OFFSHORE SERVICE SPECIFICATION
DNV-OSS-306

# VERIFICATION OF SUBSEA FACILITIES

JUNE 2004

DET NORSKE VERITAS

# 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.

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— *Offshore Standards.* Provide technical provisions and acceptance criteria for general use by the offshore industry as well as the technical basis for DNV offshore services.
— *Recommended Practices.* Provide proven technology and sound engineering practice as well as guidance for the higher level Offshore Service Specifications and Offshore Standards.

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C) Structures

D) Systems

E) Special Facilities

F) Pipelines and Risers

G) Asset Operation

H) Marine Operations

J) Wind Turbines

## Amendments and Corrections

This document is valid until superseded by a new revision. Minor amendments and corrections will be published in a separate document on the DNV web-site; normally updated twice per year (April and October). To access the web-site, select short-cut options "Technology Services" and "Offshore Rules and Standards" at http://www.dnv.com/

The electronic web-versions of the DNV Offshore Codes will be regularly updated to include these amendments and corrections.

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## INTRODUCTION

This Service Specification was approved by the Director of Technology in June 2004.

The suit of inter-related DNV-OSS documents consist of a general description of the verification systematics (DNV-OSS-300) and object specific documents - this document (DNV-OSS-306) offers the reader the application of the common framework and overview of processes in risk verification, to subsea facilities.

— It introduces a levelled description of verification involvement during all phases of an asset's life.
— The document facilitates a categorisation into risk levels High, Medium and Low, assisting in an evaluation of the risk level.
— The document assists in planning the verification through the making of a Verification Plan, and describes the DNV documentation of the process throughout.

The document provides an international standard allowing transparent and predictable verification scope, as well as defining terminology for verification involvement.

# CONTENTS

# SECTION 1
# GENERAL

## A. General

### A 100 Introduction

**101** This DNV Offshore Service Specification (DNV-OSS-306) gives criteria for and guidance on verification of the integrity and function of parts or phases of subsea facilities.

**102** This specification falls under the top level document DNV-OSS-300 Risk Based Verification.

**103** The descriptions in this specification directly support a simplified verification planning as described in Sec.2 F of DNV-OSS-300. When using the advanced or combined planning, the descriptions will give good references and starting points.

**Guidance note:**

The latest revision of all DNV documents may be found in the publications list in the DNV web site www.dnv.com.

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### A 200 Objectives

**201** The objectives of this specification are to describe the following for a subsea facility:

— preparation of a Verification Plan using DNV's risk differentiated levels of verification activities and detailed example scope of work tables
— DNV's implementation and reporting of the Verification Plan

### A 300 Scope of application for verification

**301** This specification may be adopted for the verification of parts of subsea facilities or selected project phases.

**302** Subsea facilities typically comprise the following systems:

— Downhole system
— Subsea wellhead and tree system (including: choke, tubing hanger and connection systems)
— Manifold, foundations and template
— Flowlines and risers (including dynamic umbilical risers)
— Subsea control umbilicals
— Subsea production control system
— Subsea processing system
— Well intervention/completion/workover system
— ROT intervention system

which are applied in various configurations and tailored to each particular project's specific requirements.

**303** This specification describes the principles of a levelled verification involvement. These principles may be applied both for planning of any need or obligations for independent external verification (third party) as well as internal company verification (second party).

### A 400 Structure of this document

— *Section 1* explains the relationship between this document and DNV's overall risk based verification systematics.
— *Section 2* describes the activities for each project and the project phases for a subsea system.
— *Appendix A* poses trigger questions to assist in the selection of verification level example
— *Appendix B* gives detailed scope of work tables for the different phases and levels of involvement. These tables are the basis for the development of project specific scope of work tables.
— *Appendix C* gives example verification documents and describes the documents issued during and as a result of the verification process. The use of quality management systems is addressed here also.

## B. Risk Based Verification

### B 100 Elements of the service

**101** The risk based verification concept is described in DNV-OSS-300 and visualized by Fig.1.


**Figure 1**
**The DNV Risk Based Verification Chain**

**102** The Verification Plan is the pivot element, with the Asset Specification, Risk Assessment and Definition of Involvement Level as input and the Verification Execution being the implementation.

## C. Defining a Verification Plan

### C 100 Risk based verification planning

**101** The selection of the level of verification shall depend on the risk level of each element having an impact on the management of hazards and associated risk levels of the asset. The planning can be simplified or detailed. This is further described in DNV-OSS-300.

**102** This specification mainly aids in a simplified preparation of the Verification Plan.

**Guidance note:**

Risk can be evaluated based on safety, environmental impact, economics, schedule, Public Relations, reputation or other criteria set by the owner. The example tables are mainly generated on the basis of safety and integrity risks. With business risk being the driver for verification involvement this will normally warrant a need to use the analytical approach and no the simplified one.

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## D. DNV Subsea Facility Statements of Compliance

### D 100 General on verification

**101** Verification describes the individual activities undertaken by DNV at the various stages of design, construction and operation of the subsea facility. The scope of the verification plan is ultimately determined by the owner.

### D 200 Statement of compliance

**201** A statement of Compliance may be issued by DNV to confirm compliance according to the scope of work.

### D 300 General on certification

**301** Certification describes the totality of verification activities leading up to the issue of a Certification of Conformity. The scope of work and verification plan, called a Certification Plan, is set by DNV. All design and construction aspects, related to subsea facility safety and integrity, must be covered by the Certification Plan.

**302** This DNV-OSS does not define the scope of work necessary to achieve a DNV Certificate of Conformity.

## E. Definitions / Abbreviations

### E 100 General

**101** Relevant definitions in ISO 13620 -1 also apply to this OSS.

### E 200 Abbreviations

| | |
|---|---|
| DCS | Distributed Control System |
| EDU | Electrical Distribution Unit |
| EPU | Electrical Power Unit |
| ETU | Electronic Test Unit |
| HPU | Hydraulic Power Unit |
| HTP | Hydraulic Test Panel |
| MCC | Motor Control Centre |
| MCS | Master Control Station |
| MQC | Multi Quick Connector |
| PT | Pressure Transmitter |
| SCM | Subsea Control Module |
| SCMMB | SCM Mounting Base |
| SCR | Subsea Control Room |
| SCU | Subsea Control Unit |
| SDU | Subsea Distribution Unit |
| SEM | Subsea Electronic Module |
| SPCU | Subsea Power & Communication Unit |
| TT | Temperature Transmitter |
| TUTU | Topside Umbilical Termination Unit |
| UPS | Uninterrupted Power Supply |

### E 300 Verbal forms

**301** *"Shall"*: Indicates requirements strictly to be followed in order to conform to this OSS and from which no deviation is permitted.

**302** *"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.

**303** *"May"*: Verbal form used to indicate a course of action permissible within the limits of the OSS.

### E 400 Definitions

**401** *Client:* DNV's contractual partner. It may be the Purchaser, the Owner or the Contractor.

**402** *Construction phase:* All phases during construction, including fabrication, installation, testing and commissioning, up until the installation or system is safe and operable for intended use. In relation to subsea facilities, this include transportation, on-shore and on-barge assembly, installation, rectification, tie-in, pressure testing, commissioning and repair.

**403** *Design:* All related engineering to design the subsea facilities including both structural as well as material and corrosion.

**404** *Design phase:* An initial phase that takes a systematic approach to the production of specifications, drawings and other documents to ensure that the subsea facilities meets specified requirements (including design reviews to ensure that design output is verified against design input requirements).

**405** *Fabrication:* Activities related to the assembly of objects with a defined purpose. In relation to subsea facilities, fabrication typically refers to the process of assembly or transformation of e.g. plates, profiles and pipes etc into production facilities and (installation /intervention) tools

**406** *Hazard:* A deviation (departure from the design and operating intention) which could cause damage, injury or other form of loss (Chemical Industries Association HAZOP Guide).

**407** *HAZOP (HAZard and OPerability study):* The application of a formal systematic critical examination to the process and engineering intentions of new or existing facilities to assess the hazard potential of mal-operation or mal-function of individual items of equipment and their consequential effects on the facility as a whole (Chemical Industries Association HAZOP Guide).

**408** *Installation (activity):* The operations related to installing the equipment or structure, e.g. marine operations related to placing equipment on seabed, tie-in, piling of structure etc., including final testing and preparation for operation.

**409** *Manufacture:* Making of articles or materials, often in large volumes. In relation to subsea facilities, this typically refers to activities for the production of various components under contracts from one or more Contractor or Supplier.

**410** *Operations (phase):* The phase when the subsea facilities are being used for the purpose for which it was designed.

