DNV·GL

CLASS GUIDELINE

DNVGL-CG-0121 Edition January 2018

Offshore Classification based on performance criteria determined from risk assessment methodology

DNV GL AS

FOREWORD

DNV GL class guidelines contain methods, technical requirements, principles and acceptance criteria related to classed objects as referred to from the rules.

Any comments may be sent by e-mail to *rules@dnvgl.com*

CHANGES – CURRENT

This document replaces the October 2008 edition of DNV-OSS-121.

Changes in this document are highlighted in red colour. However, if the changes involve a whole chapter, section or sub-section, normally only the title will be in red colour.

Main changes January 2018

Following the DNV GL merger, DNV-OSS-121 has been re-formatted and issued in DNV GL format. No changes have been made to the technical content.

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.

CONTENTS

SECTION 1 INTRODUCTION

1 General

1.1 Introduction

This document contains guidelines for classification of offshore installations based on risk assessment techniques. This means that the acceptability of design and the extent of verification are based on risk assessment rather than reliance upon prescriptive rules.

1.2 Objective

The objective of the approach is to provide an alternative route for classification of individual and novel designs whilst maintaining an acceptable level of safety and integrity equivalent to that achieved under more traditional classification rules.

1.3 Scope

Although not mentioned specifically through these guidelines, avoidance of adverse environmental consequences shall also be taken into account as far as covered by traditional classification rules.

1.4 Application

The requirements are applicable for non self-propelled offshore installations intended for long term service at one offshore location.

These guidelines present an alternative or complementary methodology to classification based on DNV GL rules for offshore units and installations as listed in Table 1.

Guidance note:

These guidelines are not applicable for vessels as covered by other rules, e.g. DNVGL-RU-SHIP.

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Where classification based on risk assessment is applied only to a part of an installation, the remainder of the installation shall meet the requirements of other applicable DNV GL rules.

Guidance note:

In such cases, it is important to ensure a safe interface between the two classification methods i.e. that design based on risk assessment does not have a negative effect upon safety or integrity under classification rules and vice versa.

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1.5 Methodology

1.5.1 Use of risk assessment

Under these guidelines, risk assessment means the systematic identification and evaluation of hazards to personnel and plant, see Sec.2 [1].

Risk assessment is the overall process of risk (hazard) identification, risk analysis and risk evaluation. The results of the assessment identify areas of most significant risk and enable risk reduction measures to be targeted where most effective.

The use of risk assessment for classification shall include:

a) Hazard identification and evaluation of hazards and the risks they pose to safety and integrity on the installation.

b) Demonstrating that the risks are acceptable, i.e. meet agreed risk acceptance criteria and or target risk reduction.
c) Identifying the safety-critical elements and their required performance standards that are required in order to meet the acceptance criteria.

1.5.2 Scope of work

In order to assign classification, DNV GL will review and approve the selection of safety-critical elements and performance standards, and verify their design, construction, installation and commissioning.

DNV GL will establish an installation-specific verification scheme for initial class entry as well as maintenance of class. The DNV GL scope for approval and verification is detailed further in Ch.2.

1.5.3 Retention of class

Retention of class shall be through ongoing verification that the safety-critical elements remain in adequate condition and repair to forseeably meet their performance standards.

Whilst classification is maintained, DNV GL will retain the verification scheme under review based on findings of verification activities. DNV GL will issue an annual verification status report, which may be used as documentation with other regulatory review requirements.

1.5.4 Owner or operator responsibility

Classification in accordance with these guidelines indicate that the installation has been verified as attaining an acceptable level of safety and integrity as specified by agreed risk criteria.

The owner or operator is responsible for ensuring compliance with requirements of maritime administrations or conventions, and for seeking concessions where any such requirements are not fulfilled.

1.6 Class notation

Offshore installations classed in accordance with the provisions of these guidelines will be assigned the class notation **RA**.

1.7 Terms and conditions

The general terms and conditions for classification shall be as stated in the applicable classification rules for the relevant unit type as listed in Table 1.

