping the volume of key quality documentation at a required minimum
- Being a continuous service partner, being an active part of a project development through the early phase services described in this document
- Providing access to specialist competence centres and experience available within DNV
- Providing assessments and technical support related to damage and deterioration
- Providing technical support related to maintenance, inspection, modifications etc.
- Being able to offer genuinely independent assessment of significant technical aspects

Please provide us with your feed-back in order for us to further improve our services.

Det Norske Veritas
NO-1322 Høvik, Norway
Tel: +47 67 57 99 00

www.dnv.com

NORWAY

Oslo
NO-1322 Høvik
Tel: +47 67 57 99 00
Fax: +47 67 57 99 11

UK

London
Palace House, 3 Cathedral Street
London SE19DE
Tel: +44 (0) 20 7357 6080
Fax: +44 (0) 20 7357 6048

Aberdeen

Cromarty House,
67-72 Regent Quay
Aberdeen AB11 5AR
Tel: +44 (0) 1224 335000
Fax: +44 (0) 1224 593311

USA

Houston
16340 Park Ten Place, Suite 100
Houston, TX 77082
Tel: +1 281 721 6600
Fax: +1 281 721 6900

BRAZIL

Rio de Janeiro
Rua Sete de Setembro,
111/12 Floor
20050006 Rio de Janeiro
Tel: +55 21 2517 7232
Fax: +55 21 2221 8758

SINGAPORE

DNV Technology Centre
10 Science Park Drive
Singapore 118224
Tel: +65 6779 1266
Fax: +65 6779 7949

KOREA

Busan
7th/9th Floor,
Kolon Building 36-7,
Namchon1-dong, Suyong-Gu
Busan 613011
Tel: +82 51 610 7700
Fax: +82 51 611 7172

WEST AFRICA

Luanda, Angola
Rua de Benguela, 17
Miramar
Luanda
Tel: +244 (02) 448 138
Fax: +244 (02) 447 521

CHINA

Shanghai
House No. 9,
1591 Hong Qiao Road
Shanghai 200336
Tel: +86 21 6278 8076
Fax: +86 21 6278 8090