OFFSHORE STANDARD

DNV-OS-H203

Transit and Positioning of Offshore Units

FEBRUARY 2012

The electronic pdf version of this document found through http://www.dnv.com is the officially binding version

DET NORSKE VERITAS AS

FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent foundation with the objectives of safeguarding life, property and the environment, at sea and onshore. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

DNV service documents consist of among others the following types of documents:

— *Service Specifications.* Procedual requirements.
— *Standards.* Technical requirements.
— *Recommended Practices.* Guidance.

The Standards and Recommended Practices are offered within the following areas:

A) Qualification, Quality and Safety Methodology
B) Materials Technology
C) Structures
D) Systems
E) Special Facilities
F) Pipelines and Risers
G) Asset Operation
H) Marine Operations
J) Cleaner Energy
O) Subsea Systems

© Det Norske Veritas AS February 2012

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

This service document has been prepared based on available knowledge, technology and/or information at the time of issuance of this document, and is believed to reflect the best of contemporary technology. The use of this document by others than DNV is at the user's sole risk. DNV does not accept any liability or responsibility for loss or damages resulting from any use of this document.

CHANGES

General

This is a new document in a series of documents replacing "Rules for Planning and Execution of Marine Operations" (1996/2000).

This Standard replaces Pt.2 Ch.7 in the referred Rules. Nearly all parts of the text has been considerably updated with the following main changes:

— "Section 4 - Positioning" in the Rules has been split in 3 sections, i.e. Anchored Units, DP Units and Self-elevating Units.
— The requirements to DP units covered in (the new) section 6 are extensively elaborated.

CONTENTS

Sec. 1 Introduction 6

A. Application 6
A 100 General 6
A 200 Complementary standards 6
A 300 Objectives and conditions 6

B. References 7
B 100 Referenced documents 7

C. Definitions 8
C 100 Verbal forms 8
C 200 Terminology 8
C 300 Symbols 9

Sec. 2 General Requirements 11

A. Planning and Documentation 11
A 100 General 11
A 200 Planning philosophy 11
A 300 Documentation 11
A 400 Risk management 11

B. Design Evaluations 12
B 100 General 12
B 200 Environmental Conditions 12
B 300 Loads and load effects 12
B 400 Unit global structural strength 12
B 500 Unit local structural strength 13
B 600 Strength of temporary structures 13
B 700 Stability afloat 13

Sec. 3 Transit 14

A. General 14
A 100 Application 14
A 200 Planning and documentation 14
A 300 Design evaluations 15

B. Self-propelled Transit Operations 15
B 100 General 15
B 200 Required thrust 15
B 300 Temporary mooring 16

C. Tug Assisted Transit Operations 16
C 100 Application 16
C 200 Towing vessel and equipment 16
C 300 Required thrust and bollard pull 16
C 400 Temporary mooring 16

D. Operational Aspects 17
D 100 General 17
D 200 Towing 17
D 300 Emergency jack up 17

Sec. 4 Anchored Units 18

A. General 18
A 100 Application 18
A 200 Definition of design conditions 18
A 300 Planning and documentation 18
A 400 Planning meetings 18
A 500 Design evaluations 19

B. Mooring Systems 19
B 100 General 19
B 200 Design requirements 19
B 300 Long term mooring systems 20
B 400 Mobile mooring systems 20
B 500 Weather restricted mooring systems 20

C. Clearances 22
C 100 General 22
C 200 Synthetic fibre rope lines 22
C 300 Clearances for weather restricted operations 22
C 400 Clearances between units 23
C 500 Anchor line clearances 23
C 600 Anchor clearances 24

D. Installation of Anchors 25
D 100 General 25
D 200 Drag installed anchors 25
D 300 Other anchor types 25

E. Connection to Pre-laid Mooring 25
E 100 General 25
E 200 Planning and schedule 25
E 300 Design evaluations 26
E 400 Testing 26

F. Operational Aspects 26
F 100 General 26
F 200 Anchor installation 26

Sec. 5 Dynamically Positioned Units 27

A. General 27
A 100 Application 27
A 200 Definition of design conditions 27
A 300 Planning and documentation 27
A 400 Design evaluations 27

B. Dynamic Positioning 27
B 100 DP equipment class 27
B 200 Field arrival 28
B 300 Complex and close proximity DP operations 29
B 400 Contingencies 29
B 500 Annual DP trial 29
B 600 Checklists 29

C. Operational Aspects 30
C 100 General 30
C 200 Clearances 30

Sec. 6 Self-elevating Units 31

A. General 31
A 100 Application 31
A 200 Definition of design conditions 31
A 300 Planning and documentation 31

B. Positioning of Self-elevating Units 31
B 100 Design evaluations 31
B 200 Jacking operations 32
B 300 Testing 32
B 400 Soil surveys 32
B 500 Safe jack-up locations 32

C. Operational Aspects 32
C 100 General 32
C 200 Functional testing 33
C 300 Clearances 33
C 400 Seabed conditions 33
C 500 Jacking and testing 33

SECTION 1
INTRODUCTION

A. Application

A 100 General

101 This standard, DNV-OS-H203, Transit and Positioning of Offshore Units, provides specific requirements and recommendations for positioning any type of offshore unit such as:

— semi-submersible units
— self-elevating units
— drilling ships
— floating productions and/or storage units
— loading buoys
— offshore installation vessels
— well intervention units.

Guidance note:

In this standard the term positioning covers the activities required to position a unit/vessel at an offshore location and the planning, analyses and testing required for documenting a safe condition of the unit/vessel at that location. The positioning is considered completed when the unit/vessel is ready for operation or operating under normal conditions, see 201, and all required analyses and testing have been performed and accepted.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 This standard also provides specific requirements and recommendations for transit of mobile offshore units.

103 This standard does not include specific requirements to the strength/capacity of the mooring systems. For such requirements references are made to applicable codes and standards in Sec.4 B.

A 200 Complementary standards

201 All the DNV offshore standards covering marine operation, i.e. this standard (DNV-OS-H203), DNV-OS-H101, DNV-OS-H102, DNV-OS-H201, DNV-OS-H202 and DNV-OS-H204 through DNV-OS-H206, will be referred to as the VMO Standard.

Guidance note:

The “VMO Standard” is substituting “DNV - Rules for Planning and Execution of Marine Operations”. See also Table 1-1.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 General recommendations for planning, loads and design of marine operations are given in DNV-OS-H101 and DNV-OS-H102.

203 Reference is made to DNV-OS-H202 for applicable (additional) requirements to sea transportation (transit) operations for the units.

Guidance note:

For on- and offloading of units transported on barges or HLV relevant requirements in DNV-OS-H201 should also be considered.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 300 Objectives and conditions

301 The objectives of this Standard are stated in DNV-OS-H101, Sec.1 A.

302 The general conditions for use of this Standard are stated in DNV-OS-H101, Sec.1 B200.

303 For operation of units under normal conditions, reference is made to the relevant parts of DNV's “Offshore Codes”, or the equivalent rules of other recognised bodies.

Guidance note:

By normal condition is meant the condition stated in the Classification Certificate of the unit, and covered by its Operations Manual.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B. References

B 100 Referenced documents

101 For the OS numbering system and cross references, see DNV-OS H101, Sec.1 C101 and C102.

102 The text in this standard includes references to the documents listed in Table 1-1. If indicated where the reference is given, the text in the referenced service document shall be considered as a requirement of this standard.

Table 1-1 – References including requirements

Reference	*Revision*	*Title*
DNV-OS-E301	Oct. 2010	Positioning Mooring
DNV-OS-H101	Oct. 2011	Marine Operations, General
DNV-OS-H102	Jan. 2012	Marine Operations, Design and Fabrication
DNV-OS-H201	See note	Load Transfer Operations
DNV-OS-H202	See note	Sea Transports
DNV-OS-H204	See note	Offshore Installation Operations
DNV-OS-H205	See note	Lifting Operations
DNV-OS-H206	See note	Sub Sea Operations

Note:
The DNV-OS H-series are planned issued in the period October 2011 through June 2012. Each OS will enter into force at the date of publication. Until the OS is published the relevant requirements in "DNV - Rules for Planning and Execution of Marine Operations" shall be considered governing.

103 The referred requirements are based on the document revisions indicated in Table 1-1. Any modifications of the referred requirements in later revisions of references shall be considered and normally used unless otherwise agreed.

Guidance note:

The agreement should be made between involved (normally through contracts) parties as Company, Contractors and MWS.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

104 The documents listed in Table 1-2 include information that through references in this text, clarify and indicate acceptable methods of fulfilling the requirements given in this standard.

