

NORSOK STANDARD

MARINE OPERATIONS

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Please note that whilst every effort has been made to ensure the accuracy of the NORSOK standards neither OLF nor TBL or any of their members will assume liability for any use thereof.

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FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and remove unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and are jointly issued by OLF (The Norwegian Oil Industry Association) and TBL (Federation of Norwegian Engineering Industries). NORSOK standards are administered by NTS (Norwegian Technology Standards Institution).

The purpose of this industry standard is to replace the individual oil company specifications for use in existing and future petroleum industry developments, subject to the individual company's review and application.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of this standard will be used to provide input to the international standardisation process. Subject to implementation into international standards, this NORSOK standard will be withdrawn.

Annexes are informative.

1 SCOPE

The standard defines the basic requirements to vessels performing marine operations, to the planning, execution and work associated with such operations on the Norwegian Continental Shelf. The coastal state regulations may contain requirements additional to those listed in this standard depending on the function the vessel is to perform in the petroleum activity.

2 NORMATIVE REFERENCES

The following standards include provisions which, through reference in this text, constitute provisions of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements of the standards referenced below.

International Conventions:

MARPOL 73/78	International Convention for the Prevention of Pollution from Ships 1973, as modified by Protocol of 1978.
SOLAS 74	International Convention for the Safety of Lives at Sea (SOLAS), as amended.
STWC	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.

Regulatory Acts and Regulations:

NMD	Regulations for Mobile Offshore Units
NMD	The Norwegian Ship Control Legislation
NMD	Guidelines and Notes for Mobile Offshore Units

Note: NMD regulations apply to Norwegian flagged vessels and vessels carrying a NMD Letter of Compliance (LOC) only.

International Codes and Guidelines:

ICS/ISF	Guidelines on the Application of the IMO International Safety Management Code
IMO A.469(XII)	Guidelines for the Design and Construction of Offshore Supply Vessels.
IMO A.481(XII)	Principles of Safe Manning.

IMO A.538(13)	Maritime Safe Training of Personnel on Mobile Offshore Units.
IMO MSC/Circ.645	Guidelines for Vessels with Dynamic Positioning Systems
IMO A.741(18)	International Safety Management (ISM) Code.
ISO 9000	International Standard: Quality Management and Quality Assurance Standards.
MODU Code	Code for the Construction and equipment of Mobile Offshore Drilling Units.
IMCA	Guidance Note No IMCA D 010: Diving Operations from Vessels Operating in Dynamically Positioned Mode.

The latest versions of the conventions, codes and guidelines apply.

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

Barge	Non-propelled vessel for transportation of heavy cargo.
Column Stabilised Unit	Unit with the main deck connected to the underwater hull by columns or caissons.
Company	Responsible field operator
Informative References	Shall mean informative in the application of NORSOK standards.
Installation	Offshore installation, loading system, pipeline or other permanently installed subsea facility.
Marine Operation	Any vessel operation conducted offshore.
May	May-requirements are conditional. Alternative solutions can be allowed if the required functional criteria have been met.
Mobile Offshore Unit	Self elevating or column stabilised unit.
Non Routine Operation	A specifically designed marine operation of limited duration, normally carried out in temporary phases.
Contractor	Company responsible for the operation of the vessel.
Recognised Authority control	Flag state or coastal state authority responsible for legislation and concerning vessels or marine activities.

Recognised Classification Society	Det Norske Veritas, Lloyd's, Germanische Lloyds, Bureau Veritas, American Bureau of Shipping. Other IACS member companies may be approved by the company.
Self Elevating Unit	Jack-up.
Service Vessel	A vessel, performing contractual work within one or more service functions which are not directly petroleum related, or defined by a recognised authority not to belong under the coastal state regulatory regime.
Shall	Shall is an absolute requirement. Non compliance with a shall requirement shall be approved by the company.
Ship	Surface unit with displacement type hull or hulls, with its own propulsion.
Should	Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable to the company.
Vessel	Term including ships, barges, column stabilised units or other floating units with or without propulsion, which are subject to registration and classification according to national and/or international maritime regulations.

3.2 Abbreviations

AHTS	Anchorhandling, Tug and Supply Vessel
DNV	Det Norske Veritas.
DP	Dynamic Positioning.
DSV	Diving Support Vessel. The term does not include support vessels for surface oriented diving from light craft.
IACS	International Association of Classification Societies
ICS	International Chamber of Shipping
IMCA	International Marine Contractors Association
IMO	International Maritime Organisation.
ISF	International Shipping Federation
ISM-Code	International Safety Management Code
ISO	International Standardisation Organisation
LOC	Letter of Compliance
NMD	Norwegian Maritime Directorate
NR	Norges Rederiforbund (Norwegian Shipowners' Association)
MOU	Mobile Offshore Unit
MUO	Manned Underwater Operations
QA	Quality Assurance
ROT	Remotely Operated Tool
ROV	Remotely Operated Vessel

4 FUNCTIONAL REQUIREMENTS

4.1 General

An underlying requirement shall be, that to the extent possible, equipment and procedures shall be such as to ensure that no single failure shall result in unnecessary health hazard or life threatening situations for the personnel involved.