**411** *Risk:* The qualitative or quantitative likelihood of an accident or unplanned event occurring, considered in conjunction with the potential consequences of such a failure. In quantitative terms, risk is the quantified probability of a defined failure mode times its quantified consequence.

**Guidance note:**

Risk is not only related to physical failure modes, but also to operational errors, human errors and so on. For some risks the functional failures or physical failure modes contributes less than 20% while more than 80% of the risk relates to other devices.

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**412** *Risk Reduction Measures:* Those measures taken to reduce the risks to the operation of subsea facilities and to the health and safety of personnel associated with it or in its vicinity by:

— Reduction in the probability of failure.
— Mitigation of the consequences of failure.

**Guidance note:**

The usual order of preference of risk reduction measures is:

a) Inherent Safety
b) Prevention
c) Detection
d) Control
e) Mitigation
f) Emergency Response

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**413** *Safety Objectives:* The safety goals for the construction, operation and decommissioning of the subsea facilities including acceptance criteria for the level of risk acceptable to the Owner.

**414** *Statement of Compliance:* A statement or report signed by a qualified party affirming that, at the time of assessment, the defined subsea facilities phase, or collection of activities, met the requirements stated by the Owner.

**415** *Verification:* An examination to confirm that an activity, a product or a service is in accordance with specified requirements.

**Guidance note:**

The examination shall be based on information, which can be proved true, based on facts obtained through observation, measurement, test or other means.

ISO 8402: 1994: Verification: Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.

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## F. References

### F 100 General

**101** A Guide to Hazard and Operability Studies, 1979, Chemical Industries Association Limited, London

**102** ISO 8402 Quality – Vocabulary, 1994, International Organization for Standardization, Geneva

**103** BS 4778 Quality Vocabulary, Part 2 Quality Concepts and Related Definitions, 1991, British Standards Institute, London

**104** EN 45011 General Criteria for Certification Bodies Operating Product Certification, 1998, European Committee for Standardization, Brussels

**105** EN ISO 13628 Design and operation of subsea production systems - series.

# SECTION 2
# SERVICE OVERVIEW

## A. General

### A 100 Objectives

**101** The objectives of this section are to provide:

— an overview of life cycle verification activities relating to the system
— details of DNV's verification services for subsea facilities.

## B. Service Process

### B 100 General principles

**101** The description of the process of DNV's verification of subsea facilities is based on distinct project phases and the recognition of key milestones.

**102** Verification performed by DNV normally progresses through one or more of these project phases and may include all or selected aspects of the project.

**103** The risk based verification process is described in relation to the normal project phases:

*Project initiation:*

— Conceptual design

*Project realisation:*

— Detail design
— Construction
— Manufacturing of subsea facilities
— Manufacturing and fabrication of subsea facilities components and assemblies
— Installation
— Project completion (pre-commissioning)
— Commissioning
— Issue of as-built/as-installed documentation, including Design Fabrication and Installation (DFI) resume

*Project operation:*

— Issue of Operation Manuals
— Operations, maintenance and repair

*Project abandonment*

— Decommissioning
— Removal

### B 200 Simplified verification planning

**201** The steps in the simplified verification planning are as follows:

— Use trigger questions to assess the overall risk level of the project (or manageable elements thereof).
— Evaluate the risk against the relevant owner or project acceptance criteria (often this can be directly tied to the owner core values or a sub-set of these) and decide whether the general verification involvement shall be Low, Medium or High.
— Use the example detailed scope of work tables in Appendix B to make a first draft of a Verification Plan
— Generate the project specific Verification Plan by including a project specific engineering judgment or risk analysis to adjust the table to suit the project.
— Perform the verification execution according to the Verification Plan, making revision to the plan if and when necessary.
— Report the verification.

**202** The trigger questions are included in Appendix A.

**203** Generic scopes of work for verification at the three levels of verification; *Low* (L), *Medium* (M) and *High* (H), are given in the tables in this section.

**204** Project specific detailed scope of work descriptions, based on the generic scopes of work tables and showing all the activities to be verified, should be made. Examples of the level of detail are given in Appendix B.

**205** It is the tables in this section 2 that give the principle difference between the levels of verification involvement. The detailed example tables are to be treated as examples only. They shall not be used without a project specific confirmation of their completeness.

**206** The project specific scope of work definition, derived from the tables in Appendix B (or similar), shall be part of the final DNV verification report.

### B 300 Selection of level of verification

**301** The selection of the level of verification for the simplified verification planning is facilitated by the trigger questions included in Appendix A.

### B 400 Codes, standards and reference documents

**401** The verification process described in this DNV-OSS is not tailored to a specific technical standard, code or reference document.

**402** It is recommended to use internationally recognised codes or standards. Where combinations of standards and external criteria are used the exact terms of reference and documents to be issued shall be agreed at the beginning of the project and formally defined in the contract.

**403** It is recommended strongly not to mix standards due to the possible differences in safety philosophies.

**Guidance note:**

Most standards are a coherent collection of requirements for all the relevant aspects of a pipeline system. These aspects, e.g. load and resistance, are normally among themselves adjusted to give an overall acceptable safety level. To pick requirements from different standards can then easily result in unpredictable (low) levels of safety, and non-uniform level of safety.

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## C. Project Initiation

### C 100 Verification during conceptual design

**101** Verification during the conceptual and/or feasibility studies of a project and in the early stages of a project can reduce the need for verification during the design and construction phases, and can reduce costs during the long term operation, inspection and maintenance phases.

**102** It is recommended to combine the mechanical design verification during project initiation phase with additional review of:

— environmental aspects
— project schedule
— cost.

**103** During this phase it can be beneficial to make an initial verification plan. Risk evaluations are carried out during this phase and should be used to get an indication of the general verification level; Low, Medium or High.

## D. Project Realization

### D 100 General

**101** All design and construction aspects, relevant to subsea facility, may be covered by the life cycle verification.

**102** In this specification the split in the scope of work between design and construction is made between sets of requirements (specifications) developed during design and description of the steps necessary to satisfy the specification (procedures) showing how construction will be implemented.

**Guidance note:**

The split between design and construction may vary, but it is useful spend some time on the definition to reduce interface problems later.

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### D 200 Verification of overall project management

**201** Verification of the overall project management is the examination of the means of controlling the entire subsea development project, or the phase for which verification is undertaken.

**202** This verification should confirm that the necessary controls are in place to ensure information flow across the various interfaces. It is especially important where separate contractors have been employed for different phases of the project such as design and installation.

**203** Typically the documentation is expected to be in line with ISO 9000 requirements.

**204** Definition of scope of work for verification of overall project management should follow Table 2-1.

**Table 2-1 Scope of work for verification of overall project management**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| *Review of the project management process by* | | | |
| — review of project quality management documentation. | x | x | x |
| — audit of project quality management system | | x | x |
| — review of sub-contractor control | | x | x |
| — review of interface controls | | x | x |
| — review of methods of information flow | | x | x |

**205** The verification of the overall project management quality system and documentation is optional. The reviews and audits should typically be performed if an extensive verification of a project is performed, while might be omitted for smaller sub-phase verifications.

### D 300 Verification During Design

**301** Design verification is the examination of the assumptions, methods and results of the design process and is performed at the specified level of verification to ensure that the specified requirements of the subsea facility will be achieved.

**302** Design verification should consist of one, or some, of the following:

— review of the design process,
— review of specifications for design (Asset specifications),
— review of design reports and drawings,
— performing of independent parallel calculations,
— review of specifications for construction and operation, resulting from design.

**303** The documents that shall be produced in the project should as a minimum satisfy the requirements of the selected code.

**304** Definition of scope of work for verification of design should follow Table 2-2.

**Table 2-2 Scope of work for verification of design**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| *Review of specifications for design by* | | | |
| — review of the design basis with emphasis on the design criteria | x | x | x |
| *Review of design reports and drawings by* | | | |
| — review of the main documentation to ensure that the main load conditions have been accounted for in design, that the governing conditions are identified, and that the chosen design philosophies are in accordance with specified codes and standards | x | x | x |
| — evaluation of the main methods used and spot checks of the input data and the calculation results | | x | x |
| — detailed review of main design reports | | | x |
| *Performing independent parallel calculations by* | | | |
| — check of pressure containment or overall structural integrity | x | x | x |
| — simplified independent analysis/calculation(s) performed by spot checks | | x | x |
| — advanced independent analysis/calculation(s) performed by spot checks | | | x |
| *Review of specifications for construction and operation by* | | | |
| — spot check of critical aspects | x | x | x |
| — review of main specifications | | x | x |
| — thorough review of main specifications | | | x |
| *Review of specific operational challenges (e.g. flow assurance* | | | |
| — general principles | x | x | x |
| — review of main documents supported by simplified analyses | | x | x |

**Guidance note:**

Design verification activities may be split up between Basic Design and Detailed Design, or other sub-phases, depending on type of contract.