105 The latest revision of the informative references should normally be considered.

Table 1-2 – Informative references	
Reference	*Title*
DNV-OSS-101	Rules for Classification of Offshore Drilling and Support Units
DNV-OSS-102	Rules for Classification of Floating Production, Storage and Loading Units
DNV-OS-C104	Structural Design of Self-Elevating Units
DNV-OS-E302	Offshore Mooring Chain
DNV-OS-E303	Offshore Mooring Fibre Ropes
DNV-OS-E304	Offshore Mooring Steel Wire Ropes
DNV-RP-E301	Design and Installation of Fluke Anchors in Clay
DNV-RP-E302	Design and Installation of Plate Anchors in Clay
DNV-RP-E307	Dynamic Positioning Systems - Operation Guidance
DNV-RP-H101	Risk Management in Marine- and Subsea Operations
DNV CN 30.4	Foundations
API RP 2SK	RP for Design and Analysis of Station keeping Systems for Floating Structures
NMD Reg. 10/70/09	NMD regulation 10/07/09 'Anchoring Regulation 09'
DNV Ship Rules	Rules for Classification of Ships
IMO MSC/Circ. 645	Guidelines for vessels with dynamic positioning systems
ISO 19901-7	Station keeping systems for floating offshore structures and mobile offshore units

C. Definitions

C 100 Verbal forms

101 Verbal forms of special importance are defined as indicated below in this standard.

Shall: Indicates a mandatory requirement to be followed for fulfilment or compliance with the present standard. Deviations are not permitted unless formally and rigorously justified, and accepted by all relevant contracting parties.

Should: Indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required. Other possibilities may be applied subject to agreement.

C 200 Terminology

201 Terms considered important for this chapter are listed below.

Benign area: An area that is free from tropical revolving storms and travelling depressions.

Bollard pull: Continuous static towing force applied by tug, i.e. continuous tow line force.

Coastal towing: Towing in waters less than 12 nautical miles off the coast line.

"Cold" (unit/riser): No production/transportation of oil/gas is on-going and all systems are depressurised.

Dry transport: Transport of a unit as deck cargo on a barge or on a heavy lift vessel. The term Dry tow may also be used for towing of a barge with the unit as deck cargo.

Dynamic positioning (DP): A method of automatically controlling a vessels position and heading within certain predefined tolerances by means of active thrust. This active thrust is provided by thrusters that are controlled by computers. The purpose of this active thrust is to counter the environmental forces such as wind, waves and current such that the vessel will maintain its required geographical position.

Guidance note:

DNV Class notations for DP vessels see DNV Ship Rules, Pt.6 Ch.7 Sec.1 A:

DNV notations **DYNPOS AUT*/ DPS 1** correspond to IMO DP equipment class 1, Dynamic positioning system with an independent joystick system back-up and a position reference back-up

DYNPOS AUTR*/ DPS 2 corresponds to IMO DP equipment class: Dynamic positioning system with redundancy in technical design and with an independent joystick system back-up

DYNPOS AUTRO*/ DPS 3 corresponds to IMO DP equipment class 3: Dynamic positioning system with redundancy in technical design and with an independent Joystick system back-up. Plus a back-up dynamic positioning control system in an emergency dynamic positioning control centre, designed with physical separation for components that provide redundancy

DYNPOS-ER enhanced reliability notation. Increased flexibility and increased availability of power and thrust by use of connected power systems, standby start and change-over.

*The notations **AUT, AUTR** and **AUTRO** have additional requirements to achieve higher availability and robustness as compared to DPS 1, 2 & 3 respectively.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

"Hot" (unit/riser): Production/transportation of oil/gas is on-going.

Inshore towing: Towing in areas sheltered from waves and swell from open sea.

Internal seafastening: Securing of loose items within the object to be transported.

Long term mooring: Mooring at the same location for more than 5 years. Some codes use "permanent mooring".

Mobile mooring: Temporary mooring at a specific location for a period less than 5 years.

Non-class unit: Unit not covered by class requirements.

Operating condition: The condition in which the unit carries out its normal functions, e.g. drilling. Operational restrictions and environmental related limitations may apply for this condition.

Offshore towing: Towing outside territorial waters more than 12 nautical miles off the coast line.

Operation reference period: Planned operation period plus estimated contingency time. See DNV-OS-H101.

Positioning: See A101 Guidance note.

Seafastening: Structural elements providing horizontal and uplift support of objects on-board the unit during the transport.

Self-elevating unit: A barge or ship with legs that are lowered to the sea-floor and a main deck that is raised above the surface of the water to a distance where it will not be affected by the waves. Also commonly called jack-up unit.

Standard operations: Operations carried out by the vessel on a regular basis.

Survival condition: The condition in which no environmental related operational limitations are required. I.e. normal operations are ceased (adjusted) and mooring/position/draft adjusted as required in order to withstand (survive) any possible environmental loads.

Temporary safe condition: A condition where the unit can sustain the unrestricted environmental loads for a defined time period. See Sec.4 A201 Guidance note.

Transit: The activities necessary to move a floating unit from one location to another at sea, either by towing or self-propelled.

Unrestricted operations: Operations with characteristic environmental conditions estimated according to long-term statistics.

Verification: Activity to confirm that a design, product/equipment, structure or procedure complies with defined standards and/or specifications. Verification may be documented by calculations, analysis, certificates, survey reports and inspection reports.

VMO (Veritas Marine Operations): The section(s) within Det Norske Veritas providing marine warranty survey and marine advisory services.

VMO Standard: All the DNV offshore standards covering marine operations, i.e. DNV-OS-H101, DNV-OS-H102 and DNV-OS-H201 through DNV-OS-H206.

Weather restricted operations: Operations with defined restrictions to the characteristic environmental conditions, planned to be performed within the period of reliable weather forecasts. Examples are self-elevating units prior to jacking and crane vessels.

Wet tow: Self floating towing of a mobile offshore unit, as opposed to Dry tow.

C 300 Symbols

The list below defines symbols used in this standard:

ALS: Accidental Limit States
DP: Dynamic Positioning
FLS: Fatigue Limit States
FMEA: Failure Modes and Effect Analysis
H_S: Significant wave height
HAT: Highest Astronomical Tide
HLV: Heavy Lift Vessel (the deck cargo can be floated on/off the vessel by submerging the vessel deck)
LAT: Lowest Astronomical Tide
MBL: Minimum Breaking Load
MOU: Mobile Offshore Unit
MWL: Mean Water Level

MWS: Marine Warranty Surveyor
NMD: Norwegian Maritime Directorate
PNR: Point of No Return
ROV: Remote Operated (submersible) Vehicle
SLS: Serviceability Limit States
SSCV: Semi Submersible Crane Vessel
TLP: Tension Leg Platform
T_z: Zero up-crossing period
U: Wind velocity
ULS: Ultimate Limit States
v: Current velocity.

SECTION 2
GENERAL REQUIREMENTS

A. Planning and Documentation

A 100 General

101 Transit and positioning operations shall be planned and documented according to the requirements and philosophies given in DNV-OS-H101, Sec.2.

Guidance note:

Extent of planning and documentation for a specific transit and/or positioning operation should reflect the operation complexity and existing experience with similar operations.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 200 Planning philosophy

201 The complete transit and positioning operation should be based on the basic philosophy for marine operations, see DNV-OS-H101 Sec.2 A100.

202 The overall planning of the operation should duly consider

— defined safe conditions
— operational weather limitations for each part of the operation
— operation schedule including relevant contingencies
— reversing of the operation to a defined safe condition
— point(s) of no return, if any.

A 300 Documentation

301 General requirements for documentation are given in DNV-OS-H101, Sec.2 B.

302 It shall be ensured that all relevant documentation is available, see DNV-OS-H101, Sec.2 B101.

Guidance note:

The lists of required documentation given in this standard should be used as guidance, and additional documentation may be required to show that all relevant requirements are fulfilled.

As relevant, analysis/calculations, survey reports, certificates, operational procedures/manuals, etc. may be acceptable documentation. Existing documentation may be used whenever relevant.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 Proper quality assurance shall be applied in order to ensure that all presented information is verified and the latest revision available.

304 The unit should have an operation manual that describes all “standard” operations in detail. It should be documented that this operation manual satisfies the applicable requirements of the VMO Standard.

Guidance note:

It should be duly considered if the manual has been reviewed (and accepted) by relevant authorities and/or class or not.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

305 An operation specific manual/procedure covering all relevant aspects not adequately covered in the units “standard” operation manual shall be prepared, see also DNV-OS-H101, Sec.4 G200.

306 Certificates, test reports and classification documents for units, equipment and vessels involved shall, as applicable, be presented before start of the operation. These documents shall also and be available on site.