The client may impose more stringent requirements or allow deviations from this standard when found appropriate after taking into account factors such as e.g. the characteristics of the job in question, duration of the operation, environmental factors, other operations in the area, etc.

4.2 Safety and Quality Management

A management system shall be established and maintained. The system shall comply with IMO International Safety Management Code, or equivalent. The system shall be verified by valid ISM certificates, if available. Ref. Note.

The system shall be developed and maintained in accordance with the principles laid down in ICS/ISF "Guidelines on the Application of the IMO International Safety Management Code)."

The ISM Code covers the safe management and operation of vessels and pollution prevention. For other parts of the marine operation , e.g. the quality of the work performed, the quality management shall be in accordance with the contractually agreed parts of the ISO 9000 quality standards series.

Note: The ISM Code will be mandatory from 1 July 1998 for passenger ships and oil tankers, chemical tankers, gas carriers, bulk carriers and high speed cargo crafts of 500 gross tons and over. For all cargo vessels and mobile offshore drilling units (MODUs) of 500 gross tons and over, the application date is 1 July 2002.

4.3 Safety Zones and Temporary Limited Areas Corresponding to Safety Zones

Vessels may not pass inside the safety zone surrounding an installation, or a temporary limited area corresponding to a safety zone, without authorization issued by the operator of the installation.

4.4 Emergency Preparedness

Risk analyses shall be carried out for MOUs and DSVs in conformance with regulatory requirements. An emergency preparedness analysis shall form a part of the risk analysis, and plans and procedures shall be developed and implemented to prepare for and respond to potential emergency situations which are likely to represent a danger to personnel, environment or equipment.

The plans and procedures shall include:

- precise description of duties, responsibilities and reporting lines for emergency personnel on board and ashore,
- precise descriptions of emergency equipment, its location and use, and
- notification procedures.

A program of drills to be undertaken, aimed at training and maintaining a competent team to cope with emergencies shall be developed.

Acceptable safety level shall be defined by the company.

4.5 Personnel

4.5.1 Qualifications

All personnel shall be qualified for their assigned work. Qualification requirements shall be specified for job categories of significance to safety.

4.5.2 Safety Training

All personnel on board vessels participating in marine operations shall have valid safety training. For vessels under coastal state regulations (Ref. Clause 5.6.1, table 1) the OLF/NR “Guidelines for Safety and Contingency Training” applies. For shuttle tankers STCW applies.

4.5.3 Alcohol, Narcotics and Drugs

Any use of alcohol, drugs or narcotics are prohibited. Procedures shall be established for personnel which due to medical reasons need medication.

4.5.4 Verbal Communication Skills

Key personnel participating in marine operations shall be able to speak a Scandinavian language or English.

4.5.5 Manning Level

IMO “Principles of Safe Manning” shall apply if the requirements of this code exceeds the flagstate requirements..

4.6 Verification of Compliance

4.6.1 Contractor’s Confirmation

Before a vessel enters into service under a contract the contractor shall confirm that the requirements outlined in this document are complied with.

Any non-compliance with regard to these requirements shall be identified and reported. Necessary corrective actions, with a schedule, shall be proposed. Reasons shall be stated for those non-conformances which are proposed for acceptance. A program for verification of critical systems shall be presented by the contractor.

4.6.2 Audit

To ensure compliance with relevant requirements, audits/inspections of vessels, equipment, safety and quality management system and documents may at any time be performed by the company provided due notice is given.

Any non-conformance to vessels, equipment, safety and QA system or documents revealed during such audit/inspection shall promptly be corrected.

4.7 Applicability of Regulations

4.7.1 General

Coastal state regulations apply in general to the petroleum activities, that is, activities related directly to the petroleum activity, including production and/or storage of hydrocarbons or in any other way implying direct contact with the well or hydrocarbon process are petroleum activities, e.g. well stimulation., as well as to certain activities that are central support activities to the petroleum activity and not a maritime activity in traditional sense, e.g. accommodation units and manned underwater operations. Normally, the entire unit and its personnel will then be included under the Coastal state regulations.

Documentation of compliance with relevant Coastal state regulations shall be as agreed between client and vessel operator. Ref. OLF/NR "Guidelines for Documentation of Mobile Offshore Units" as listed in Annex B.

For manned underwater operations Coastal state regulations apply to the diving function and to the diving team.

For certain construction vessels Coastal state regulations may be applied if decided by Coastal state authority.

4.7.2 Minimum Requirements

All vessels shall maintain valid class with a recognised classification society. The classification should include all systems of importance to the safety of the operation (e.g. anchor systems, DP systems, cargo handling systems, well stimulation systems, diving systems).

The fitness of equipment for intended use from a safety point of view shall be verified by a competent person/institution prior to its use in operations.