DNV GL will manage and document approval and verification activities for class entry and maintenance of class. DNV GL will also interface with and direct the risk assessment activities as necessary to ensure acceptability for classification. The owner or operator shall cooperate with DNV GL as necessary to establish and undertake the approval and verification process.

2 Normative references

Table 1 DNV GL Rules for classification - offshore units

Document code	*Title*
DNVGL-RU-OU-0102	Floating production, storage and loading units
DNVGL-RU-OU-0103	Floating LNG/LPG production, storage and loading units

3 Definitions

Table 2 Definitions

Term	*Definition*
consequences	the expected effects of an event occurring
frequency	the number of occurrences of an event per unit time In risk assessment, it is usually expressed as the frequency per year.
hazard	a source of potential harm or a situation with a potential to cause loss (any negative consequence)
inspection and maintenance plan	(or *schedule*) is a programme of scheduled inspection and maintenance activities that ensure the safety-critical elements continue to meet the identified performance standards to maintain the safety and integrity of the installation
major hazards	hazards with a potential for causing major accidents, i.e. involving fatality due to fire or explosion, multiple fatalities, or severe damage to the installation Major pollution should be covered as indicated in Ch.2 Sec.3.
performance standard	a statement, which can be expressed, in qualitative or quantitative terms as appropriate, of the performance required of a safety-critical element in order to ensure the safety and integrity of the installation
risk	the combination of likelihood and consequence of hazards being realised, i.e. the chance of a specific event occurring within a specific period of time
risk analysis	the quantification of risks without making judgements about their significance It involves identifying hazards and estimating their frequencies and consequences, so that the results can be presented as risks. Risk analysis is sometimes known as risk estimation or risk quantification.
risk assessment	a systematic analysis of the risks from hazardous activities and making a rational evaluation of their significance by comparison against predetermined standards, target risk levels or other risk acceptance criteria Risk assessment is used to determine risk management priorities.
risk acceptance criteria	standards by which the results of the risk assessment can be measured The acceptance criteria represent the acceptable level of safety and integrity of the installation. They relate quantitative risk estimates to qualitative value judgements about the significance of the risks.
safety-critical elements	parts of the installation, or plant, which are essential to maintain the safety and integrity of the installation This includes any items which: — if they failed, could cause or contribute substantially to a major hazard affecting safety or integrity of the installation, or — are intended to prevent or limit the effect of a major hazard. Safety-critical elements include measures for prevention, detection, control, mitigation (including personnel protection) of hazards.
verification	examination, testing, audit or review to confirm that an activity, a product, or a service, is in accordance with specified requirements For DNV GL classification, this normally includes verification of the design, manufacturing, construction, installation, commissioning and in-service condition of safety-critical elements such that they fulfil the requirements of the performance standards.

SECTION 2 DESIGN PRINCIPLES AND RISK ASSESSMENT METHODOLOGY

1 General

This section states the design principles and requirements for risk assessment that are to be applied for award of DNV GL classification.

Risks shall be assessed in accordance with recognised methods and shall be performed by qualified and competent persons with the necessary understanding of risk, and the risk assessment process.

The risk assessment methodology and tools, assumptions, and system boundary limits shall be clearly documented. Sensitivity analysis to examine how the results may vary as significant individual assumptions are changed shall be used to document the uncertainties of the identified risks. This documentation shall be subject to DNV GL approval.

2 Design principles

The following principles shall apply in addition to the identified requirements from risk assessment:

1) The installation shall be designed and constructed with sufficient integrity to withstand operational and environmental loading throughout the installation lifecycle.
2) Systems and structures shall be designed with suitable functionality and survivability for prevention, detection, control and mitigation of foreseeable accident events affecting the installation.
3) Escalation to plant and areas, which are not affected by the initiating event, shall be avoided.
4) Effective escape, shelter and evacuation facilities shall be provided to safeguard all personnel, as far as practicable, at all times when the installation is manned.

3 Risk assessment

3.1 Risk assessment steps

3.1.1 Hazard identification

3.1.1.1

Hazards with the potential to threaten safety of personnel or integrity of the installation shall be identified. The hazard identification shall include all normal expected states of the installation, such as operation, maintenance, and shutdown.