A 400 Risk management

401 The risk management process shall identify if any other operations are planned to take place in the same area at the same time. Normally such simultaneous operations should be avoided. If simultaneous operations nevertheless are carried out proper co-ordination between the various vessels and operators in order to avoid conflicts shall be documented.

Guidance note:

Risk management should include a bridging document to describe the responsibility of all vessels in normal and emergency response situation and to specify common rules and agreement during simultaneous operations.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 It shall be ensured that all parties involved in the operations have taken active part in the risk identification and risk reducing activities.

Guidance note:

Planning meeting(s) with participants both from engineering and all involved vessels is a recommended means to obtain this. See e.g. NMD Reg. 10/70/09 § 16 and Sec.4 A400.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B. Design Evaluations

B 100 General

101 Classification of a unit is based on certain design assumptions regarding operation of the unit. The operation manual should as a minimum describe all such assumptions relevant for transit and positioning.

Guidance note:

Design assumptions for non-class units, or for operational phases not covered by classification, should be described in an operation manual.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 200 Environmental Conditions

201 Characteristic environmental conditions are defined in DNV-OS-H101, Sec.3.

202 It should be documented that environmental conditions according to 201 are within the assumptions, see 101, for design of the unit.

Guidance note:

Environmental conditions and assumptions should normally be given in the defined design conditions at least for all relevant combinations of:

— Significant wave height, H_S.
— Range of zero up-crossing periods, T_Z.
— Wind velocity, U, normally given as 10 minutes wind at reference height 10 meters.
— Current velocity, v.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 Environmental conditions for a weather restricted part of the operation should be selected duly considering any operational restrictions imposed by class or other involved parties.

B 300 Loads and load effects

301 Characteristic loads and load effects are defined in DNV-OS-H102, Sections 3 and 4.

Guidance note:

Possible impact loads during setting and slamming loads during jacking of self-elevating units should be considered.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

302 Load cases for the transit and positioning operations shall generally be defined according to DNV-OS-H102, Sec.4 C.

303 It should be documented that the unit design has been verified for all loads and load cases relevant for transit and positioning according to 301 and 302.

B 400 Unit global structural strength

401 The transit (and positioning) condition of the unit shall be confirmed to be within the conditions for class.

Guidance note 1:

Class conditions for temporary phases are normally described in a letter from the classification society.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

Special attention should be given to structural integrity of legs and their supports of self-elevation units, both in transit and during positioning. E.g. any class restrictions regarding leg operating should be strictly adhered to.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 Any planned operation of the unit outside the class conditions is to be accepted by the class.

403 Structural strength verification of non-class units, or for any phases not covered by the class, shall comply with recognized codes and the principles described in DNV-OS-H102.

B 500 Unit local structural strength

501 It should be documented that calculated forces (reactions) on local structures are within class restrictions. E.g. maximum pull forces on permanent towing brackets.

502 Local strength in way of temporary installed elements, e.g. towing brackets, grillage (cribbing) and seafastening, shall comply with DNV-OS-H102.

B 600 Strength of temporary structures

601 Strength of all structures temporarily installed for the transit and/or positioning should comply with DNV-OS-H102.

602 Seafastening of loose items and non-permanent cargo carried on-board shall comply with DNV-OS-H202, as relevant.

B 700 Stability afloat

701 Acceptable stability of the unit shall be documented for all phases of the transit and positioning.

Guidance note:

General stability requirements are given in DNV-OS-H101, Sec.5. However, compliance with the stability requirements of the actual Flag State and/or the classification society is sufficient, and is normally covered in the operation manual or the stability manual of the vessel.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

702 The unit should be operated in accordance with the approved stability manual.

SECTION 3
TRANSIT

A. General

A 100 Application

101 This section is applicable for transit operations, which is defined as the activities necessary for moving a floating unit or self-elevating unit between two geographical locations. The operation may be either self-propelled transit or tug assisted transit.

102 The start and stop points for the transit shall be clearly defined and agreed by all involved parties. See also Sec.2 A200.

Guidance note:

If the transit operation is weather restricted the complete repositioning needs to be considered as one marine operation from the defined PNR during mooring line release (or jacking down) to the mooring (jacking) is sufficiently completed to define the new position as a temporary safe condition. The self-elevating unit should be considered to have reached a temporary safe condition when the integrity of the seabed foundation has been proven by preloading and the unit is capable of withstanding the loads defined in Sec.2 B300.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 200 Planning and documentation

201 See Sec.2A for general requirements to planning and documentation.

202 Generally, a weather-unrestricted transit of a self-elevating unit should only be planned as a "dry transport". See DNV-OS-H202 for requirements to such transports.

Guidance note:

In benign areas and/or if adequate weather routing could be adopted wet tows may be accepted.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 For a self-elevating unit with limitations in the environmental conditions it can sustain in floating condition, transit operations shall be planned as weather restricted operations with defined safe locations.

Guidance note:

Planning must be in place to move the self-elevating unit to shelter afloat or to an alternative safe location where the self-elevating unit can be elevated before the onset of any weather that is forecasted to exceed the specified limits. (See Sec.6B 500)

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

204 General requirements for towing vessels, towed unit and towing equipment are given in DNV-OS-H202.

205 Particulars of the following items shall at least be presented for review prior to the operation:

a) Operational weather limitations including swell for all phases of the operation.
b) Any other operational limitations (e.g. bollard pull or fairlead angle restrictions).
c) Arrangement of the towing equipment.
d) Fairleads and towing brackets.
e) Permanent towing equipment, chain cables, steel wire ropes, shackles, rings, thimbles and flounder plates.
f) Retrieving arrangement.
g) Emergency towing arrangement.
h) Seafastening arrangement of non-permanent equipment.
i) Particulars for the towing vessel(s).
j) Stability calculations for the intended operation (see Sec.2 B700).
k) Tug towing equipment certificates (i.e. winches capacity and details, tow lines, pennants, shackles, sockets) and towing arrangement.
l) Required bollard pull calculations for the tow.
m) Planned transit route with specification of:
   - narrows and shallow waters
   - statistical current conditions
   - prevailing weather conditions
   - port(s) of refuge

- refuelling port(s)
- safe jack-up positions.

206 In addition to 205, the following plans or information should be available on-board prior to operation:

a) The operation manual for the unit.

b) Stability data for the unit in relevant modes of the transit condition, and if relevant, statement confirming watertight integrity.

c) General arrangement plan.

d) Certificates for all components of the unit's, towing gear.

e) Diagrams showing:
- wind forces as function of wind velocity
- current forces as function of current velocity
- wave drift forces in relation to significant wave height and period.

f) Specification of thrust, including level of redundancy, provided by the unit's own propulsion machinery (if fitted).

g) Securing of legs, equipment and solid variable load.

h) Spud cans configuration.

i) Pumping arrangements.

j) Manning.

k) Protection of machinery.

l) Anchor particulars.

m) Safety equipment.

A 300 Design evaluations

301 See Sec.2B for general requirements.

302 Helicopter deck and other exposed structure shall have sufficient clearance to avoid contact with waves in floating condition.

B. Self-propelled Transit Operations

B 100 General

101 Transit operations may be performed without tug assistance if the units own propulsion machinery fulfils the requirements in 201 and 202, and is capable of undertaking sea passages within their certified tracking area under their own power.

Guidance note:

In some cases national governmental regulations may require tug assistance regardless of the unit's own propulsion force. The need for tug assistance should anyhow be duly considered for port entry and departure, positioning on site, navigation in constricted waters and areas with high velocity currents and positioning in deep water with the legs fully extended below the hull.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 200 Required thrust

201 The propulsion force of the unit shall be sufficient to maintain zero speed in open sea under the following conditions:

— sustained wind velocity $U = 20$ [m/s]
— head current velocity $v = 1$ [m/s]
— significant wave height $H_s = 5$ [m].

Guidance note:

For transit in benign areas, and/or for weather restricted transits, reduced conditions could be acceptable. See DNV-OS-H202 for guidelines.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 For transit in coastal and narrow waters the unit's propulsion should be able to both:

— Maintain a minimum speed of 2 knots in the environmental design condition.
— Maintain zero speed in the environmental design condition with failure in any one single part of the propulsion system.

Guidance note:

The design environmental condition for calculation of required propulsion should be defined as applicable, based on a restricted- or an unrestricted operation. See DNV-OS-H101, Sec.3.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 300 Temporary mooring

301 For classed units it should be documented that the class required temporary mooring equipment will be operable during transit.

Guidance note:

Temporary mooring should not be considered as a safe condition where the unit can sustain unrestricted environmental loads.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

302 Non-class units should have at least one operable anchor during transit. The anchor(s) is to be of sufficient capacity and with sufficient line length for temporary mooring.