5 TECHNICAL REQUIREMENTS

5.1 General

The work, all vessels and equipment shall comply with the technical requirements of this document, including those stipulated by recognised authority and recognised classification society.

5.2 Dynamic Positioning

DP vessels shall be designed, equipped and operated in accordance with IMO MSC Circ.645 “Guidelines for Vessels with Dynamic Positioning Systems”. Vessels which have been assigned “Consequence class” prior to 20 October 1994 will normally be accepted on equal terms.

A DP operation shall be subject to a risk analysis taking into account:

- The planned operation.
- Technical evaluation of vessel with DP system.
- Vessel DP history and crew experience.
- Emergency procedures.

In order to determine requirements to the DP system for the subject operation guidelines for the selection of DP equipment class for various types of operations are given in table 1.

The class ratings in the table are guidance values. A vessel may be used in a higher class operation than its equipment class rating indicates provided that a detailed risk study covering all aspects of the subject operation show that this may be done within an acceptable level of safety.

The table does not exclude the use of manual positioning for certain types operations, provided that the acceptance criteria which the company has established are met.

Table 1: Guidelines on Dynamic Positioning Equipment Class Selection for various types operations (Based on the vessels complying with the minimum requirements for the class).

OPERATION	EQUIPMENT CLASS	NOTES
Drilling	3	Applies to all drilling in hot zones
Production of hydrocarbons	3	
Subsea well workover	3	Workover operations entailing hydrocarbons on deck
Wireline operations on subsea wells	2	With subsea lubricator
Well stimulation	2	
Manned subsea operations,	3	For diving inside structures etc.
Manned subsea operations,	2	For diving in open water
Support of diving from light craft.	2	When the light craft is attached to the support vessel
Unmanned subsea intervention with ROT	2	Inside hot template
Accommodation Vessel with gangway connection to Installation	3	
Accommodation Vessel outside 500 m safety zone	2	
Well stimulation, platform wells	2	
Construction activities in general, inside 500 m safety zone.	2	
Construction activities in general, outside 500 m safety zone	1	

DP operators shall be trained in accordance with NMD Guideline No 23: “Certification of DP-Operators”. Other training institutions than those listed in the guidelines may be accepted.

5.2.1 Voice Communication

Means for voice communication shall be available to enable necessary information to be passed between DP controls and all other parties directly involved in or responsible for the operation. All essential communication systems should be provided with 100% redundancy, either through duplication or provision of an alternative system.

5.2.2 Remote Alarms

Audio visual alarms shall be connected to the system to draw the attention of personnel in control of or responsible for operations whose safety is dependant of the position keeping to an indication of degraded status.

5.2.3 Manned Underwater Operations from DPDSV

For manned underwater operations carried out from DPDSV IMCA “Diving Operations from Vessels Operating in Dynamically Positioned Mode” shall be used supplementary to IMO MSC Circ. 645.

5.3 Anchoring Operations

Anchoring systems on vessels kept in position by anchors (with or without thruster assistance) while performing marine operations, shall:

- comply with the requirements of a recognised authority, and
- be verified to have the required capacity for the proposed location.

A mooring analysis shall be performed by qualified personnel, using a computer programme approved by a recognised authority, to verify compliance with safety factors under the applicable weather conditions.

Less severe than all year weather criteria for a given return period may be accepted as a basis, taking into consideration e.g. time of the year, duration of the operation, distance to nearby installations, possibility to leave the site in an emergency situation.

Duration may be considered as follows:

- Until 3 days: The work may be commenced when the weather forecast provides adequate certainty that the presupposed wave height or wind speed will not be exceeded.
- Duration in excess of 3 days, but where it is possible within 24 hrs to bring the vessel into a condition which will resist greater loads, may be designed for a lower dimensioning environmental load. The operation shall be discontinued if the weather forecast for the next 3 days indicates values in excess of what has been presupposed.
- Duration in excess of 3 days, but where there is no danger of injury or damage to people or to the environment, or of major financial consequences, may be designed with a return period of one year for the time of the year in question. The time of the year should not be calculated less than two months.

5.4 Towing Operations

Towing systems shall comply with the requirements of a recognised authority /recognised classification society and flag state requirements.

When required, towing permit shall be applied for.

6 DOCUMENTATION

Table 2: Manuals and procedures.

	TITLE	NOTES
1	QA Manual	
2	Vessel Emergency Preparedness Plans.	A bridging document to link with the company's emergency plans shall be a part of the Emergency Preparedness Plans.
3	Vessel Operations Manual	
4	Vessel Stability Manual	
5	Project Operations Manual	

7 PLANNING OF OPERATIONS

7.1 General

Marine operations shall be properly planned for all stages of a project or operation. The feasibility of extending proven technology shall be thoroughly documented. The planning of non routine marine operations shall, as far as practicable and agreed between the contract parties, be based upon recognised standards issued by a recognised authority.

Annex A is a checklist for guidance in the planning of some non routine marine operations.