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### D 400 Verification During Construction

**401** The construction phase comprises fabrication, manufacturing, sub-unit / unit integration testing, installation and commissioning. An important element is to ensure that the contractual design requirements are incorporated in the purchase documentation, and that correct materials, joining and corrosion control, have been applied, and that pressure rating, capacity and function are meeting the requirements as per approved specifications and procedures. It is imperative that relevant preparations for this is started as early as possible, e.g. by the appointment of a vendor supply verification co-ordinator.

**402** Verification during construction is carried out by means of full time attendance, audits, inspection or spot checks of the work, as appropriate, in sufficient detail to ensure that the specified requirements of the subsea facility will be achieved.

**403** Verification of these activities relates not only to the contractor's work but also to the monitoring of this work carried out by others.

**404** During construction verification should consist of one, or some, of the following:

— reviewing the construction process,
— reviewing construction procedures,
— reviewing qualification process,
— surveillance during construction activities,
— reviewing final documentation.

**405** The documents that should be produced in the project and submitted for review prior to start up are typically:

— Manufacturing Procedure Specification (MPS)
— Manufacturing procedures, including test requirements and acceptance criteria, repairs, personnel qualification records etc
— Material specifications
— Quality plans
— Welding Procedure Specifications (WPS) / Welding Procedure Qualification Record (WPQR)
— NDT procedures
— Manufacturing Procedure Qualification Test (MPQT) results; and
— Manufacturer's / fabricator's quality system manual

**406** Particularly for installation it is highly recommended to prepare a formal 'ready for start of installation' document to be verified prior to commencement.

**407** The "as-built" documentation to be submitted after manufacturing should include but not be limited to:

— Manufacturing procedures including test requirements and acceptance criteria, repairs, personnel qualification records etc
— Material certificates
— Production test records (visual, NDT, test samples, dimensional, heat treatment etc.)
— Hydrostatic test report
— Commissioning report
— Relevant statistics of chemical composition, mechanical properties and dimensions for the deliveries
— Relevant logs

**408** Definition of scope of work for verification of manufacturing and fabrication Table 2-3 and Table 2-4 for installation and Table 2-5 for final testing and completion.

**Table 2-3 Scope of work for verification of manufacturing and fabrication**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| *Review of the manufacturing and fabrication process* | | | |
| — Review of manufacturing and fabrication management systems | x | x | x |
| — Audit of the quality management system | | (x) | x |
| *Review of manufacturing and fabrication procedures* | | | |
| — Review manufacturing, fabrication and inspection procedures for confirmation of compliance with the manufacturing specification | x | x | x |
| — Review method statements | | x | x |
| *Review of qualification process* | | | |
| — Review the Manufacturing Procedure Specification, (MPS), Manufacturing Procedure Qualification Test (MPQT), as applicable | x | x | x |
| — Full time attendance during MPQT, as applicable, or first day production | | x | x |

**Table 2-3 Scope of work for verification of manufacturing and fabrication (Continued)**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| *Surveillance during manufacturing and fabrication activities* | | | |
| — Visit-based attendance during testing, to ensure, based on spot checks, that the delivered products have been produced in accordance with the manufacturing specification | x | x | x |
| — Visit-based or full-time attendance during manufacturing and fabrication to ensure, based on spot checks, that the delivered products have been produced in accordance with the manufacturing specification | | x | x |
| — Full-time attendance during manufacturing and fabrication to ensure, based on spot checks, that the delivered products have been produced in accordance with the manufacturing specification | | | x |
| *Review of final documentation* | x | x | x |

**Guidance note:**

Materials may be ordered with certificates of varying degrees of independent 3rd party verification (e.g. 3.1C according to EN 10204). This can this be integrated in the overall verification activities, so not to duplicate work.

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**Table 2-4 Scope of work for verification of installation**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| *Review of installation procedures* | | | |
| — Spot check of Installation Manual, (IM) | x | x | x |
| — For critical operations (identified from the FMEA and HAZOP studies) review the IM | | x | x |
| *Review of qualification process* | | | |
| — For critical operations, review the qualification of the IM | x | x | x |
| — Full time attendance during qualification tests, if applicable, or production start-up | | x | x |
| *Surveillance during installation activities* | | | |
| — Visit-based attendance during start up of each offshore operation (i.e. installation, completion, intervention works, etc). | x | x | x |
| — Full time attendance during defined test and trials | | x | x |
| *Review of final documentation* | x | x | x |

**Table 2-5 Scope of work for verification of final testing for operation, including as-built survey and project completion**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| *Review of procedures* | | | |
| — Review of the procedures for infield tests and commissioning to ensure that the procedure adequately covers the system in accordance with the design requirements | x | x | x |
| *Surveillance during testing and completion activities* | | | |
| — Full time attendance during commissioning | | x | x |
| — Full time attendance during specific tests testing and audit based attendance during ongoing testing | | | x |
| — Review of test results | x | x | x |
| *Review of final documentation* | | | |
| — Spot check of as-built documentation | x | x | x |
| — Review of as-built documentation | | | x |

## E. Project Operation

### E 100 Verification during operation

**101** Verification during operation is carried out by audit or spot check of the work in sufficient detail to ensure that the specified requirements of the subsea facilities continue to be achieved.

**102** Assessment of these activities will relate to the Owner's, as well as any contractor's, work.

**103** During operations, these assessments should consist of:

— review of operations processes:
— review of operations management systems,
— audit of the quality management system, if necessary,
— review of operations specifications and procedures:
— confirmation of design assumptions,
— method statements,
— inspection plans,
— inspection methods,
— procedures for evaluation of inspection results,
— attendance during operations activities:
— attendance during inspections,
— review of inspection records.

**104** In order to be able to carry out periodical surveys, the minimum documentation should include:

— personnel responsible for the operation of the subsea facilities
— history of the subsea facilities operation with reference to events that may have significance with respect to safety and functionality
— installation condition data as required
— physical and chemical characteristics of transported media including sand and sand detection measures
— inspection and maintenance / intervention philosophy, schedules and records
— inspection / intervention procedures and results as appropriate.

**105** Definition of verification of the operations phase should follow Table 2-6.

**Table 2-6 Scope of work for verification of operations**

| *Verification activity* | *Level* | | |
|---|---|---|---|
| | *L* | *M* | *H* |
| General review of the main document(s) to check compliance with applicable design documentation. Audit during repair and modification. | x | x | x |
| Audit attendance during start-up of periodical survey, modification and repair activities. For critical aspects, as identified by the contract, audit attendance throughout the activities. Review of contractors' documentation of the survey/modification. | | x | x |
| Review of the main document(s) to check compliance with applicable codes and standards. Audit attendance during start-up and performance of periodical survey, modification and repair activities. For critical aspects, as identified by the contract, full attendance throughout the preparations of and the activities. Issuing of independent confirmation documentation of the survey/modification. | | | x |

**106** Verification during operations is carried out to confirm that the subsea facilities continue to meet the Owner's specified requirements.

**107** Annual assessments may be carried out to confirm that any deterioration of the subsea facilities are within acceptable limits and that the facilities continues to be fit for the intended purpose.

**Guidance note:**

Annual assessments do not necessarily involve annual inspections as such regular inspections may not be required under a risk-based inspection strategy. Annual assessments may be limited to review of records confirming that the subsea facilities have been operated within its design limits.

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**108** Additional assessments should be carried out to confirm that any damage, deterioration or modification to the pipeline system or other systems does not render the subsea facilities unsuitable for the intended purpose.

## F. Verification Documents

### F 100 General

**101** The hierarchy of verification document is given in DNV-OSS-300 Appendix B. The descriptions of the content of these documents as well as examples of document forms are given in Appendix C to this specification.

# APPENDIX A
# SELECTION OF VERIFICATION LEVEL

## A. General

### A 100 General principles

**101** The selection of the level of verification depends on the risk level of each of the elements that have an impact on the management of risks to the asset.

**102** Verification shall direct greatest effort at those elements of the asset where the risk is highest and whose failure or reduced performance will have the most significant impact on the project objective and goals, e.g.:

- safety risks,
- environmental risks,
- economic risks.

**103** Suitable selection factors include, but are not limited to, the:

- Overall safety and other objectives for the asset
- Assessment of the risks associated with the asset and the measures taken to reduce these risks.
- Degree of technical innovation in the asset.
- Experience of the contractors in carrying out the work.
- Quality management systems of the Owner and its contractors.