Guidance note 1:

The applicable DNV class requirements to a similar type of unit should be used as guidance. Tow route including water depths are to be taken into consideration. See also DNV-OS-H202.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

The lack of an operable mooring system may be compensated by additional tug capacity, after evaluation of characteristics of the unit, towing route and season.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C. Tug Assisted Transit Operations

C 100 Application

101 This section is applicable both for tug assisted transit operations also utilizing the unit's own thrust capacity, and for towing operation without contribution from the unit.

C 200 Towing vessel and equipment

201 General requirements for towing vessels, towed unit and towing equipment are given in DNV-OS-H202.

202 Requirements for the capacity of towing bridle and towing brackets are given in DNV-OS-H202.

Guidance note 1:

Note that for some mobile offshore units these requirements may be in excess of what is required by its class.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

If the tug has considerably more bollard pull than required, the strength requirement to the towing arrangements including the brackets on the towed unit/vessel can be reduced to comply only with the minimum bollard pull required. In such cases a restriction on maximum bollard pull to be exercised by the tug should be given in the towing procedure, see Sec.2 A305.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 If the unit's anchor chain (or wire rope) is used for towing the following should be documented:

— Acceptable fairlead angles are obtained for all possible towline directions.
— Adequate strength and reliability of locking of chain/wire rope.
— Flounder plate design and connections.

C 300 Required thrust and bollard pull

301 The total propulsion force, i.e. the combined unit/vessel thrust and the tug(s) bollard pull, shall fulfil the requirements in B201 and B202.

302 Bollard pull efficiencies for tugs and the reduced efficiency due to combined thrust sources shall be accounted for with reduction factors as given in DNV-OS-H202.

C 400 Temporary mooring

401 Temporary mooring shall comply with requirements in B300.

D. Operational Aspects

D 100 General

101 General requirements to operational aspects of transit operations are given in DNV-OS-H101, Sec.4.

102 The operation shall be carried out with due consideration to identified risks and prescribed risk mitigations. See Sec.2 A400.

103 Any draught restrictions should be adhered to in due time in case of deteriorating weather conditions.

104 If relevant, area(s) with sufficient sea room (or shelter) for safe holding of the unit should be described in the operation manual/procedure.

D 200 Towing

201 Requirements to operational aspects of towing operations are given in DNV-OS-H202.

D 300 Emergency jack up

301 The criteria regarding actual and forecasted environmental conditions, for leaving and entering safe jack-up locations, see Sec.6 B500, shall be clearly stated in the operation manual/procedures.

302 Acceptable weather windows for leaving a safe condition shall consider all phases of the operation and include ample contingency time for delay caused by e.g. leg extraction problems, waiting for slack water, breakdown or reduced towing/transit speed.

Guidance note:

For "wet tow" of self-elevating units the environmental criteria for setting are often stricter than the criteria for towing, i.e. the criteria for setting should govern the decision for leaving a safe condition.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 It is recommended that the emergency response procedure includes situations where jacking-up at other locations than the pre-defined safe jack-up locations could be required.

Guidance note:

Such situations may occur if insufficient time remains to reach a safe jack-up location before the anticipated onset of adverse weather and where the risk of remaining afloat is deemed to be greater than the risk of elevating on a location with an unproven jack-up foundation.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 4
ANCHORED UNITS

A. General

A 100 Application

101 This section is applicable for positioning (see Sec.1 A101 Guidance Note) of anchored units.

102 The anchoring system could be established during the positioning, or the unit could be connected to a pre-laid mooring system.

A 200 Definition of design conditions

201 All anchoring operations are normally considered to be weather restricted. Hence, it should be documented that the positioning operation including adequate contingency time will be completed, see 202, or a "temporary" safe condition will be reached within a defined weather window.

Guidance note:

A "temporary" safe condition can be considered reached when the unit can sustain the seasonal unrestricted environmental loads according to the operation reference period (T_R), see DNV-OS-H101, Sec.3 for guidance. T_R should be taken as the planned period in the temporary safe condition added appropriate contingency, see DNV-OS-H101, Sec.4.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 When the positioning is completed the unit is regarded to be in a normal operating condition and the design conditions shall then comply with the relevant classification requirements, national maritime regulations, or equivalent.

203 See B500 for applicable design conditions for weather restricted moorings (e.g. lifting by crane vessel).

A 300 Planning and documentation

301 See Sec.2 A for general requirements to planning and documentation.

302 It shall be thoroughly checked that the applied field charts are updated and include all sub-sea items with their "as installed" position.

303 In due time prior to a positioning operation the following information should, as relevant, be presented:

a) Design documentation, see Sec.2 A302.

b) Other surface or sub-sea operations on-going in the area.

c) Coordinates of the new location and planned position and heading of the unit.

d) Water depth, preferably chart showing depth curves with equidistance not exceeding 5 metres, LAT, MWL and HAT and the storm surge at the specified location.

e) Position of all floating and/or fixed structures within 5 nautical miles off the specified location.

f) Position of obstructions on the seabed. (Wellheads, debris, etc.)

g) Position of pipelines and their protection, i.e. buried, rock dumped or no protection.

h) Detailed description of seabed topography and soil stratigraphy for prediction of anticipated penetration and/or anchor holding power. The description shall contain information on rock outcrops, pockmarks, ice-plough marks, soil classification properties and depth boundaries of each soil layer.

i) Detailed chart(s) showing the exact position of each unit (including stand-off positions when applicable), the position of each anchor, anchor pattern including any associated equipment, obstructions and sub-sea assets and associated exclusion zones.

j) Available experience from previous positioning operations in the area.

k) Anchor holding power verification procedure, including minimum installation tension of drag-installed anchors, as assumed in the anchor design calculations.

l) Positioning procedure detailed plan for the operation including data for the attending vessels, number of positioning anchors to be used, calculated clearances to assets etc.

A 400 Planning meetings

401 Planning meeting(s) shall be arranged as required by the relevant Governmental authority and/or Company.

402 Normally an anchor handling meeting, with participants from all involved vessels, should be arranged as a part of the risk management process. The agenda should include a detailed review/discussion of at least the following items:

— overall planning, see Sec.2 A202
— risk assessments to identify critical conditions of the anchoring procedure
— interaction with the anchor handling vessel
— sea bed conditions
— sub-sea structures and pipelines
— required clearances
— required testing
— required inspection (before, during and after anchor/mooring installation).

403 Communication between the offshore unit and the others involved shall be planned and the operation shall be preceded by a joint start-up meeting.

A 500 Design evaluations

501 See Sec.2 B for general requirements to design evaluations.

502 The positioning keeping system should have adequate capacity during all relevant phases of the positioning.

Guidance note:

All forces which may arise on the unit, anchor handling vessel or anchoring equipment, including environmental loads such as wind, waves and currents should be considered.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

503 Possible design limitations, as e.g. maximum line twist and bending, shall be identified any duly considered during the mooring installation.

504 Control and monitoring systems shall be established as required to ensure that design limitations are not exceeded during installation and that the mooring system has been installed according to the design assumptions.

B. Mooring Systems

B 100 General

101 This chapter gives requirements to design, installation and testing of mooring systems with anchors. The systems could be with or without thruster assistance.

102 The following types of offshore mooring systems are referred to in this chapter:

— long term (permanent) mooring systems
— mobile mooring systems
— thruster assisted mooring systems
— weather restricted mooring systems.

103 Requirements to inshore mooring systems are given in DNV-OS-H101, Sec.6 B.

B 200 Design requirements

201 The mooring design lay-out shall comply with the requirements to clearances in Sub-section C.

202 Design requirements to mooring system strength and testing are given in B300, B400 and B500.

Guidance note 1:

See Table 4-1 for a summary of requirements to drag installed anchors.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

See DNV-OS-E302, DNV-OS-E303 and DNV-OS-E304 for DNV's classification requirements to offshore mooring chains, fibre ropes and steel wire ropes.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 All design assumptions related to operation of the unit shall be clearly identified.

Guidance note:

Such assumptions are normally related to:

— limiting environmental conditions (e.g. the most extreme weather the rig can operate in without disconnecting from the drill riser)
— obtainable anchor test loads (see e.g. 503)
— adjustment of line tensions
— adequate clearances
— use of thrusters
— survival or operational draft
— stand-off positions
— moored cargo barges alongside the unit (applicable for offshore installation vessels)
— maximum offset (e.g. due to riser angle).

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

204 During normal operation the offshore unit shall have reliable equipment with sufficient accuracy for continuous measurement and display of line lengths out of the winch and line tension.

205 Sufficient length (normally minimum 100 meters) of classed chain or wire should be available for moving from work position to stand-off position.

B 300 Long term mooring systems

301 Long term (permanent) moorings are normally applicable for production (and storage) units.

302 The design and testing of long term mooring systems shall comply with a recognized code, such as DNV-OS-E301, ISO 19901-7 or API RP 2SK.