A project operations manual shall be prepared for and cover all phases of the work, from start of preparations for the operation to the completed demobilisation, and shall include but not necessarily be limited to:

- organisation and communication and a program for familiarisation of personnel,
- description of and procedures with acceptance criteria for testing and commissioning of all equipment to be used for the operations,
- description of vessel and site(s),
- detailed procedures for all stages of the operation, towing routes with estimated sailing times and possible ports of refuge,
- definition of hold and approval points,
- criteria for starting each phase of the operation,
- acceptable tolerances, monitoring and reporting details,
- plan for verification that the operations have been completed in accordance with the approved procedures and requirements of this document,
- other companies' requirements when operating within their safety zone.

Design criteria shall be stated and relevant design calculations shall be referred to in the manual.

Marine operations shall, unless otherwise agreed between the parties, be planned in such a way that the operations can be reversed.

Risk evaluations/analyses shall be carried out when specified or required by recognised authority.

The engineering, materials selection, fabrication and testing of systems, equipment and structures including seafastening, grillages, etc. shall comply with requirements stipulated by recognised authority, recognised classification society and recognised codes and standards.

7.2 Organisation and Communication

The organisation of key personnel (marine, non marine and third party personnel) involved in marine operations, shall be established prior to the execution of an operation.

Responsibilities and lines of communication shall be defined. The organisation chart shall be apart of the project operations manual. Details shall be given on communication with contact persons within the company's organisation.

7.3 Clearances During Operations Offshore

7.3.1 General

The vessel and its anchorlines shall be located at a safe distance from other installations, cables, pipelines, lighthouses, navigation marks etc., and due consideration to such shall be taken at all times. Safe distances shall be defined prior to the marine operation, paying due consideration to water depth, environmental conditions, nature of the operation etc., and be included in the project operations manual.

7.3.2 Marine Operations close to Third Party Facilities

All marine operations close to third party installations or their surrounding safety zones shall be performed in compliance with third party requirements.

8 EXECUTION OF OPERATIONS

Marine operations shall be conducted in accordance with the project operations manual. Any deviations from the accepted procedures shall be considered a non conformance from Company's requirements.

If during an operation it becomes evident that the operation cannot be performed according to the established manual, any deviation to the plans shall be accepted by all parties involved, and the consequences for the work shall be highlighted. The requirement for a safe and effective performance of the operation shall be maintained.

9 REPORTING

Reports shall be prepared and submitted at specified intervals throughout the duration of the work. The reports shall have a format and content agreed between the parties.

ANNEX A NON ROUTINE MARINE OPERATIONS (INFORMATIVE)

A.1. Total Operation Level

In this Annex a simple hierarchy with three levels of checklists / flowchart is presented in order to obtain an overall view of the most important elements involved in planning of non-routine marine operations. The planning shall, as far as practicable and agreed between the contract parties, be based upon recognised standards issued by a Recognised Authority or Recognised Classification Society (e.g. DNV Rules for Planning and Execution of Marine Operations, 1996, which are used as reference in these checklists). Note that Coastal state regulations may pose additional requirements to those listed.

A.1.1 Checklist for Overall Planning

MAIN ASPECTS	KEY ITEMS	DNV Rule for Marine Operations Part & Chapter
Non Routine Operations	Valid for specially designed operations of limited duration or carried out in temporary phases.	
Documentation Establish operational procedures as well as engineering and fabrication documentation	Establish a list of all types of marine operations to be carried out.	Pt.2
	Follow the Checklists for the different types of operations to be carried out.	Checklist for each type.
	Consider the needs for 3rd. party verification and Warranty Surveys (required by Marine Insurance).	Pt.1 Ch.1
Criteria Relevant assumptions and requirements, including weather criteria to be specified for the operations.	If a Warranty Surveyor is needed he shall specify required document review, site surveys prior to operation and possible attendance. He may base his work on relevant 3rd. party verification. All criteria shall be approved and referred to in the Marine Operation Declarations to be issued.	Pt.1 Ch.1
Preparations for operations	Check that all vessels and equipment to be involved comply with the general requirements to routine operations and are suited for this particular work.	This Standard and Pt.1 Ch.2
Execution of operations	Ensure that all established procedures are followed.	Pt.1 Ch.2
	If modifications are necessary the deviation shall be logged.	
	If a Warranty Surveyor is needed he shall approve any deviations in order to avoid breach of Warranty.	Pt.1 Ch.1
Completion of operations	Experience feedback should be ensured.	

A.2 Types of Operation Level

The different types of typical Non-Routine Operations are presented in the following checklists. These operations are either of limited duration, belong to the temporary phases and/or are specially designed operations. For each type of operation some characteristic key-words are given for items to be specially considered. (See recognised Standards for details).