**104** Due to the diversity of various subsea systems, their contents, their degree of innovation, the geographic location, et cetera, it is not possible to give precise guidelines on how to decide what level of verification is appropriate for each particular subsea system.

**105** Therefore, guidance is given as a series of questions that should be answered when deciding the appropriate level of verification for a subsea system. This list is not exhaustive and other questions should be added to the list if appropriate for a particular subsea system.

**106** It must be emphasised that the contribution of each element should be judged qualitatively and/or quantitatively. Wherever possible quantified risk assessment data should be used to provide a justifiable basis for any decisions made.

**107** Depending of the stage of the project, the activities may not have taken place yet in which case the questions can also be posed in another form, i.e. “Is …. planned to be?”

## B. Trigger Questions

### B 100 Overall project objective and goals

- Does the safety objective address the main safety goals?
- Does the safety objective establish acceptance criteria for the level of risk acceptable to the owner?
- Is this risk (depending on the subsea system and its location) measured in terms of human injuries as well as environmental, economic and political consequences?

**Guidance note:**

Substitute Safety Objective with other relevant objectives for the project, and go through all of them.

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### B 200 Assessment of risk

- Has a systematic review been carried out to identify and evaluate the probabilities and consequences of failures in the subsea system?
- Has this review judged the contribution of each element qualitatively and/or quantitatively and used, where possible, quantified risk assessment data to provide a justifiable basis for any decisions made?
- Does the extent of the review reflect the risk level of the subsea system, the planned operation and previous experience with similar subsea systems?
- Does this review identify the risk to the operation of the subsea system and to the health and safety of personnel associated with it or in its vicinity?
- Has the extent of the identified risks been reduced to a level as low as reasonably practicable by means of one or both of:
  - Reduction in the probability of failure?
  - Mitigation of the consequences of failure?
- Has the result of the systematic review of the risks been measured against the Owner’s safety (or other) objective?
- Has the result of this review been used in the selection of the appropriate verification activity level?

### B 300 Technical innovation

- Has the degree of technical innovation in the subsea system been considered?
- Has it been considered that risks to the subsea system are likely to be greater with a high degree of technical innovation than with a subsea system designed, manufactured and installed to well-known criteria in well-known waters?
- Have factors been considered in the selection of the appropriate verification level such as:
  - Degree of difficulty in achieving technical requirements.
  - Knowledge of similar subsea systems.
  - Effect of the new subsea system on the surrounding area.

### B 400 Contractors’ experience

- Has the degree of risk to the subsea system been considered where design, construction or installation contractors are inexperienced?
- Has the degree of risk been considered where the contractors are experienced but not in similar work?
- Has the degree of risk been considered where the work schedule is tight?

### B 500 Quality management systems

- Have all parties involved in the subsea system implemented an adequate quality management system to ensure that gross errors in the work are limited?
- Do these parties include the:
  - Owner?
  - Design contractor?
  - Construction contractors?
  - Installation contractor?
  - Operator?

— Do the factors being considered when evaluating the adequacy of the quality management system include:
  — Whether or not an ISO 9000 or equivalent certified system is in place?
  — Results from external audits?
  — Results from internal audits?
  — Experience with contractors' previous work?
  — Project work force familiarity with the quality management system?

# APPENDIX B
# DETAILED EXAMPLE SCOPE OF WORK TABLES FOR VERIFICATION

## A. General

### A 100 General introduction

**101** This appendix provides the format of the detailed verification lists (tables), generated for typical systems comprising a subsea facility:

1) Downhole system
2) Subsea wellhead and tree system (including: choke, tubing hanger and connection systems)
3) Manifold, foundations and template
4) Flowlines and risers (including dynamic umbilical risers)
5) Subsea control umbilicals
6) Subsea production control system
7) Subsea processing system
8) Well intervention/completion/workover system
9) ROT intervention systems

which shall be made for each particular project.

**102** The detailed project-specific verification lists for the chosen level of verification shall be based on these tables. For project scenarios or components not covered in this Appendix, similar lists with the same degree of detail shall be made.

**Guidance note:**

Descriptions of these systems can be found on top of the design tables.

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**103** If any of the activities are moved from one phase to another, then this must be identified clearly identified on the list where it is removed. Similarly, the detailed list for the phase to where it is moved shall be amended.

**Guidance note:**

Typically, contractual boundaries may give natural splits of activities between phases. However, then it is then even more important to ensure that there is a traceably as to which phases what activity belong and that this is also conveyed to the contractors also.

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## B. Description of Terms Used in the Verification Lists

### B 100 General

**101** The following abbreviations have been used. The definition contents of which are given subsequently given:

A = Audit
S = Surveillance
H = Hold Point
R = Review

**102** These abbreviations are DNV's preferred terms and will normally be used in DNV-generated documents. However, other terms, for example monitoring or witnessing, will be used by DNV if these are the terms commonly used in documents, such as Inspection and Test Plans, generated by others. In that case, it is expected that these other terms are defined in these documents.

### B 200 Audit

**201** Systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives (ISO 8402:1994).

**Guidance note:**

This activity differs from the Surveillance by being focused on the adherence to and completeness and robustness of the procedures and not on the actual result of the procedure (although this is not ignored). Further, the audit is normally a 'one-off' activity as opposed to the continuity in monitoring.

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### B 300 Surveillance

**301** Continual monitoring and verification of the status of an entity and analysis of records to ensure that specified requirements are being fulfilled (ISO 8402:1994).

**Guidance note:**

Other commonly used terms for Surveillance are Monitoring or Witnessing.

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**302** The amount of work involved in surveillance is not described in detail in the tables. This shall be part of the final contractual scope of work which shall define the frequency of surveillance based on the overall surveillance and the quality control performed by other parties as well as DNV's experience.

**303** The following shall be used to describe the frequency if nothing else is specifically defined:

S1 = Surveillance on a visit basis, e.g. frequency minimum once per week
S2 = Surveillance frequency minimum once per day
S3 = Surveillance frequency minimum once per shift

**Guidance note:**

These surveillance frequencies may be modified to correspond with production work flow.

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### B 400 Hold point witnessing

**401** A point, defined in an appropriate document, beyond which an activity must not proceed without the approval of a designated organization or authority (ISO 8402:1994).

### B 500 Review

**501** Systematic examination of reports and documentation. The depth of review will depend both on the type of document and the level of involvement.

**502** The following shall be used to describe the extent of the review if nothing else is specifically defined:

I = for information only
R1 = review of principles and general aspects
R2 = comprehensive review

**Guidance note:**

Review of production records does not guarantee their correctness. It is a confirmation to DNV that the manufacturer and/or

sub-contractor has preformed the required activity and issued a report.

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**503** Documents that are reviewed by DNV will, unless otherwise agreed, not be signed and stamped.

## C. Overall Project Management

### C 100 General

**101** The project quality management documentation, if part of scope, should be available at the early stages of the project, preferably before design is underway, to ensure that the necessary controls are in place.

**Table C1 Overall project management**

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Medium* | *High* |
| 1 | review of project quality management documentation. | R1 | R2 | R2 |
| 2 | audit of project quality management system | R1 | R2 | R2 |
| 3 | review of sub-contractor control | R1 | R2 | R2 |
| 4 | review of interface controls | R1 | R2 | R2 |
| 5 | review of methods of information flow | | | R1 |

## D. Design

### D 100 General

**101** For design verification a list similar to that given in Tables D1 to D10 shall be made for the specifics of the minimum requirement to documentation for each subsea facility.

### D 200 Design Verification

**201** Tables D1 to D10 describe issues to be verified. Tables D11 to D19 identifies relevant independent analyses/calculations included in the three verification levels.

### D 300 Low level Design Verification

**301** The initial Low level design verification consists of a detailed document review of the design basis, risk assessment/ analysis documentation, quality management documentation and (if they exist) method or design philosophy documents. The presumed high risk aspects of the project shall be identified by DNV from the initial review and conveyed to the Owner and designer for discussion and agreement on correct understanding.

**302** The subsequent verification consists of document review of the calculations analysis methods used to conclude the high risk aspects. Other design documents are used as information and a few will be spot checked for confirmation of the quality control.

**303** Implementation of the transfer of conclusions from design calculations and or reports into drawings and specifications is not included.

### D 400 Medium level Design Verification

**401** *Medium* level design verification consists of a review of all main design documents related to subsea facilities safety and integrity. Less critical aspects will be spot checked. The review will be detailed for high risk aspects and independent checks will be performed.