Guidance note 1:

Guidance for verification of the anchor resistance after installation for permanent moorings is given in DNV-RP-E301 and DNV-RP-E302, as relevant. For long term mooring national governmental regulations may also be applicable for the design and testing of the mooring system.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

For thruster assisted mooring systems testing of the thruster systems should be carried out as agreed in each case. Any national and/or Class requirements should be considered.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B 400 Mobile mooring systems

401 Mobile moorings systems are used at several locations throughout the lifetime of the unit. The stay at each location could vary from a few days up to 5 years. The system could be modified for each location.

Guidance note:

The distinction between mobile and permanent moorings may not be clear for operations with design lives of a few years. See API RP 2SK for further guidance.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 In general, the mobile mooring system for offshore units shall comply with national governmental regulations and/or the requirements of their classification society.

403 Testing of anchor holding shall be carried out according to the applied design code and/or national governmental regulations. See also 302, Guidance note 2.

404 The resistance of pre-set, drag-installed anchors planned to be used several times should normally be verified as for a permanent mooring system. See 302.

B 500 Weather restricted mooring systems

501 The characteristic environmental condition for a weather restricted mooring could be defined according to DNV-OS-H101 Sec.4 B500. See also Sec.2 B203.

Guidance note:

Due to operational limitations (e.g. due to required clearances) the lay-out of a weather restricted mooring system normally differs from the standard mooring pattern for the unit.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

502 Analyses, safety factors and operational limitations for weather restricted mooring systems should comply with DNV-OS-H101 Sec.4 and Sec.6 B.

503 The resistance of drag installed anchors shall be verified by applying a mooring test load to the anchor, which is 1.25 times the maximum characteristic line tension for an intact mooring system. The tension shall be maintained for at least 15 minutes without dragging of the anchor to ensure that sufficient anchor resistance has been reached.

Guidance note 1:

If a theoretical verification of the anchor resistance has been carried out, e.g. based on DNV-RP-E301, the test load should be taken according to the applied code.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

A reduced test load could be found acceptable at locations where anchor dragging is not considered critical to adjacent installations, human life or the environment. At these locations adequate anchor resistance may be verified by applying a mooring test load that previous experience at the location has proved sufficient in the maximum characteristic environmental condition.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

504 It shall be ensured that any reduced test load according to 503 Guidance Note 2 is adequate to obtain sufficient tension to prove that the anchor has dug in properly.

Guidance note:

Line catenary calculations should be presented to document the above. It may also be required to inspect the anchors with ROV after installation. This, in order to make sure that they are fully penetrated and have the correct orientation relative to seabed so they can further penetrate into the soil and gain more resistance if needed.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

505 Limiting weather conditions and other operational restrictions for operation close to a fixed or floating platform shall be clearly identified. See also 203.

Guidance note:

E.g. if operating in the vicinity of other facilities it should be ensured that the maximum anchor line tension does not exceed 0.8 times the anchor test load reached. ALS conditions should be assessed, see also DNV-OS-H101 Sec.6 B.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Table 4-1 - Verification of resistance of drag-installed anchors – Summary

	Mooring category		
	1 *Long-term or permanent mooring*	*2* *Mobile mooring*	*3* *Weather restricted mooring*
Mooring period, P	P > 5 years	P < 5 years	P = Operation reference period (T_R)
Typical unit involved	Production/storage unit or loading buoy	Drilling unit and accommodation unit.	Installation vessel, SSCV
Theoretical verification of anchor resistance	As required by national governmental regulations, or as given in: DNV-OS-E301, DNV-RP-E301 and DNV-RP-E302, or equivalent recognised code/standard.		Calculations normally not required. See 503 and 504.
Minimum test load and procedure for verification (testing) of anchor resistance as installed on actual location	As approved in the anchor design. Any applicable national governmental regulations to be considered.		*1.25 times* the maximum calculated line tension.
Maximum test load	Chain cable: Maximum of chain proof load and 0.66 MBL Steel wire or fibre rope: 0.66 MBL		
Minimum time for final test load	15 minutes		

C. Clearances

C 100 General

101 This sub-section gives requirements for minimum clearances that shall be ensured at all times between units, pipelines/sub-sea structures, cables and mooring elements during positioning and normal operation.

Guidance note:

The field operator (Company) may specify more strict requirements for clearance than given herein. Also, national authorities may have other clearance requirements, in particular for floating production units.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 The clearance in ALS should be taken as the minimum distance during transient motion after breaking any one anchor line or loss of any one thruster system.

Guidance note 1:

For certain combinations of operations and mooring consequence classes other clearances and ALS cases are applicable. See DNV-OS-E301 Ch.2 Sec.2 D for guidance.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

For a mobile offshore unit in drilling mode or moored close to a fixed structure with gangway connection, the actual operation (e.g. drilling or accommodation) should normally be suspended and the unit brought to a survival condition when the anchor line tension reaches 0.8 times the tested anchor line tension.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

103 During positioning of a floating unit the clearance should at all times duly reflect the actual stage in the anchor operation. The minimum clearance indicated in Tables 4-2 and 4-3 should be maintained until all anchors are tested.

Guidance note:

The indicated clearance during positioning relates to that the operation is carried out without any uncontrolled line slackening. However, possible line slackening (failures) e.g. due to winch problems or line/anchor failures (during testing), should be considered in the continuous evaluation of required clearance. It should whenever possible be avoided to run the anchor line directly above structures or unburied pipelines. Maximum horizontal distance should be maintained.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

104 Maximum motions due to the design environmental conditions during the operation shall be considered in order to establish sufficient clearance.

105 If any aspects are reducing the normal reliability of the units positioning systems, and/or are increasing the normally expected consequences of contact, the clearances given in the sub-section should be re-assessed.

106 For water depths less than 60 meters, less severe mooring line clearance requirements than given in this section may be accepted, after thorough consideration of anchoring arrangement and consequences of failures or erroneous operations.

C 200 Synthetic fibre rope lines

201 For mooring systems using synthetic fibre rope anchor lines, the clearances are to be assessed on a case-to-case basis. The minimum clearances required will depend upon the geometry of the mooring system during variation of environmental loads and the consequences of contact between anchor lines and pipelines/structures.

Guidance note:

The specified minimum clearances between anchor lines and pipelines/structures given in this sub-section are for chain cable and steel wire rope anchor lines.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 Contact with the seabed shall be avoided both during installation and operation for synthetic fibre rope lines unless the fibre ropes have been certified for such contact. The procedure for handling and installation stated on the certificate shall be followed.

Guidance note:

See DNV-OS-E301, Sub-section 4J for further guidelines. Sea bed contact is never allowed during cyclic loading according to DNV-OS-E303.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 300 Clearances for weather restricted operations

301 This paragraph applies for situations where a unit needs to approach another unit in a defined weather window as a part of the normal operation. This may typically be an offshore lifting operation.

302 For weather restricted operations the clearance requirements should be agreed case by case upon thorough consideration of:

— operational procedures
— duration of the operation
— environmental conditions (in particular wind, wave direction and visibility)
— available back-up systems such as thrusters, connected tug(s)
— fender systems etc.
— consequences of unintended contact.

Guidance note:

The following minimum clearances normally apply:

— Between units: As indicated in Table 4-2.
— Between line and line/unit/pipeline/structure: 50% of the values indicated in Table 4-3.
— Between anchor and pipeline/structure: As indicated in Table 4-3.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 400 Clearances between units

401 Minimum horizontal clearances between the actual unit and adjacent fixed structures or other floating units that shall be maintained are indicated in Table 4-2.

402 The horizontal minimum clearances shall be maintained for all possible relative vertical positions, including motions, between the units.

C 500 Anchor line clearances

501 Minimum clearances between chain and wire rope anchor lines and units, structures, pipelines and other lines are indicated in Table 4-3.

Guidance note:

Buoys may be attached along the anchor lines during installation and operation in order to ensure sufficient vertical clearance to sub-sea structures and pipelines.

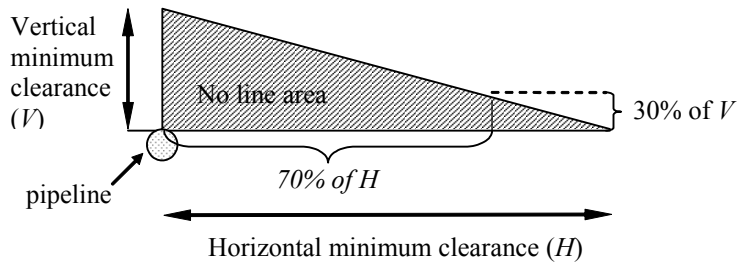
---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

502 The minimum clearances between lines and platforms (units) are in any direction, i.e.

$$\sqrt{Vertical_clearance^2 + Horizontal_clearance^2} \geq \text{minimum clearance.}$$

503 Between lines and pipelines linear relationship between vertical and horizontal clearances should be assumed. E.g. if the horizontal clearance is 70% of the required minimum clearance the vertical clearance should be ≥ 30% of the minimum vertical clearance corresponding to zero horizontal clearance. See Figure 4-1.