A.2.1 Load Transfer Operations**A.2.1.A - Definition of Types of Load Transfer Operations**

OPERATION	DEFINITION	DNV Rule Ref.
General	A marine operation transferring an object from one support condition to an other.	Pt.2 Ch.1
Load out	Horizontal transfer of a heavy object from land onto a transport vessel or barge. (Reverse = Load in)	Pt.2 Ch.1 Sec.2
Float out	Object fabricated in dry dock, brought afloat, floated out.	Pt.2 Ch.1 Sec.3
Lift off	Transfer object positioned on land/sea bed supports into floating condition. (Reverse = Lift on)	Pt.2 Ch.1 Sec.4
Mating	Join two floating objects, e.g. supported by barges, pontoons (typically deck mating onto GBS).	Pt.2 Ch.1 Sec.5
Construction afloat	Construction of a self floating structure.	Pt.2 Ch.1 Sec.6

A.2.1.B - Items Normally to be Considered for Load Transfer Operations

MAIN ASPECTS	KEY ITEMS	DNV Rule Ref.
- Operational	Description of the operation including schedule	Pt.1 Ch.2 Sec.3
	Weather forecast procedure	
	Operational limitations, assumptions and tolerances	
	Organisation chart(s), including responsibilities	
	Communication	
- Loads	Environmental loads	Pt.1 Ch.3
	Permanent and live loads	Pt.2 Ch.1
	Deformation and Accidental loads	
- Structural Strength	Object	Pt.1 Ch.4
	Civil engineering and support structures (steel)	
	Barges, vessels	
- Stability	Intact, all phases and Damage	Pt.1 Ch.2 Sec.4
- Ballasting	Weight transfer	Pt.2 Ch.1
	Tide compensation	
	Spare capacity and contingency plans	
	Power supply and Test procedures	
- Mooring	Intact system calculations	Pt.1 Ch.2 Sec.5
	One line broken calculations	
	Safety factors	
	Adequate equipment including bollards	
	Certificates	
- Load Transfer Equipment	Push/pull systems	Pt.2 Ch.1
	Trailers/skidshoes/rollers/jacks	
	Spare equipment and contingency plans	
- Monitoring	Object levels, deflections and support reactions	Pt.2 Ch.1
	Tide/water levels and tank ullages	
	Barge/vessel levels and deflections	
	Alignments and clearances	

A.2.2 Towing

MAIN ASPECTS	KEY ITEMS	DNV Rule Ref.
Planning. - What - Where - When - How	Description of intended towing operation	Pt.2 Ch.2
	Objects to be transported, number, size, shape and weight.	Pt.1 Ch.2 & Pt.2 Ch.2 Sec.2
	Check that objects are built for the type of loads to be experienced during transportation. Wave slamming in case of cargo hanging over barge deck shall be considered.	
	Route of transportation, coastal or open sea.	
	Climatic conditions at time of tow	Pt.1 Ch.3 Sec.2
	Single tow with one or more tugs (multibarge see 2.3)	
Towing Equipment - Towing line - Barge suitability	Arrangement and equipment for towing. Towline connections, Minimum Breaking Load (MBL) Emergency towing arrangement	Pt.2 Ch.2 Sec.3
	Relevant Barge Certificates to be presented. Consider barge cargo capacity, deck load and need for grillage arrangements to distribute support loads.	
	Seafastening arrangement to be based on barge motion analysis and strength calculations.	Flowchart & Pt.2 Ch.2 Sec.2
	Barge intact and damage stability to be checked.	Flowchart & Pt.1 Ch.2 Sec.5
	Relevant Tug Certificates to be presented. Sufficient bollard pull for intended tow to be documented.	Pt.2 Ch.2 Sec.3
Towing Operation	Marine Operation Manual to be worked out and followed.	Pt.1 Ch.2 Sec.4
	This shall include weather criteria.	Flowchart
	Procedures to obtain reliable weather forecast	

A.2.3 Special Sea Transportations

OPERATION	KEY ITEMS	DNV Rule Ref.
Ship transportations - Planning - Ship suitability - Operation	Transport onboard a conventional / supply vessel.	Pt.2 Ch.3 Sec.2
	Apply Towing checklist regarding “what, where & when”.	Checklist 2.2
	Check that ship comply with the general requirements to routine operations and are suited for this particular work.	This Standard
	Consider ship cargo capacity, deck load and need for grillage arrangement to distribute support loads.	Pt.2 Ch.3 Sec.2
	Seafastening to be based on ship motion analysis and strength calculations.	
	Seafastening to be regularly inspected, special attention shall be given to chain tensioner or wire/turnbuckles.	
Multi barge towing - Planning - Design loads - Barges - Tugs - Operation	Object resting on two or more barges.	Pt.2 Ch.3 Sec.3
	Apply complete checklist for Towing plus the following.	Checklist 2.2
	Motion analysis to take account of barges individual responses.	Pt.2 Ch.3 Sec.3
	Skew loads due to fabrication and operation tolerances, offset, inaccuracy etc. shall be considered	
	Ballasting shall ensure favourable load distribution between barges.	
	Flexible supports and needs for a “fall back” securing arrangement shall be considered.	
	Seafastening shall have strength and flexibility to take the relative deflections and avoid overstressing the object.	
	Towing fleet shall maintain control over the unit in all phases of operation with loss of thrust from one tug.	
	Two independent navigation systems shall be applied.	
	Clearances along the towing route shall be checked	
Self floating towing - Planning, - Tugs and Operation - Design conditions	Object supported by own buoyancy and pushed/ pulled by tugs, e.g. gravity based structures, jacket substructures.	Pt.2 Ch.3 Sec.4
	Apply checklists for Towing and Multi barge towing where relevant (disregarding items related to barges).	Checklist 2.2
	Detailed control of buoyancy and stability of towed object in all conditions are necessary.	Pt.2.Ch.3 Sec.4
	In addition to still water and wave loads, other loads may be important, e.g. wave slamming and vortex shedding.	
Heavy lift carriers - Planning - Design conditions - Operation	Heavy object on submersible barge/vessel and loaded/ off-loaded by float on/ float off operations.	Pt.2 Ch.3 Sec.5
	Apply checklists for Towing and Ship transportation where relevant.	Checklist 2.2
	Cargo hanging over the sides shall be considered for slamming, uplifting, drag loads and motions/ stability.	Pt.2 Ch.3 Sec.5
	For low GM, effects of wind heeling may be important.	
	The cribbing shall be adequate and guide posts sufficient high and strong to function during load on/off operations.	
	Daily inspection of cargo and seafastening during voyage.	