Guidance note:

Typical hazard identification techniques include e.g. HAZOPs, FMEA, safety reviews, etc.

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3.1.1.2

A typical, but not necessarily exhaustive list of hazards includes:

— loss of well containment (blowout etc.)
— hydrocarbon releases with potential to result in fires, explosions, or toxic hazards
— release of other toxic or hazardous substances
— collisions
— helicopter crash
— structural and or foundation failure
— stability and buoyancy
— dropped objects

— mooring, propulsion, and station keeping.

3.1.1.3
The results of the hazard identification and any relevant assumptions shall be documented.

3.1.2 Risk analysis

3.1.2.1
The identified hazards can be ranked based on combination of likely frequency and consequence. Insignificant risks may be eliminated from further evaluation provided that relevant assumptions are documented.

Guidance note:
Risks shall not be subdivided such that individual risk elements appear trivial, whereas collectively still representing a substantial risk.

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Consideration of frequency includes identification of initiating events, and combinations of events, which could lead to a hazard. The likelihood of occurrence of such events can be found from historical or other appropriate data.

The consequences of the hazards shall include analysis of the effects of accidents or accidental events on the safety of personnel and integrity of the installation.

3.1.2.2
The availability and vulnerability of key prevention and protection systems shall be assessed with respect to required functionality against each of the identified hazards. Any significant findings shall be consistent with assumptions made in other parts of the risk analysis and assessment.

3.1.2.3
The hazards remaining after the screening exercise are termed significant major hazards. The selection of significant major hazards, including assumptions made as part of the ranking process, shall be documented.

Guidance note:
Tools such as HAZOPs, fault trees and engineering judgement may be effectively applied to screen out hazards that are trivial or of minor significance. This includes hazards and escalations which are extremely unlikely to occur (e.g. due to the effectiveness of prevention measures in place), or which will have minor consequence to personnel or property.

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Guidance note:
The screening exercise can also be useful for early optimisation of prevention and protection measures against major hazards prior to performing the risk assessment.

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3.1.2.4
The basis for the risk ranking, including assumptions related to functioning of safety systems and exclusion of low significance risks shall be subject to DNV GL approval.

3.1.3 Risk assessment

3.1.3.1
The risks from significant major hazards shall be assessed and considered together in order to show:

— the annual safety risk for typical personnel groups on the installation (individual risk)
— the annual loss of integrity risk for the installation
— the relative contribution of different hazards to the total calculated risks.

3.1.3.2
The annual risks shall be assessed against predefined risk acceptance criteria (see [1.4]). If necessary, risk reduction measures shall be applied in order to meet the acceptance criteria.

3.1.3.3
The results of the risk analysis and evaluation shall be documented and subject to DNV GL approval.

3.1.4 Acceptance criteria

3.1.4.1
DNV GL rules for classification have been developed over many years in order to give an acceptable level of safety and integrity for design, construction and ongoing condition of the installation. Classification based on risk assessment techniques shall achieve at least the equivalent level of safety as class based on prescriptive DNV GL rules.

In cases where deviations from the rules are justified on the basis of risk assessment, the required acceptable level of safety on the installation shall be demonstrated through fulfilment of agreed acceptance criteria.

3.1.4.2
The owner or operator shall define the acceptance criteria before performing the risk analysis. The criteria shall take into account both the probability and consequences of significant major accident events. Meeting the acceptance criteria will establish the basis for identification of safety-critical elements and selection of performance standards.

3.1.4.3
Acceptance criteria shall be approved by DNV GL.

4 Safety-critical elements

4.1 Introduction

Once the acceptance criteria have been fulfilled, the safety-critical elements and performance standards shall be recorded for input to classification.

Safety-critical elements are defined in Ch.1 Sec.2 [1], and include all components or systems upon which the safety of the installation depends. This includes all means for the prevention, detection, control and mitigation of risk from major hazards.