Figure 4-1 Combined clearances



504 In case of cross anchoring of two or more units the documentation of the anchor pattern shall include catenary plans for all anchor lines.

505 In one line broken conditions, contact between steel wire rope (or chain and steel wire rope) anchor lines shall not take place, while contact between chain cable anchor lines is accepted.

506 In the one line broken condition contact may be accepted between anchor lines and "cold" structures based on a case-by-case evaluation.

507 In the one line broken condition bottom contact at buried pipelines is normally acceptable. However, type of mooring line, documented quality of burying and anticipated duration of line bottom contact should be considered.

508 Required clearances to the tendons of TLPs should be assessed for each case, but the indicated clearances between the lines of two units in Table 4-3 may be used as guidance.

509 For a protected (e.g. by a trawl protection structure) sub-sea structure the same clearance requirements as for a protected pipeline may be found acceptable based on an evaluation of the strength and functionality of the protection structure.

C 600 Anchor clearances

601 Minimum clearance between anchors and pipelines/sub-sea structures are given in Table 4-3.

Guidance note:

The minimum anchor clearances to seabed structures given are for drag-installed anchors. For other anchor types without significant drag, less clearance may be accepted.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

602 If considerable anchor dragging is experienced at a location the minimum clearance should be increased accordingly.

603 50 meters minimum clearance is acceptable if the anchor drag sector is away from the structure. Ability for accurate positioning, e.g. by ROV control during installation, of the anchor shall be documented.

Table 4-2 - Minimum clearances between units

Units/structures involved	*Text references[1)]*	*Clearance during positioning*		*Clearance in normal operation*	
		Vertical	*Horizontal*	*Vertical*	*Horizontal*
Floating and fixed units, or two floating units		See 402	50 m	See 402	ALS: 10 m
Floating and fixed units, or two floating units, weather restricted operations	C300		50 m		ULS: 5 m ALS: 3 m

[1)] See C100 for general requirements in addition to the indicated text references.

Table 4-3 - Minimum clearances between lines[2)]/anchors and platforms/pipelines[3)]/risers/structures

Units/structures and mooring elements involved	*Text references[1)]*	*Clearance during positioning*		*Clearance in normal operation*	
		Vertical	*Horizontal*	*Vertical*	*Horizontal*
Line and a “hot” unit	502	30 m		ULS: 10 m ALS: No contact	
Line and a “cold” unit	502 & 506	10 m		ULS: 5 m ALS: See 506	
Line and a “hot” riser		Infinite, i.e. no crossing	150 m	Infinite, i.e. no crossing	ULS: 100 m ALS: 30 m
Line and unprotected pipeline[3)]	503	30 m	150 m	ULS: 20 m ALS: No contact	ULS: 100 m ALS: No contact
Line and protected pipeline[3)]	503 & 507	10 m	50 m	ULS: 10 m ALS: See text	ULS: 50 m ALS: See text
Line and sub-sea structure	509	Infinite, i.e. no crossing	150 m	Infinite, i.e. no crossing	ULS: 100 m ALS: 50 m
Lines of two or more units	505 & 508	20 m	-	ULS: 10 m ALS: See text	-
Anchor and pipeline[3)] (line crossing pipeline)	602 & 603	See D.103 & D.104	250 m	-	250 m
Anchor and pipeline[3)] (line not crossing pipeline)			150/50 m	-	150/50 m
Anchor and sub-sea structure			300/50 m	-	300/50 m

[1)] See C100 for general requirements in addition to the indicated text references.
[2)] This table applies for chain and wire rope anchor lines. See C200 for requirements to synthetic fibre rope lines.
[3)]This means any kind of pipes/cables as umbilical’s, heating and electrical cables, which could be damaged.

D. Installation of Anchors

D 100 General

101 An anchor handling/installation procedure documenting safe working conditions should be presented.

102 Requirements to subsea lifting of anchors are given in DNV-OS-H206.

103 The anchor handling/installation procedure shall address how the minimum required clearance between anchors/anchor lines and sub-sea installations are achieved and maintained during the installation operation. See C500 and C600.

104 Handling and transfer of anchors shall not take place above (unburied) pipelines and sub-sea installations.

Guidance note:

"Handling and transfer of anchors" in this connection means anchors suspended over the stern or side of an anchor installation vessel. "Above" the sub-sea structure means inside a surface sector defined by ± 20 degrees from the vertical. In circumstances where anchors cannot be stowed on deck, the anchors should be redundant secured. The redundant securing arrangement should be detailed in the anchor handling procedure.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 200 Drag installed anchors

201 Anchors shall be installed by suitable anchor-handling vessel.

Guidance note:

The anchor handling vessel should have adequate winches size, sufficient intact and damage stability (see e.g. DNV Ship Rules Pt.5 Ch.7 Sec.12 E), and sufficient bollard pull capacity in combination with any heading requirement for the intended operation.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 If sufficient resistance is not obtained with a single anchor on a mooring line due to unexpected soil conditions on the location, "piggy back" anchor(s) may be applied. Documentation of arrangement, strength and operation procedure for installation and testing of "piggy back" anchors are to be presented.

Guidance note:

It should be considered that not all anchors are suitable to piggy back as force from the 2nd anchor may close the fluke on the first anchor.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 300 Other anchor types

301 This paragraph covers installation of anchors usually used for permanent or long-term mooring of floating structures, such as pile anchors, plate anchors, suction anchors and gravity anchors.

302 The anchors are to be installed within the tolerances given in the design documentation.

303 It shall be ensured that the installation manual addresses the following items properly (see also Sec.2 A305):

— Transport of the anchors, including seafastening.
— All governing installation tolerances, including position, orientation, verticality, twist, snaking, line corridor etc.
— Procedure for reversing the installation of any anchor not installed within acceptable tolerances.
— Procedure for tensioning and lay down of the anchor lines after installation of the anchors.
— Procedure for inspection of anchors and anchor lines after installation, including acceptance criteria.

E. Connection to Pre-laid Mooring

E 100 General

101 This sub-section gives requirements to connection of offshore units, such as FPSOs, FPSSs and spar platforms, to a pre-laid mooring system.

102 Operational aspects are covered in sub-section F.

E 200 Planning and schedule

201 The planning shall be made with due consideration to a realistic operation schedule, including contingency time.

202 See A300 for general requirements to planning and documentation.

E 300 Design evaluations

301 General requirements to design evaluations are given in A500.

302 Minimum number of lines to be connected in order to reach a temporary safe condition, see A201 Guidance note, shall be documented by mooring analysis.

303 The design calculations/evaluations should at least include the following:

— pre-fitting of forerunners, messengers and temporary platforms
— removal of transit securing arrangements (e.g. seafastening of fairleads)
— recovery of pre-laid lines
— design details regarding the connection to pre-laid lines
— any temporary structures
— tugs and station keeping configuration
— station keeping tolerances
— line forces during connection
— line tension, heading control and monitoring requirements
— tensioning equipment
— other equipment on unit
— other involved vessels and equipment
— connection sequence including alternatives,
— validation of position (tolerances, etc.)
— contingency measures.

E 400 Testing

401 When the resistance of drag installed anchors for mobile and weather restricted mooring have been tested according to B403/B503 during pre-laying operation, the tension applied after connecting the pre-laid mooring system to the floating unit may be reduced to a tension ensuring any snaking in mooring lines are straightened out.

402 Winches or other critical means used for mooring line pull-in should be commissioned according to approved procedures. See DNV-OS-H101, Sec.4 F.

Guidance note:

Normally the winch commissioning should include dynamic load testing with 110% of the maximum expected load during operation. Testing should be carried out using the same wire rope layer(s) that will be in use with maximum expected load.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

F. Operational Aspects

F 100 General

101 General requirements to operational aspects of marine operations are given in DNV-OS-H101, Sec.4.

102 The operation shall be carried out with due consideration to identified risks and prescribed risk mitigations. See Sec.2 A400.

103 All mooring operations should be carried out according to the operation manual for the unit. See also Sec.1 A.

104 All design assumptions and imposed limitations, see e.g. B203, should be duly considered.

F 200 Anchor installation

201 The anchor installation should be carried out according to approved procedures. See also sub-section D.

202 Anchor handling vessels shall be equipped with a surface positioning system of sufficient accuracy for anchor drops. See DNV-OS-F101 Sec.10 C701.