**402** A design quality management system audit will be performed.

**403** Implementation of the conclusions from design calculations/reports into drawings and specifications will be or is included on a spot check basis.

### D 500 High level Design Verification

**501** *High* level design verification consists of a full review of most of the produced documents related to integrity. The review will be detailed for all high risk aspects and independent checks shall be performed.

**502** Implementation of the conclusions from design calculations reports into drawings and specifications is included.

**503** The main specifications are also checked for clearness and ambiguity.

**Table D1 Subsea production system design**

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| *Availability/reliability of the systems:* | | | | |
| 1 | System RAM analysis | I | R1 | R2 |

**Table D2 Downhole system design**

*The downhole system typically consists of the following systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

— *Downhole safety valve*
— *Production tubing*
— *Packer*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |

| **Table D2 Downhole system design (Continued)** | | | | |
|---|---|---|---|---|
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | I | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | - | R1 | R2 |
| 10 | Intervention philosophy | - | R1 | R2 |
| 11 | Internal/external corrosion protection philosophy | I | R1 | R2 |
| 12 | Material selection philosophy | R1 | R2 | R2 |
| 13 | Downhole safety valve specification | R1 | R2 | R2 |
| 14 | Production tubing specification | I | R1 | R2 |
| 15 | Packer specification | R1 | R2 | R2 |
| 16 | NDE specifications | R1 | R2 | R2 |
| 17 | Installation and commissioning philosophy | - | R1 | R2 |
| *Review of design drawings and reports:* | | | | |
| 18 | Component design and qualification reports | R1 | R2 | R2 |
| 19 | Environmental/structural/accidental loading report | R1 | R2 | R2 |
| 20 | Intervention tools design and qualification reports | I | R1 | R2 |
| 21 | Internal/external corrosion protection report | - | I | R2 |
| 22 | Tree mounted hydraulic/electric control interface selection and qualification reports | - | I | R2 |

**Table D3 Subsea wellhead and tree system design**

*The subsea wellhead and tree system typically consists of the following systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

a) *Subsea tree assembly, including:*

- *subsea tree*
- *tree connectors*
- *valves, valve blocks and valve actuators*
- *chokes and choke actuators*
- *tree cap*
- *tree piping*
- *tree guide frames*
- *tree mounted controls interfaces: instrumentation, sensors, control pod interface, hydraulic piping and fittings, electrical cables and fittings*
- *protection frame (if an individual frame is fitted directly to the tree assembly)*
- *ROV interfaces (e.g. main subsea tree valve overrides, choke/SCM replacement, relevant docking points, again if these are fitted individually to each tree assembly).*

b) *Subsea wellhead assembly, including:*

- *conductor housing*
- *wellhead housing*
- *casing hangers*
- *seal assemblies*
- *guide base*
- *bore protectors and wear bushings*
- *corrosion caps*

c) *Tubing hanger*

d) *Flowline and umbilical connectors*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |

| **Table D3 Subsea wellhead and tree system design (Continued)** | | | | |
|---|---|---|---|---|
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | - | R1 | R2 |
| 10 | Intervention philosophy | - | R1 | R2 |
| 11 | Internal/external corrosion protection philosophy | I | R1 | R2 |
| 12 | Material selection philosophy | R1 | R2 | R2 |
| 13 | Subsea tree and piping specification | R1 | R2 | R2 |
| 14 | Valve and actuator specifications | R1 | R1 | R2 |
| 15 | Choke and actuator specifications | R1 | R2 | R2 |
| 16 | Tree cap specifications | R1 | R2 | R2 |
| 17 | Tree guide frames specifications | - | - | R1 |
| 18 | Protection frame specifications | - | - | R1 |
| 19 | Tree mounted hydraulic/electric control interface specifications | R1 | R2 | R2 |
| 20 | Wellhead assembly specification | R1 | R2 | R2 |
| 21 | Tubing hanger specification | R1 | R2 | R2 |
| 22 | Flowline and umbilical connector specification | I | R1 | R2 |
| 23 | Manufacturing/inspection/test specifications | R1 | R2 | R2 |
| 24 | Welding procedure specifications | R1 | R2 | R2 |
| 25 | NDE specifications | R1 | R2 | R2 |
| 26 | Installation and commissioning philosophy | - | R1 | R2 |
| *Review of design drawings and reports:* | | | | |
| 27 | Component design and qualification reports | R1 | R2 | R2 |
| 28 | Environmental/structural/accidental loading report | R1 | R2 | R2 |
| 29 | Intervention tools design and qualification reports | I | R1 | R2 |
| 30 | Internal/external corrosion protection report | - | I | R2 |
| 31 | Tree mounted hydraulic/electric control interface selection and qualification reports | - | I | R2 |
| 32 | Installation analysis | R1 | R2 | R2 |

**Table D4 Manifold, foundations and template design**

*The Manifold, foundations and template system consists of the following sub-systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

— *Manifold piping*
— *Flowline connections*
— *Isolation valves and actuators*
— *Chemical injection valves and actuators (if applicable)*
— *Production/Injection choke body, insert and actuator (if applicable)*
— *Protection frame*

*ROV interfaces (e.g. valve overrides, choke/SCM replacement, and relevant docking points).*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | - | R1 | R2 |
| 10 | Intervention philosophy | - | R1 | R2 |
| 11 | Internal/external corrosion protection philosophy | I | R1 | R2 |
| 12 | Material selection philosophy | R1 | R2 | R2 |
| 13 | Manifold and piping specifications | R1 | R2 | R2 |

| Table D4 Manifold, foundations and template design (Continued) | | | | |
|---|---|---|---|---|
| 14 | Flowline connections specifications | R1 | R2 | R2 |
| 15 | Production/Injection choke body, insert and actuator specifications | R1 | R2 | R2 |
| 16 | Protection frame specifications | R1 | R2 | R2 |
| 17 | ROV interface specifications | R1 | R2 | R2 |
| 18 | Valve specifications | R1 | R2 | R2 |
| 19 | Actuator specifications | R1 | R2 | R2 |
| 20 | Instrumentation specifications | I | R1 | R2 |
| 21 | Manufacturing/inspection/test specifications | R1 | R2 | R2 |
| 22 | Welding procedure specifications | R1 | R2 | R2 |
| 23 | NDE specifications | R1 | R2 | R2 |
| 24 | Installation and commissioning philosophy | - | R1 | R2 |
| *Review of design drawings and reports:* | | | | |
| 25 | Design and qualification reports | R1 | R2 | R2 |
| 26 | Environmental/accidental loading report | R1 | R2 | R2 |
| 27 | Intervention tools design and qualification reports | I | R1 | R2 |
| 28 | Internal/external corrosion protection report | - | I | R2 |
| 29 | Valve selection and qualification reports | R1 | R2 | R2 |
| 30 | Actuator selection and qualification reports | R1 | R2 | R2 |
| 31 | Instrumentation selection and qualification reports | - | I | R2 |
| 32 | Foundation design report | R1 | R2 | R2 |
| 33 | Installation analysis | R1 | R2 | R2 |

**Table D5 Flowlines and risers design**

*Flowlines and risers typically consist of the following applications, and the verification activities relate to safety, integrity, functionality and reliability of these applications.*

a) *Flowlines:*

- *Rigid flowlines*
- *Rigid flowline tie-in spools (e.g. between wellheads and manifold, manifold and production installation)*
- *Flexible flowlines*

b) *Rigid risers:*

- *Rigid metallic risers*

c) *Dynamic risers*

- *Dynamic metallic risers*
- *Dynamic composite risers*
- *Dynamic flexible risers*
- *Dynamic umbilical risers*

*The detailed verification of the above components will performed according the following documents:*

a) *Flowlines: DNV-0SS-301, Certification and verification of pipelines.*

b) *Rigid risers: DNV-0SS-301, Certification and verification of pipelines.*

c) *Dynamic risers: DNV-0SS-302, Offshore riser systems.*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |

**Table D6 Subsea control umbilicals design**

*The subsea control umbilical typically consists of the following functions and applications, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these functions and applications.*

*Functions:*

— *Electric, hydraulic and electro-hydraulic control*
— *Chemical injection*
— *Gas lift*
— *Flowline depressurization*
— *UT*