A.2.4 Offshore Installations of Fixed Structures

MAIN ASPECTS	KEY ITEMS	DNV Rule Ref.
Offshore installation	Installation of fixed offshore structures such as jackets, gravity base structures, and towers. Check below listed items relevant for the type of structure / installation.	Marine Operations Pt. 2 Ch.4
Installation site	Bathymetric survey, obstruction survey and determination of soil parameters for installation site	Pt.2 Ch.4 Sec. 1
Loads	Environmental loads to be identified, limitations stated	Pt.1 Ch.3
	Identification of other loads due to hydrostatic, soil, positioning e.g	Pt.1 Ch.3 Pt.2 Ch.4 Sec.2
Launching - Load cases - Environmental - Barge/equipment - Operational	Longitudinal or sideways launching from transport barge(s)	Pt.2 Ch.4 Sec.3
	Launching sequence to be considered step by step and most critical loadcase for each member identified.	
	Establish environmental limitations for operation	
	Barge and equipment to meet requirements with respect to capacity, arrangement, inspection and testing	Pt.1 Ch.2 Pt.2 Ch.4 Sec. 3
	Operational procedures to be prepared and complied with	
Upending - Load cases - Object	Upending of objects carried out by controlled ballasting, flooding and/or lifting. Consequence of single failure. Fallback positions. System failure/backups	Pt.2 Ch.4 Sec.4 Checklist 2.5
	Identify most critical load case for each member	
	Check structural strength, stability, clearances etc. of main object and attachments	
Positioning & Setting - Load cases - Object - Positioning systems -Docking	Vertical movement of object achieved by controlled ballasting or flooding. Reversibility of operation. Consequence of single failure. Structural analysis during docking.	Pt.2 Ch 4 Sec.5
	Identify most critical load case for each member	
	Stability both afloat and on bottom	
	Object may be positioned using towing and mooring system	Pt.1 Ch.2 Sec.5 Pt.2 Ch.2 Sec.3 Pt.2 Ch.4 Sec.5
	Vertical or horizontal docking	
Piling & Grouting -Pile installation - Grouting	Ensure sufficient on bottom stability when required	Pt.1 Ch.4 Sec. 6
	Pile lifting/upending and stabbing to be carefully consider with respect to method, rigging and location	
	Special attention to be paid to pile and hammer protruding the splash zone	
	Required grout strength to be documented prior to transfer of heavy items to the structure. No piling after grouting	