Guidance note:

Maximum deviation of anchor position is normally +/- 5° from the intended bearing and -50 m (maximum 3% of line length) and +100 m from the intended distance.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

203 During anchor running, attention shall be paid to the catenary of the anchor line, to maintain minimum clearance. See Sub-section C.

204 During testing of moorings the line tension for chain cable shall neither exceed the proof load of the chain nor 0.66 times the MBL of the chain.

205 For steel wire- and fibre rope anchor lines the mooring test load shall not exceed 0.66 times the MBL of the rope.

SECTION 5
DYNAMICALLY POSITIONED UNITS

A. General

A 100 Application

101 This section is applicable for positioning and station keeping of DP vessels.

Guidance note:
Note that further (operation) guidance to dynamic position systems is given in DNV-RP-E307.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 200 Definition of design conditions

201 The applicable design conditions (i.e. ULS, ALS, FLS, and SLS) and other main design assumptions for the DP operations shall be clearly defined.

202 The characteristic environmental conditions for the defined design conditions should be specified, see DNV-OS-H101, Sec.3 for guidance.

A 300 Planning and documentation

301 See Sec.2 A for general requirements to planning and documentation.

302 In due time prior to a positioning operation the following information shall, as relevant, be presented:

a) Items listed in Sec.4 A303.

b) Specification of the means and points of reference.

A 400 Design evaluations

401 See Sec.2 B for general requirements to design documentation.

402 The capacity of the DP system shall be documented for all design conditions to ensure compliance with the motion envelopes set for the actual operation.

403 Additional wind load on installation vessels due to objects on deck and crane operation should be considered in DP capability analysis/charts.

404 If the available vessel thrust is partly needed in one specific direction, e.g. to keep necessary tension during pipe laying, this shall be considered in DP capability analysis and charts.

405 For vessels operating with heading restrictions or with a fixed heading the DP capacity for all wind, wave and current directions shall be documented.

406 Possible effects due to varying external loads on vessel from e.g. mooring lines should be duly considered.

407 For DP operations requiring DP equipment class 2 and 3, see B100, the capacity should be documented considering the worst single failure. See also B400.

B. Dynamic Positioning

B 100 DP equipment class

101 The DP operation procedure shall address the DP equipment class required for the operation. Table 5-1 gives guidelines to DP equipment class for different operations. If the guidance in Table 5-1 is not followed this shall be justified. See also 102 and 103.

Guidance note:

For a description of the equipment classes in Table 5-1, see Sec.1 C201 and IMO/MSC Circular 645, Chapter 2.

Table 5-1 DP equipment class selection	
ACTIVITY	*CLASS*
a) Manned underwater operations where loss of position entails a high risk for divers or diver platforms.	3
b) Other manned underwater operations where loss of position entails risk for divers or diver platforms.	2
c) Support vessels for manned underwater operations conducted from work boats where loss of position for the support vessel has direct consequences for the work boat.	2
d) Drilling and well activities where well control is handled by a DP facility	3
e) Facilities that produce hydrocarbons	3
f) Flotels with gangway connected Two reference systems may be accepted for arrival and departure.	3
g) All activities within the safety zone Two reference systems may be accepted for arrival and departure. The need for relative position reference system(s) shall be evaluated considering the facilities displacements and the minimum clearance to the facility.	2
h) Activities with limited clearance to the facility where the vessel represents a risk to the facility The requirement applies if the vessel exceeds the vessel size the facility is designed for with regard to withstanding a collision and is working with a limited clearance to facility. Two reference systems may be accepted for arrival and departure. The need for relative position reference system(s) shall be evaluated considering the facilities displacements and the minimum clearance to the facility.	3
i) Loading operations from FSUs and FPSOs The requirement applies to the tank vessel	2
j) Loading operations from buoys (quick release available)	1
k) Other well activities The requirement applies to well maintenance facilities if well control is handled by another facility	2
l) Shallow drilling if one does not expect to encounter hydrocarbons and emergency disconnect is feasible in case of drift-off.	1
Notes to the table 1) For dynamic positioning, consideration should be given to the reference systems' limitations as regards reliability, accessibility and quality. 2) High risk as mentioned in a), means the cases when the diver does not have an unrestricted return to the diving bell, or where loss of the vessel's position can lead to loss of or damage to the diving bell, and possibly the associated bottom weight. 3) The requirement to equipment class 3 as mentioned in d), does not apply to all drilling and well activities. For shallow drilling, other requirements in the table may be relevant, such as the requirements in h), l) and emergency disconnect response time. Well activities that require equipment class 3 are e.g. well intervention including wire line operations. Other well activities as mentioned in k) may be well stimulations and unmanned underwater operations, including the use of remote-controlled sub-sea vessels or sub-sea tools.	

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 Required equipment class for DP operations not stated in Table 5-1 should be decided based on a thorough evaluation of operational risks.

103 Vessels with lower equipment classes than required as of Table 5-1 may be accepted on a case by case basis. Elements to be evaluated with regard to acceptance of lower equipment classes are:

— time needed to safely abandon DP operation
— weather conditions
— possibility of operating with open waters on leeward side
— availability of reliable position reference systems
— crew experience with the vessel
— other operational and technical means of reducing risk and/or consequence of DP failures.

B 200 Field arrival

201 Prior to commencement of DP operations, the DP system shall be adequately set up with position reference systems, and thoroughly tested with regard to equipment functionality and system redundancy. The set-up of systems are normally dictated by the premise for failure as stated in the DP FMEA.

202 Engine room and switchboards shall be configured to fulfil the level of redundancy and safety required by the defined DP equipment class.

203 A vessel specific "Field Arrival Checklist" ensuring that the DP setup and equipment function is according to the DP class requirement shall be prepared, and executed upon arrival at field or work site.

204 If the vessel frequently leaves and re-enters the field (or work site), a less extensive "Field re-entry Checklist" may be accepted. The field re-entry checklist shall include verification of system set-up and equipment functionality.

B 300 Complex and close proximity DP operations

301 For complex and close proximity DP operations involving one or more DP vessels, a DP operation procedure shall be presented.

302 Position reference systems shall be selected based on a functional requirement of the operation.

Guidance note:

Between two mobile vessels a mixture between absolute and relative reference systems needs special considerations as this may impact vessels station keeping abilities due to diverging positioning from the systems.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 The DP procedure shall as a minimum include:

— A description of the work that is planned performed.
— Weather criteria (force and direction).
— Minimum distances between vessels.
— Pre-operation DP testing requirements. Foot print testing should be included if found relevant based on the required station keeping accuracy.
— Reference systems setup, including evaluation of possible shadow effects on aerials and thrust interference on hydro-acoustic transducers.
— Engine room and switchboards configuration.
— Communication procedures, internally and between vessels.
— Copy of HAZOP/risk analysis findings and risk reducing measures.
— Training/competence level of key DP personnel.

B 400 Contingencies

401 DP operations requiring equipment class 2 or 3 shall be restricted (planned) based on power/thrust availability after worst single failure.

Guidance note:

The worst single failure concept is further described in DNV Ship Rules Pt.6 Ch.7- Dynamic Positioning Systems, and in IMO MSC/Circ. 645.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 Complex DP operations will require location- or operation specific contingency instructions.

403 The DP operator(s) should be familiar with the contingency plans.

404 If relevant the DP manning should be increased in order to minimize the risk of/in contingency situations.

405 Key elements of the contingency planning should be posted in the vicinity of the DP operator station, so that situation specific required actions are immediately available to the DP operator.

B 500 Annual DP trial

501 In addition to class related surveys, an annual DP trial is recommended.

Guidance note:

Operator and/or Oil Company may have a mandatory requirement to annual DP trial.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

502 The annual DP trial should be carried out within three months before or after the anniversary date of the initial DP trial.

503 The annual DP trial should ensure (and document) that the DP-system has been maintained in accordance with applicable parts of the IMO MSC/Circ. 645 guidelines and is in good working order.

504 Annual DP trial should include testing of all important systems and components. The ability of the DP-vessel to keep position and heading after single failures associated with the assigned equipment class should be included in the test program.

B 600 Checklists

601 The following checklists, test procedures and instructions should be incorporated into the DP operating manuals for the vessel:

— field arrival checklist, see 203

— field re-entry checklist, see 204
— watch keeping / watch handover checklist
— engine control room (ECR) checklists
— DP-operation instructions / procedures
— operation specific guidelines, see 303 and 402
— annual DP trial procedures, see B500.

C. Operational Aspects

C 100 General

101 General requirements to operational aspects of marine operations are given in DNV-OS-H101, Sec.4. Also see guidance to DP operations in DNV-RP-E307 "Dynamic Positioning Systems - Operation Guidance".