*Applications:*

— *Static only. Please note that dynamic umbilical risers are addressed under "Flowlines and risers".*
— *Surface-surface, surface-subsea and subsea-subsea*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | - | R1 | R2 |
| 10 | Internal/external corrosion protection philosophy | - | R1 | R2 |
| 11 | Material selection philosophy | I | R2 | R2 |
| 12 | Installation, repair and commissioning philosophy | R1 | R2 | R2 |
| 13 | Manufacturing/inspection/test specifications | R1 | R2 | R2 |
| 14 | Welding procedure specifications | R1 | R2 | R2 |
| 15 | NDE specifications | R1 | R2 | R2 |
| 16 | End connector/pull-in head/bend restrictor specifications | I | R1 | R2 |
| *Review of design drawings and reports:* | | | | |
| 17 | Design and qualification reports | R1 | R2 | R2 |
| 18 | Environmental/accidental loading report | R1 | R2 | R2 |
| 19 | Material and component qualification reports | R1 | R2 | R2 |
| 20 | External corrosion protection report | - | I | R2 |
| 21 | Installation analysis report | R1 | R2 | R2 |

**Table D7 Subsea production control system design**

*The subsea production control system consists of the following systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

| *Topside* | *Subsea* |
|---|---|
| *SPCU*<br>*UPS*<br>*HPU*<br>*MCC*<br>*TUTU*<br>*MCS*<br>*HTP*<br>*DCS*<br>*EPU*<br>*SCR*<br>*SCU*<br>*Chemical Supply*<br>*ETU*<br>*SCM test stand*<br>*Test flushing plate*<br>*SCM shipping skid* | *SCM*<br>*Hydraulic jumpers*<br>*Electrical jumpers*<br>*SCMMB*<br>*Test/flushing plate hydraulic and chemical junction plate*<br>*SDU*<br>*EDU*<br>*Sensors*<br>*Connectors*<br>*MQC*<br>*SEM*<br>*PT*<br>*TT* |

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis | R1 | R2 | R2 |
| 9 | Control philosophy | R1 | R2 | R2 |
| 10 | Corrosion protection philosophy | - | R1 | R2 |
| 11 | Communication philosophy | I | R1 | R2 |
| 12 | Hydraulic system philosophy | R1 | R2 | R2 |
| 13 | Electrical/power supply philosophy | R1 | R2 | R2 |
| 14 | Material selection philosophy | R1 | R2 | R2 |
| 15 | Welding procedure specifications | R1 | R2 | R2 |
| 16 | NDE specifications | R1 | R2 | R2 |
| *Review of electro-hydraulic functions:* | | | | |
| 17 | Electrical analysis to confirm power distribution and consumption | I | R1 | R2 |
| 18 | Design requirements for the electrical communication and protocol | R1 | R2 | R2 |
| 19 | Electrical communication analysis | I | R1 | R2 |
| 20 | Design requirement for the hydraulic supply | R1 | R2 | R2 |
| 21 | Hydraulic analysis to confirm response time | I | R1 | R2 |
| *Review of control functions:* | | | | |
| 22 | Control valve/choke valve specification | I | R1 | R2 |
| 23 | Control valve/ choke valve qualification procedures and reports | - | I | R2 |
| 24 | Chemical/methanol dosing requirements | I | R1 | R2 |
| 25 | Scale inhibitor system | I | R1 | R2 |
| *Review of mechanical components:* | | | | |
| 26 | Pressure rating for pressure retaining components such as tubing and stab plates | R1 | R2 | R2 |
| 27 | Umbilical termination stress analysis | - | I | R2 |
| 28 | Electrical jumper and connector specification | I | R1 | R2 |
| 29 | Electrical jumper and connector qualification procedures and reports | - | I | R2 |
| 30 | Hydraulic/chemical jumper and connector specification | I | R1 | R2 |
| 31 | Hydraulic/chemical jumper and connector qualification procedures and reports | - | I | R2 |
| 32 | Stab plate pressure rating | - | I | R1 |
| 33 | Jumper/umbilical deployment tools specification | I | R1 | R2 |
| 34 | Intervention tools | I | R1 | R2 |

| **Table D7 Subsea production control system design (Continued)** | | | | |
|---|---|---|---|---|
| *Subsea electronic modules(SEM):* | | | | |
| 35 | Microprocessors and power supply unit(s) specifications | I | R1 | R2 |
| 36 | Microprocessors and power supply qualification procedures and reports | - | I | R1 |
| 37 | SEM software specifications | I | R1 | R2 |
| 38 | SEM software qualification procedures and reports | - | I | R1 |
| 39 | Instrumentation specifications | I | R1 | R2 |
| 40 | Instrumentation qualification procedures and reports | - | I | R1 |
| *Corrosion control:* | | | | |
| 41 | Internal corrosion (i.e. corrosion allowance) specification/design | - | I | R2 |
| 42 | External corrosion (e.g. cathodic protection) design and specification | - | I | R1 |
| *System survivability:* | | | | |
| 43 | System design to ensure an overall fail-safe design | R1 | R2 | R2 |
| 44 | Electro-hydraulic P&ID to ensure fail-safe principle is implemented | R1 | R2 | R2 |
| 45 | FMEA study to ensure risk of common mode failure is acceptable | I | R1 | R2 |
| *Availability/reliability of the systems:* | | | | |
| 46 | UPS specification to confirm power back up | I | R1 | R2 |
| 47 | HIPPS system for integrity level | I | R1 | R2 |
| 48 | Hydraulic system back-up | I | R1 | R2 |
| 49 | Communication capacity and redundancy | I | R1 | R2 |
| 50 | Subsea electronic module for redundancy | I | R1 | R2 |
| 51 | System RAM analysis | I | R1 | R2 |
| *Installation, commissioning, operation* | | | | |
| 52 | Installation procedures | I | R1 | R2 |
| 53 | Test procedures | I | R1 | R2 |
| 54 | Operation manual | I | R1 | R2 |
| *Environment Impact Assessment* | | | | |
| 55 | Open hydraulic system only | I | R1 | R2 |

**Table D8 Subsea processing system design**

*The subsea processing system typically consists of the following sub-systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

— *Separator*
— *Control valves and actuators*
— *Isolation valves and actuators*
— *Protection frame*
— *ROV interfaces (e.g. valve overrides, boosting unit/SCM replacement, relevant docking points).*

*Subsea separation, typically one of the following:*

i) *gas/liquid*
ii) *hydrocarbon/water*
iii) *3-phase*

*Subsea boosting station comprising one or more of the following:*

i) *combined oil/water/gas (multi-phase pump)*
ii) *gas compression*
iii) *water injection*
iv) *oil boosting*
v) *oil/water boosting (multi-phase pump)*
vi) *combined gas/water injection (multi-phase pump)*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |

| **Table D8 Subsea processing system design (Continued)** | | | | |
|---|---|---|---|---|
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | I | R1 | R2 |
| 10 | Installation and commissioning philosophy | - | R1 | R2 |
| 11 | Internal/external corrosion protection philosophy | I | R1 | R2 |
| 12 | Intervention philosophy | I | R1 | R2 |
| 13 | Material selection philosophy | R1 | R2 | R2 |
| 14 | Separator specifications | R1 | R2 | R2 |
| 15 | Boosting station specification {could split into smaller components e.g. pump, filter, cooler, seals, compressor, lube oil system, etc.} | R1 | R2 | R2 |
| 16 | Valve/actuator specifications | I | R1 | R2 |
| 17 | Instrumentation specifications | I | R1 | R2 |
| 18 | Protection frame specifications | I | R1 | R2 |
| 19 | ROV interfaces specifications | I | R1 | R2 |
| 20 | Manufacturing/inspection/test specifications | R1 | R2 | R2 |
| 21 | Welding procedure specifications | R1 | R2 | R2 |
| 22 | NDE specifications | R1 | R2 | R2 |
| *Review of design drawings and reports:* | | | | |
| 23 | Design report | R1 | R2 | R2 |
| 24 | Environmental/accidental loading report | R1 | R2 | R2 |
| 25 | Intervention tools design and qualification reports | I | R1 | R2 |
| 26 | Internal/external corrosion protection report | - | I | R2 |
| 27 | Valve/actuator selection and qualification reports | R1 | R2 | R2 |
| 28 | Booster station selection and qualification reports | R1 | R2 | R2 |
| 29 | Instrumentation selection and qualification reports | - | I | R2 |
| 30 | Foundation design report | R1 | R2 | R2 |
| 31 | Critical material/component selection and qualification reports {e.g. high wear, novel materials, high corrosion resistant, new technology} | R1 | R2 | R2 |
| 32 | Installation analysis | R1 | R2 | R2 |

**Table D9 Well intervention/completion/workover system design**

*The well intervention/completion/workover system typically consists of the following systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