A.2.5 Lifting

MAIN ASPECTS	KEY ITEMS	DNV Rule Ref.
Type of lift - Risk assessment - Load effects .	Evaluate the overall rigging configuration and consequences of single element or system failures.	Pt.2 Ch.5
	Feasibility, safety and possible failure consequences	Pt.2 Ch.5 Sec. 1
	Dynamic effects	Pt.2 Ch.5 Sec.2
	Skew load effects	
	Tilt and Yaw effects	
	Upending/Rotation	
Lifting equipment	Overall evaluation of design/ functionality of equipment.	
	Sling & Shackles	Pt.2 Ch.5 Sec.3
	Spreader bars	Pt.2 Ch.5 Sec.4
	Padeyes	
	Guide and tugger line system	
	Crane vessel and vessel mooring or positioning system.	Pt.2 Ch.5 Sec.5
Loads	Establish design loads and load cases	
	Object weight, inaccuracy and CoG inaccuracy	Pt.2 Ch.5 Sec.2
	Weight of lifting equipment	
	Design loads for lifting equipment correct (all relevant load effects considered)	
	Load cases for lifting equipment correct (all load effects and load combinations considered)	Pt.2 Ch.5 Sec.2 & Sec.4
	Load cases for lifted object (all relevant load effects and load cases considered)	
Capacity of lifting equipment Verification of object and equipment capacity	Slings (certification, design loads, effects of bending, splicing, condition, doubling and safety factors)	Pt.2 Ch.5 Sec.3
	Spreader bars (design, design factors, strength verification, inspection)	Pt.2 Ch.5 Sec.4 & Sec.5
	Shackles (certificate, proofloading, inspection)	Pt.2 Ch.5 Sec.3
	Padeys (design, design factors, strength verification, inspection)	Pt.2 Ch.5 Sec.4 & Sec.5
	Crane capacity (boom radius, dynamic effects, mooring & manoeuvring, certificates)	Pt.2 Ch.5 Sec.5
	Guides (design principles, design loads, capacity of support structure)	Pt.2 Ch.5 Sec.4
	Object strength (design, design factors, load cases strength verification, inspection)	Pt.2 Ch.5 Sec.4
Operational Verification of the operational aspects.	Design Criteria	Pt.2 Ch.5 Sec.1 Pt.1 Ch.3
	Operational Criteria	Pt.2 Ch.5 Sec.1 Pt.1 Ch.3
	Clearances	Pt.2 Ch.5 Sec.5
	Operation procedure	Pt.2 Ch.5 Sec.5
	Lifting arrangement	Pt.2 Ch.5 Sec.3 & Sec.5

A.2.6 Sub Sea Operations

MAIN ASPECTS	KEY ITEMS	DNV Rule Ref.
Planning	Description of intended operation, including specifications of vessels to be applied. For general aspects of subsea lifting Checklist for Lifting shall be applied.	Marine Operations Pt.2 Ch.6
Design loads	Design wave height and weather window shall be established for actual type of vessel and handling equipment and be based on evaluations of each step of operation. For lift in air apply Lifting checklist	Checklist 2.5
- Crane tip motions	Establish design acceleration & amplitude for crane tip motions and evaluate effect of type of vessel.	Pt.2 Ch.6 Sec.2
- Through surface	Lowering through water surface may be critical. Optimize design wave height and lowering speed to ensure low slamming & impact loads and to avoid slack lifting wire.	
- Submerged object	Forces on submerged object depends on type of installation vessel.	
- Snap forces	Snap forces on hoisting line depends on design wave height for installation and weight of object versus hydrodynamic characteristics (size and shape).	
Soil capacities	Soil conditions shall be evaluated (soft/hard/mud)	Pt.2 Ch.6 Sec.3
- On bottom stability	Effect of seabed soil properties and needs for mudmats/skirts/piling shall be evaluated.	
- Pull out forces	Undrained shear capacity of soil is important for pull out forces or repositioning of subsea installations.	
Operation	Marine Operation Manual to be worked out and followed.	Pt.1 Ch.6 Sec.4
- Installation vessel	Evaluate operational effects related to type of vessel	
	Consider possibility of stepwise and reversible operation.	
- ROV operations	Evaluate operational effects of ROV downtime/failure and consider needs for backup.	
	Complex operations may give special requirements.	

A.2.7 Transit and Positioning of Mobile Offshore Units

OPERATION	KEY ITEMS	DNV Rule Ref.
Planning	Description of intended move and location	Marine Operations Pt.2 Ch.7
Requirements	General basis for operation shall be Operation Manual with Classification restrictions and weather criteria.	
Semisub units		Pt.2 Ch.7 Sec.3
- Transit	A main tug with min. 120 t BP (Bollard Pull) plus additional tug to be considered if semi has no propulsion. General requirements to towline, connection, emergency arrangement and tug suitability shall be as for Towing.	Checklist 2.2
- Positioning	Procedures to be established for positioning and anchor handling including required number and size of vessels.	
- Mooring analysis	Mooring system analysis to be carried out with due regard to water depth and possible pipeline crossings, other structures and vessels and their moorings.	
Self elevating units		Pt.2 Ch.7 Sec.4
- Transit	Same as for Semisubs above, but two tugs required. Special attention to unit motions and needs for emergency jacking positions with corresponding weather criteria.	
- Positioning	Procedures to be established for positioning.	
- Installation	Detailed information on seabed condition is required.	
Lay-up	Protected harbour to be selected.	Pt.2 Ch.7
- Mooring	Shore bollards with certified capacity and mooring arrangement designed for “one line broken”, as offshore.	