102 The operation shall be carried out with due consideration to identified risks and prescribed risk mitigations. See Sec.2 A400.

103 All operations should be carried out according to the (DP) operation manual(s) for the unit. See also Sec.1 A.

104 Design evaluations, see A400, and operational limitations imposed by these shall be duly considered.

Guidance note:

Where loss of position is not accepted for any single failure, the DP should run a consequence analysis program ensuring the position keeping capability for the predefined worst failure is not exceeded. The design limitations in DP capability analysis / operation analysis should be adhered to in order to avoid this alarm to trigger.

Consequence analysis: A monitoring function in the DP control system that issue an alarm if the vessel (in its current operating mode) in the current weather conditions would not be able to keep the heading and position in the case that any of the predefined worst case failures should occur.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

105 The relevant checklists, see B600, should be filled in and made available for Company and/or MWS (3rd party) review.

Guidance note:

It is recommended that MWS, if on-board, are present during testing/filling in of check lists.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 200 Clearances

201 Minimum clearance between vessels and structures during DP operations shall be based on a thorough consideration of operational risks and limitations, vessel equipment, weather conditions/limitations, position reference systems accuracy (absolute/ relative positioning) and reliability.

Guidance note:

It is recommended that minimum distance between vessels and vessel/ structures should not be set less than 20 metres.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 6
SELF-ELEVATING UNITS

A. General

A 100 Application

101 This section is applicable for positioning of a self-elevating unit which is defined as the activities necessary for jacking the unit up to a safe condition at a new location.

102 The requirements in this section should, as applicable, also be considered for jacking down from a safe position to a floating condition.

103 The requirements to transit of self-elevating units are given in Sec.3.

A 200 Definition of design conditions

201 The applicable design conditions (i.e. ULS, ALS, FLS, and SLS) and other main design assumptions for the positioning operation shall be clearly defined.

202 The characteristic environmental conditions for the defined design conditions should be specified, see DNV-OS-H101, Sec.3 for guidance.

A 300 Planning and documentation

301 See Sec.2 A for general requirements to planning and documentation.

302 In due time prior to a positioning operation the information listed in Sec.4 A303 shall, as relevant, be presented.

303 For site assessment and evaluation of the foundation behaviour of a self-elevating unit, adequate geotechnical and geophysical information shall be available, including information about:

— seafloor topography and sea bottom features
— soil stratification and classification
— characteristics for soil in various strata
— spud can geometry and dimensions
— spud can jetting system
— jacking system description and limitations
— maximum spud can penetration.

Guidance note:

For further recommendations regarding methods and extent of soil investigations, reference is made to DNV CN 30.4.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B. Positioning of Self-elevating Units

B 100 Design evaluations

101 See for general requirements to design documentation.

102 The structural strength, air gap and overturning stability on the seabed of the self-elevating unit shall comply with the requirements of DNV-OS-C104, or equivalent.

Guidance note:

DNV classification requirements can be found in DNV-OSS-101 and DNV-OSS-102.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

103 Prior to commencing the installation of a self-elevating unit at any location, the anticipated foundation behaviour of the unit during all phases from installation to removal shall be thoroughly considered.

104 The penetration depths of the individual leg foundations (spudcans) shall be calculated. Calculations can be based on bearing capacity formula. A range for possible penetration shall be worked out. It shall be checked that required hull air gap can be obtained when maximum penetration of spud can occurs. See also C401.

Guidance note:

Acceptable criteria for soil conditions and methods for analysis of foundation behaviour can be found DNV CN 30.4.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

105 The possibility for punch-through and the corresponding maximum punch-through distance shall be evaluated. It shall be demonstrated that the self-elevating unit can withstand such punch-through

displacements. The change in both overturning moment and resisting moment due to increase in penetration of any one leg shall be taken into account.

B 200 Jacking operations

201 Jacking operations shall be performed within the limitations given in the operation manual.

B 300 Testing

301 As a part of the installation procedure, the unit shall be pre-loaded in such a manner that the required in-place capacity is documented for each leg.

Guidance note:

Guidance on how to calculate pre-load capacity and required pre-loading is given in DNV-OS-C104, Sec.8 B and in CN 30.4.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

302 The maximum loads shall be determined for the most unfavourable combination of environmental and functional loads in survival and operating conditions. Full pre-load shall be maintained for minimum 1 hour after the penetration has stopped.

B 400 Soil surveys

401 The survey documentation shall include bathymetric mapping and a shallow seismic survey for the location, which can be tied back to nearby existing soil boring(s) to assist in the assessment of the soil stratigraphy.

402 The seismic survey shall be of good quality using equipment which can trace the shallow layering and detect possible presence of buried erosion channels within the depth of interest, normally down to 50 m below seabed.

403 The seismic surveys, the soil borings and the interpretation of the corresponding soil conditions for the actual location shall be documented.

B 500 Safe jack-up locations

501 Maximum distance between the safe jack-up locations should be such that the time needed to suspend operations and to reach the nearest safe haven or safe elevated location and to complete positioning shall be less than the allowed maximum planed time for these activities.

Guidance note:

The NMD regulations concerning field moves for Norwegian flagged offshore units require that the planned operation time between the emergency jack-up locations should not exceed 24 hours. This 24 hours period covers jacking down to floating condition, towing and jacking up to sufficient air gap to avoid wave impacts on the hull at the new location. See also Sec.3 D302.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

502 For defined safe jack-up locations it shall be documented, see Sec.1 A, that the soil conditions are such that the jack-up will not experience sudden significant penetration of the spudcans during the jacking process or during the stay at the location in elevated position.

Guidance note:

The documentation should clearly show that the locations consist of soils which have sufficient strength to exclude the possibility of foundation punch-through. Dense sands and stiff clays to an adequate depth fulfil the above requirement.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

503 Soil conditions with soft, normally consolidated clays or with stiff soil overlying soft soil (punch-through conditions) shall be avoided.

C. Operational Aspects

C 100 General

101 General requirements to operational aspects of marine operations are given in DNV-OS-H101, Sec.4.

102 The operation shall be carried out with due consideration to identified risks and prescribed risk mitigations. See Sec.2 A400.

103 All operations should be carried out according to the operation manual for the unit. See also Sec.1 A.

Guidance note:

Limitations on sea state, wind, current, visibility etc. should be assessed. Sea state limitations should normally include both wave heights and periods. If the operation manual only specifies a limiting wave height the acceptable period

range for this wave should be established by analysis before the operation. It may also be beneficial to define the limiting wave heights for periods outside the range or for more narrow ranges.

Any operational limitations imposed by the design evaluations, see B100, should be duly considered.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 200 Functional testing

201 Prior to positioning operations of self-elevating units the functioning of the following equipment shall in particular be checked or tested and found in order:

— elevating machinery
— bilge, ballast and pre-loading system
— mooring equipment/tugs.

C 300 Clearances

301 Minimum horizontal clearance to floating and fixed units shall be determined for the positioning operation, based on environmental conditions and motion characteristics of the unit(s) involved.

302 During positioning the distance between the unit and a "hot" fixed structure/platform shall normally be minimum 10 meters at any point. If a closer position is required, the production shall be closed down and the systems depressurised (i.e. "cold" condition).

303 The required minimum clearance to an adjacent fixed structure/platform during operation (i.e. after completion of the positioning operation) should be considered in each case.

304 For required clearance to floating units see Sec.4 C400.

305 It should be documented that the final elevation reached fulfils the design air gap requirement.

Guidance note:

The air gap is defined as the clear distance between the lower part of the hull structure and the maximum wave crest elevation. See DNV-OS-C104 Sec.8 D for further information.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 400 Seabed conditions

401 If the conditions at the location and the anticipated penetration depth are such that erosion may occur around the spudcans, bagging to avoid this situation shall be considered.

Guidance note:

If jetting is used to increase the leg penetration depth, some erosion may be accepted.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

402 It shall be verified that the installation area is free from obstructions such as boulders, wrecks and lost construction material.

403 When entering a pre-used location, care shall be taken during positioning to avoid that any leg hits an abandoned leg-hole.

C 500 Jacking and testing

501 Due care should be taken in order to carry out jacking, see B200, and testing, see B300, according to the approved procedures.

502 If studies show that there is a risk for punch-through failures, the hull clearance to the sea surface shall be kept as small as possible during pre-loading.

Guidance note:

The clearance should nevertheless be sufficient to ensure an air gap of minimum 0.5 m in the maximum tide and forecasted (considering uncertainty, i.e. alpha factor) maximum wave height in the pre-loading period. For guidance see DNV-OS-H101, Sec.4 B700.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---