— *Riser joints*
— *Connectors*
— *Work over control systems*
— *Surface flow trees*
— *Swivels*
— *Surface tree tension frames*
— *Lower workover riser packages*
— *Lubricator valves*
— *Retainer valves*
— *Subsea test trees*
— *Shear subs*
— *Tubing hanger orientation systems*
— *Annulus circulation hoses*
— *Riser spiders*
— *Umbilical clamps*
— *Wire Line/Coiled Tubing adapters*
— *Handling and test tools*
— *ROV interface*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organization | I | I | R1 |

| Table D9 Well intervention/completion/workover system design (Continued) | | | | |
|---|---|---|---|---|
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | R1 | R1 | R2 |
| 10 | Intervention philosophy | I | R1 | R2 |
| 11 | Internal/external corrosion protection philosophy | - | R1 | R2 |
| 12 | Material selection philosophy | R1 | R2 | R2 |
| 13 | Subsea well intervention/completion/workover system specification | R1 | R2 | R2 |
| 14 | Riser joints specifications | I | R1 | R2 |
| 15 | Connectors specifications | I | R1 | R2 |
| 16 | Work over control systems specification, see applicable elements in D7 | I | R1 | R2 |
| 17 | Surface flow trees specification | I | R1 | R2 |
| 18 | Swivels specification | I | R1 | R2 |
| 19 | Surface tree tension frames specifications | I | R1 | R2 |
| 20 | Lower workover riser packages specifications | I | R1 | R2 |
| 21 | Lubricator valves specifications | I | R1 | R2 |
| 22 | Retainer valves specifications | I | R1 | R2 |
| 23 | Subsea test trees specifications | I | R1 | R2 |
| 24 | Shear subs specifications | I | R1 | R2 |
| 25 | Tubing hanger orientation systems specifications | R1 | R2 | R2 |
| 26 | Annulus circulation hoses specifications | I | R1 | R2 |
| 27 | Riser spiders specifications | I | R1 | R2 |
| 28 | Umbilical clamps specifications | - | R1 | R2 |
| 29 | Handling and test tools specification | I | R1 | R2 |
| 30 | Wire Line/Coiled Tubing adapters specification | I | R1 | R2 |
| 31 | ROV interface specifications | I | R1 | R2 |
| 32 | Manufacturing/inspection/test specification | R1 | R2 | R2 |
| 33 | Welding procedure specification | R1 | R2 | R2 |
| 34 | NDE specifications | R1 | R2 | R2 |
| 35 | System design to ensure an overall fail-safe system | R1 | R1 | R2 |
| *Review of design drawings and reports:* | | | | |
| 36 | Component design and qualification reports | R1 | R2 | R2 |
| 37 | Environmental/structural/accidental loading report | R1 | R2 | R2 |
| 38 | Intervention tools design and qualification reports | I | R1 | R2 |
| 39 | Internal/external corrosion protection report | - | I | R2 |
| 40 | Tree mounted hydraulic/electric control interface selection and qualification reports | - | I | R2 |

**Table D10 ROT intervention system design**

*The ROT intervention system typically consists of the following systems and components, and the verification activities described in the following tables relate to safety, integrity, functionality and reliability of these systems/ components and the interaction between them.*

— *ROT for dedicated intervention task*
— *Deck handling equipment*
— *ICS*
— *Deployment/landing equipment*
— *ROV spread interface with ROT systems*

*ROT intervention systems shall be verified for all phases of an intervention operation, which typically are:*

i) *Mobilization*
ii) *Deck handling and preparation*
iii) *Launch, descent and landing*
iv) *Intervention task*
v) *Testing*
vi) *Complementary tasks*
vii) *Retrieval*
viii) *Demobilization*
ix) *Contingency*

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med.* | *High* |
| *General* | | | | |
| 1 | Safety objective | I | I | I |
| 2 | Confirmation that the different contractors and sub-contractors' quality systems meet the requirements of ISO 9000 | R2 | R2 | R2 |
| 3 | Description of subsea system and overall project organisation | I | I | R1 |
| 4 | Risk assessment and identification of critical aspects | R2 | R2 | R2 |
| 5 | Document register | I | R1 | R2 |
| *Review of the design process by:* | | | | |
| 6 | Review of design quality management documentation | R2 | R2 | R2 |
| 7 | Audit of design quality management documentation | - | A | A |
| *Review of specifications for design:* | | | | |
| 8 | Design basis (including pressure/thermal/structural/vibration/environmental /transportation/installation/accidental loading premise) | R2 | R2 | R2 |
| 9 | Operation philosophy | I | R1 | R2 |
| 10 | Intervention philosophy | I | R1 | R2 |
| 11 | Internal/external corrosion protection philosophy | - | R1 | R2 |
| 12 | Material selection philosophy | R1 | R2 | R2 |
| 13 | ROT specifications | R1 | R2 | R2 |
| 14 | ROT equipment specifications | I | R1 | R2 |
| 15 | Deck handling and preparation specifications | - | - | I |
| 16 | ICS specifications | - | I | R1 |
| 17 | Deployment/landing equipment specification | - | - | I |
| 18 | Intervention procedures specifications | R1 | R2 | R2 |
| 19 | Manufacturing/inspection/test specifications | R1 | R2 | R2 |
| 20 | Interface specifications | I | R1 | R2 |
| 21 | System design to ensure an overall fail-safe system | R1 | R1 | R2 |
| *Review of design drawings and reports:* | | | | |
| 22 | Component design and qualification reports | R1 | R2 | R2 |
| 23 | Environmental/structural/accidental loading report | R1 | R2 | R2 |
| 24 | Intervention tools design and qualification reports | I | R1 | R2 |
| 25 | Internal/external corrosion protection report | - | I | R2 |
| 26 | Tree mounted hydraulic/electric control interface selection and qualification reports | - | I | R2 |

| **Table D11 Downhole system independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Downhole safety valve and casing:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Valve/choke/actuator calculations | - | - | X |
| *Corrosion:* | | | | |
| 3 | Internal corrosion/erosion calculations | - | - | X |
| 4 | Cathodic protection calculations | - | - | X |
| *System survivability:* | | | | |
| 5 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| **Table D12 Subsea wellhead and tree system independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Tree assembly, wellhead assembly, tubing hangers:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Valve/choke/actuator calculations | - | - | X |
| *Corrosion:* | | | | |
| 3 | Internal corrosion/erosion calculations | - | - | X |
| 4 | Cathodic protection calculations | - | - | X |
| *System survivability:* | | | | |
| 5 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| **Table D13 Manifold, foundations and template independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Piping, structure and valves:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Valve/actuator calculations | - | - | X |
| 3 | Pile/foundation analysis | - | - | X |
| *Corrosion:* | | | | |
| 4 | Internal corrosion/erosion calculations | - | - | X |
| 5 | Cathodic protection calculations | - | - | X |
| *System survivability:* | | | | |
| 6 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| **Table D14 Flowlines and risers independent design analysis / qualification** |
|---|
| Please refer to Table D5 |

| **Table D15 Subsea control umbilicals independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Pressure, temperature and structural:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Design life calculations | - | - | X |
| *Materials and corrosion:* | | | | |
| 3 | Material/fluid compatibility calculations | - | - | X |
| 4 | Cathodic protection calculations | - | - | X |
| *Connection systems:* | | | | |
| 5 | Review of compatibility/interfaces | - | - | X |
| 6 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| **Table D16 Subsea production control system independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Electro-hydraulic functions:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Tree/choke/chemical injection valve/actuator calculations | - | - | X |
| 3 | Independent electrical communication analysis to confirm communication time | - | - | X |
| *Control functions:* | | | | |
| 4 | Calculation for dosing requirement | - | - | X |
| 5 | Control valve/ choke valve qualification | - | - | X |
| *Mechanical components:* | | | | |
| 6 | Umbilical termination stress analysis | - | - | X |
| 7 | Electrical jumper and connector qualification | - | - | X |
| 8 | Hydraulic/chemical jumper and connector qualification | - | - | X |
| 9 | Stab plate qualification | - | - | X |
| 10 | Jumper/umbilical deployment tools qualification | - | - | X |
| 11 | Intervention tools qualification | - | - | X |
| *Subsea electronic modules (SEM):* | | | | |
| 12 | Microprocessors and power supply qualification | - | - | X |
| 13 | SEM software qualification | - | - | X |
| 14 | Instrumentation qualification | - | - | X |
| *Corrosion:* | | | | |
| 15 | Calculation of cathodic protection | - | - | X |
| *System survivability:* | | | | |
| 16 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| **Table D17 Subsea processing system independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Separators, rotating equipment and valves:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Pump/compressor mechanics/fluid dynamics | - | - | X |
| 3 | Valve/actuator calculations | - | - | X |
| *Corrosion:* | | | | |
| 4 | Internal corrosion/erosion calculations | - | - | X |
| 5 | Cathodic protection calculations | - | - | X |
| *System survivability:* | | | | |
| 6 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| **Table D18 Well intervention/completion/workover system independent design analysis / qualification** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Well intervention/completion/workover assembly:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| 2 | Valve/choke/actuator calculations | - | - | X |
| *Mechanical components* | | | | |
| 3 | Umbilical analysis see D15 | | | |
| 4 | Workover control system analysis see D16 | | | |
| *Corrosion:* | | | | |
| 5 | Internal corrosion/erosion calculations | - | - | X |
| 6 | Cathodic protection calculations | - | - | X |
| *System survivability:* | | | | |
| 7 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

| Table D19 ROT intervention system independent design analysis / qualification | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *ROT intervention system:* | | | | |
| 1 | Pressure containment, thermal, structural and fatigue calculations | - | - | X |
| *System survivability:* | | | | |
| 5 | Review/conduct an HAZID / FMECA as applicable | - | - | X |

x = analysis/check will be included in the scope of work (if relevant)

(x) = analysis/check should be included in the scope of work if the issue is identified as critical or highly utilised. Then final decision of inclusion in the scope of work will be a result of the document review of simple analysis.