4.2 Identification and selection

Safety-critical elements shall be identified from, and shall be fully consistent with, the major hazard scenarios considered in the assessment.

Guidance note:

Identification of elements should also include input from good engineering judgement.

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The selection of items as safety-critical shall be based on consequence of failure.

4.3 Recording

The safety-critical elements shall be recorded and shall be subject to DNV GL approval.

5 Performance standards

5.1 General

Performance standards shall be established for the safety-critical elements. The performance standards shall be such that the safety-critical elements are suitable for fulfilment of the acceptance criteria as demonstrated in the assessment.

The performance standards shall be suitably described, normally in quantified terms, so as to be verifiable for the safety-critical elements.

The performance standards shall reflect any relevant lifecycle requirements of the critical element.

The performance standard shall also reflect any interaction or dependence between safety-critical elements for a particular major accident scenario.

5.2 Approval

Performance standards shall be documented and approved by DNV GL.

6 Risk reduction

6.1 Introduction

The results of hazard identification and evaluation present a good opportunity for targeted risk reduction. For assigning classification, such risk reduction shall be undertaken wherever significant and practicable opportunities are identified.

6.2 Hazard identification and evaluation

Hazard identification and evaluation is most effectively initiated at concept design stage where risks can be avoided or reduced.

For existing installations where this is not possible, hazard identification and evaluation shall be used to address hazards and optimising the protection measures to manage them. In order of importance, this means measures to prevent, detect, control and mitigate against hazards.

Guidance note:

Identified hazards can be avoided through e.g.:

— removal of the source of a hazard (without introducing new sources of hazard)
— breaking the sequence of events leading to realisation of a hazard.

Where hazards cannot be avoided, installation design and operation should aim to reduce the likelihood of hazards occurring where practicable, e.g. by:

— reduction in number of leak sources (flanges, instruments, valves, etc.)
— removal or relocation of ignition sources
— simplifying operations, avoiding complex or illogical procedures and inter-relationships between systems
— selection of better materials
— mechanical integrity/protection
— reducing the probability of external initiating events, e.g. lifting operations, etc.
— reduction in inventory, pressure, temperature
— use of less hazardous materials, process or technology.

The consequences of hazards should be controlled and mitigated with the aim of reducing risk to personnel where practicable, e.g. through:

— relocation of equipment, improved layout
— provision of physical barriers, distance separation, fire walls, etc.
— provision of detection and protection systems
— provision of means to escape and evacuate.

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SECTION 3 CLASS ENTRY

1 Introduction

In order to award classification, DNV GL will verify that the installation is designed and constructed to an acceptable level of safety.

This includes verification of the selection of all safety-critical elements and that they are specified, provided and installed as suitable for the intended purpose. In this context, suitable means appropriate for the intended use and able to perform as intended.

2 New installations

2.1 Initial verification

The initial verification will include review and approval of:

a) Selection of safety-critical elements.

The safety-critical elements shall be traceable back to major hazards threatening safety or integrity. The selection shall be identified via the risk assessment but may also reflect good engineering judgement.

b) Specified performance standards.

The performance standards shall adequately define the necessary functionality and availability. The performance levels stated shall be justified based on the performance assumed or required in the risk assessment, including that required before, during and immediately following major accidents.

c) Design and specification of safety-critical elements.

The safety-critical elements shall be designed as suitable to meet the approved performance standards.

2.2 Safety-critical elements

In order to verify that the safety-critical elements are provided to meet agreed performance requirements, they shall be subject to final approval of:

a) Manufacture or construction or assembly of safety-critical elements.

The safety-critical elements shall be supplied in accordance with the approved design specification.

b) Installation or operation of the safety-critical elements.

The safety-critical elements shall be installed and commissioned in order to function as required in an emergency.

These tasks can include a selective combination of examination, testing, examination of certificates and records etc.

2.3 Verification scheme

The content of the DNV GL verification scheme depends on the selection of safety-critical elements and their respective performance standards.

Once this information is identified, DNV GL will establish a structured verification scheme to apply the review, approval and surveying requirements to the safety-critical elements.