A.3 Basic Element Level

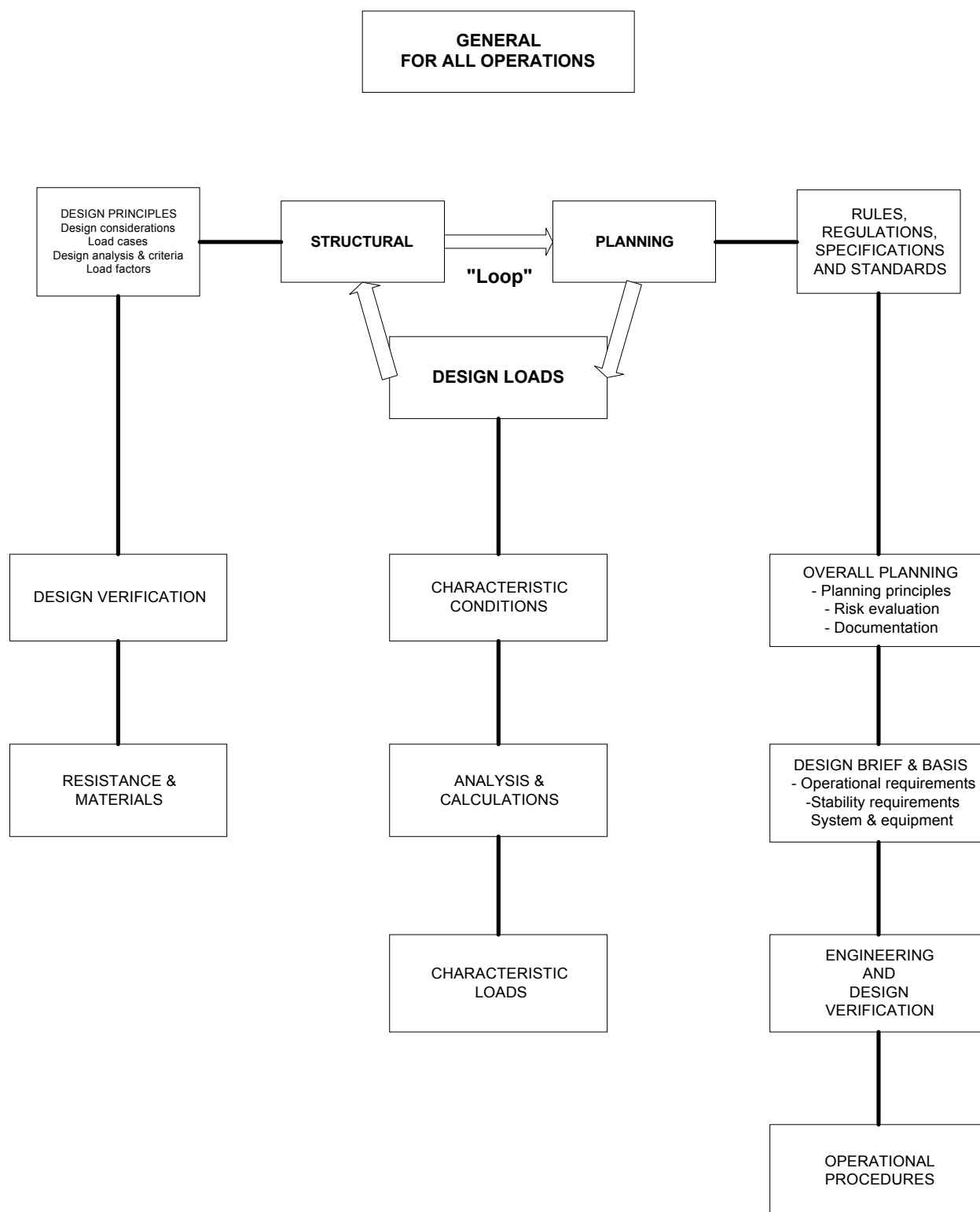
For each operation most of the items /subjects must be considered according to the three step circle presented in the Flowchart below. This covers:

- **Planning of Each Step**, including risk assessments, specifying requirements for planning, preparations and performance.
- **Design Loads**, defining the characteristic conditions to be designed for and the analysis to be carried out in order to obtain the loads to be considered.
- **Structural Design**, based on the loads and corresponding load combinations with relevant safety factors.

It is emphasised that the risk of each step of operation shall be evaluated and the actions to be taken in order to ensure a “tolerable risk level” shall be specified. The risk is a function of both probability of hazards and consequences.

In practice it may be difficult to define probability levels for marine operations directly, and therefore robustness or vulnerability aspects such as complexity of the operations or weather sensitivity on one side may be evaluated against safety margins or redundancy on the other.

In marine operations the weather criteria is normally of major importance since strict limitations may result in costly waiting on weather and unrestricted operations may give high loads and therefore costly vessels, equipment, design or operations. In order to find an optimum solution the three step circle may have to be repeated several times for each item / subject.

**FLOWCHART**

**ANNEX B LIST OF RECOMMENDED STANDARDS AND GUIDELINES
(INFORMATIVE)**

ICS/ISF	Guidelines on the Application of IMO International Safety Management Code.
OLF/NR	Retningslinjer for sikkerhets- og beredskapsopplæring. (Guidelines for Safety and Contingency Training).
OLF	List of Recommended Schools and Courses Giving Safety and Emergency Preparedness Training.
OLF/NR	Anbefalte retningslinjer for flyttbare innretninger til bruk ved innleie i petroleumvirksomhetene på norsk sokkel. (Recommended Guidelines for the Documentation of MOUs)
DNV	Rules for the Planning and Execution of Marine Operations.