The scheme will:

— record the identified safety-critical elements for the installation, and the required performance of such elements
— set out the work plan and schedule for the verification work at each stage of the project
— document the results of verification work.

The scheme will provide a direct link from verification activities back to the risk assessment, and hence a documented basis for safety and integrity of the installation.

For new build installations, early DNV GL involvement is strongly recommended to facilitate timely execution of the verification process.

3 Existing installations

Existing installations without class or classed with a society other than DNV GL may apply for risk based classification.

The initial verifications requirements will be determined on a case by case basis depending upon installation design, novelty, previous class (if any), age, history etc. As a general rule, the requirements will be similar to those for newbuildings but with the following exceptions:

a) Limited design and construction verification depending upon the extent of original documentation and certification available.
b) Examination of records pertaining to the operating history of the installation.
c) Comprehensive condition surveys, potentially including examination and testing, in order to indicate the actual condition of the installation and its acceptability for class.

SECTION 4 MAINTENANCE OF CLASS

1 Introduction

In order to maintain valid classification in-service, DNV GL will verify the suitability of the safety-critical elements. This includes verification by examination, testing, audit and review, as necessary to give assurance that all safety-critical elements are selected and that they will remain in good repair and condition suitable for the intended purpose.

2 In-service verification scheme for maintenance of class

2.1 General

DNV GL will establish a verification scheme for the ongoing review, approval and surveying of safety-critical elements for an installation in service.

The scheme will include:

— review of the selected safety-critical elements and performance standards, particularly with respect to:
  — changes in operational requirements
  — modifications planned or performed
  — knowledge accumulated during operation of the scheme
— continuing and updated work plan and schedule for the verification work
— documented results of verification work including any identified remedial actions or other need for change.

2.2 Review of safety-critical elements

The review of safety-critical elements will continue on from the initial verification during design and construction, and will take account of:

— changes in operational requirements
— modifications planned or performed
— accumulated knowledge during operation of the scheme.

2.3 Verification scheme

2.3.1 General

The verification scheme will indicate all activities to be performed for each safety-critical element. The scheme will take credit for activities performed under the operator's inspection and maintenance plan.

The extent of verification work will be determined based on a review of the operator’s own maintenance arrangements, including review of:

— maintenance and inspection objectives and management
— competency of personnel
— planning, scheduling and reporting tasks
— inspection intervals
— inspection and maintenance methods
— type, accuracy and condition of equipment used
— systems for planning and recording.

Once the level of maintenance and testing has been reviewed, the content of the verification scheme will be tailored as necessary to provide assurance that safety-critical elements meet the performance standards. Activities under the scheme will consist of an appropriate combination of:

— physical examination
— testing of systems and or components
— audit of activities and procedures
— review of inspection records.

2.3.2 Activities

Verification activities shall be undertaken as and when appropriate according to the verification scheme. This may be on a continuous basis dependent upon the actual safety-critical elements, and the operator's own maintenance and inspection plan.

2.3.3 Modifications

The content of the operator’s maintenance and inspection plan is a key element in the verification scheme. Therefore, any revision to the maintenance and inspection plan shall be notified to DNV GL for review and approval. DNV GL will update or revise the verification scheme as necessary to reflect such changes to the maintenance and inspection plan.

Based on indications and results, the verification scheme may be modified to include greater or lesser level of activities as necessary to ensure the ongoing performance of safety-critical elements.

2.3.4 Documentation

Results and status of verification tasks will be documented within the scheme itself and through annual verification reports. The reports may in turn be used as documentation for other obligatory or regulatory requirements.

The operator shall cooperate with the application of the verification scheme, through timely provision of adequate information and access to all facilities as necessary to fulfil the verification tasks.

2.3.5 Remedial measures

Necessary remedial measures with associated conditions of class and time scales will be notified to the operator or owner and recorded within the verification scheme.

Failure to effect remedial measures within the given time scales or obstruction of execution of the verification scheme may result in suspension or withdrawal of class.

CHANGES - HISTORIC

There are currently no historical changes for this document.

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping our customers make the world safer, smarter and greener.

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