## E. Construction

### E 100 General

**101** Construction consists of a number of different site activities and their associated documentation, related office and paper work.

**102** For construction, verification lists similar those shown hereafter shall be made for the specifics of the particular project.

### E 200 Construction Verification

**201** Sec.2 D specifies typical documentation to be submitted before, during and after construction.

**202** Verification of subsea facility construction activities includes:

— initial activities,
— surveillance and review activities, and
— final activities.

**203** The *initial activities* include the review of procedures, attendance during qualification of procedures (e.g. MPQT) and personnel (e.g. welders) and other start-up activities. The *surveillance and reviewactivities* are the site attendance and the *final activities* are the (continuous) review of production results/ records and the completion of documentation and reports.

### E 300 Low Level Construction Verification

**301** For *Low* level verification, the procedure review consists of a review of the construction management procedures and confirmation that the most important aspects of the main specifications have been included in the procedures. For the qualification of procedures and personnel DNV will not attend the actual qualification, but will review the results.

**302** During the construction, DNV's verification will be performed during site visits. The verification will focus on the critical items/aspects identified in the detailed scope of work tables.

**303** The subsequent verification of the final activities will be by spot-checks of the production records including non-conformance logs, and results from audits, both Contractors internal audits or audits performed by other parties.

### E 400 Medium Level Construction Verification

**401** For *Medium* level verification, the procedure review consists of a detailed review of construction management procedures. Other important procedures will be spot checked to confirm that the most important aspects of the specifications have been included.

**402** A Quality system audit of relevant installation vessel(s) will be performed.

**403** For the qualification of procedures and personnel DNV will visit the main qualifications and review the results.

**404** During construction, DNV's verification will be performed by full time attendance at the main sites. The verification will focus on the critical items/aspects as identified in the detailed scope of work tables.

**405** Verification of the final activities will be by review of the production records including non-conformance logs, and results from audits, both Contractor's internal audits or audits performed by other parties, from the main sites and spot checks of the same from other important sites.

### E 500 High Level Construction Verification

**501** For *High* level verification, the procedure review consists of a detailed review of construction management procedures. Other procedures will be spot checked to confirmation that important aspects of the specifications have been included.

**502** A Quality system audit of relevant installation vessel(s) will be performed.

**503** For qualification of procedures and personnel DNV will attend the main qualifications, visit other qualifications and review the results.

**504** During construction, DNV's verification will be performed by full time attendance at the main sites and by visits to the other important sites. Verification will focus on the critical items/aspects as identified in the detailed scope of work tables.

**505** Verification of the final activities will be by detailed review of manufacturing records, installation records, test results, non-conformance logs and relevant audit findings.

### E 600 Verification of Work in Progress

**601** The monitoring by the Owner during construction relates to the activities of the contractor. The monitoring of these activities by DNV relates not only to the contractor's activities but also to the monitoring of these activities carried out by the Owner.

**602** The emphasis placed on the various activities in the verification plan varies depending on:

— any areas of concern revealed during design verification,
— any areas of concern revealed during the audit of the Owner's or contractor's quality management systems,
— the progress of design or construction,
— the findings of the contractor surveillance personnel.

**603** Many contractors have adequate quality control systems and quality control departments, with competent personnel to perform required assessments of suppliers and sub-contractors.

**604** In such a case, all verification work need not be done by DNV personnel. Where applicable, the various inspections may be carried out by competent persons other than DNV personnel. In that situation DNV's verification activities can be confined to:

— reviewing the competence of the Contractor's personnel,
— auditing their working methods and their performance of that work, and
— reviewing the documents produced by them.

**605** DNV personnel will spend more time in areas where problems have occurred, or are considered likely to occur. Conversely, less time is spent in areas where the likelihood of problems is considered lower.

### E 700 DNV Final Report

**701** All the Scopes of Work tables for construction end with a Point entitled "Issue of DNV Visit Report". This item is not related to the production process is intended as a reminder to the DNV (or others) inspection personnel that a final report of their verification activities is required to finish the work.

**Table E1 Downhole system fabrication, manufacturing, sub-unit / unit and integration testing**

| *Item* | *Description* | *Level* | | |
|---|---|---|---|---|
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm valve functions by:<br>— witness FAT on all valve functions | S2 | S3 | S3 |
| 9 | Confirm cleanliness of hydraulic systems by:<br>— review of cleanliness report | I | R1 | R2 |
| 10 | Confirm pressure integrity of components by:<br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 11 | Confirm corrosion control by:<br>— correct application of paint systems<br>— inspection of anode locations in accordance with approved drawings | S1 | S2 | S3 |
| 12 | Confirm correct markings by:<br>— inspection of markings in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S2 |
| 13 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br>— pressure tests<br>— structural loading tests<br>— valve operation<br>— integration with control system<br>— hydraulic fitness | S1 | S3 | S3 |
| 14 | Confirm correct integration with subsea tools and equipment. Monitor System Integration Tests (SIT) with particular attention to:<br>— systems assembly/fit-up<br>— well intervention tool interfacing<br>— integration with Subsea Control System | S1 | S2 | S3 |
| *Final activities* | | | | |
| 15 | Confirm downhole system functions by review of:<br>— FAT records | I | R1 | R2 |
| 16 | Confirm integration with subsea tools and equipment by review of:<br>— SIT reports | I | R1 | R2 |
| 17 | Issue DNV visit / close-out report | H | H | H |

| **Table E2 Subsea wellhead and tree system fabrication, manufacturing, sub-unit / unit and integration testing** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br><br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm valve functions by:<br><br>— witness FAT on all valve functions | S2 | S3 | S3 |
| 8 | Confirm function of tree instrumentation by:<br><br>— witness FAT on all instrument functions | S2 | S3 | S3 |
| 9 | Confirm cleanliness of hydraulic systems by:<br><br>— review of cleanliness report | I | R1 | R2 |
| 10 | Confirm pressure integrity of components by:<br><br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 11 | Confirm corrosion control by:<br><br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 12 | Confirm correct markings by:<br><br>— inspection of all markings in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S2 |
| 13 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br><br>— pressure tests<br>— valve operation<br>— structural loading tests<br>— integration with control system<br>— hydraulic fitness | S1 | S3 | S3 |
| 14 | Confirm correct integration with subsea tools and equipment. Monitor System Integration Tests (SIT) with particular attention to:<br><br>— systems assembly/fit-up<br>— ROV access<br>— ROV tool interface compatibility and function<br>— well intervention tool interfacing<br>— integration with Subsea Control System | S1 | S2 | S3 |
| *Final activities* | | | | |
| 15 | Confirm tree system functions by review of:<br><br>— FAT records | I | R1 | R2 |
| 16 | Confirm integration with subsea tools and equipment by review of:<br><br>— SIT reports | I | R1 | R2 |
| 17 | Issue DNV visit / close-out report | H | H | H |

| **Table E3 Manifold, foundations and template fabrication, manufacturing, sub-unit / unit and integration testing** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br><br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm valve and choke functions by:<br><br>— witness FAT on all valve/choke functions | S2 | S3 | S3 |
| 8 | Confirm function of manifold/template instrumentation by:<br><br>— witness FAT on all instrument functions | S2 | S3 | S3 |
| 9 | Confirm cleanliness of hydraulic systems (if applicable) by:<br><br>— review of cleanliness report | I | R1 | R2 |
| 10 | Confirm pressure integrity of components by:<br><br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 11 | Confirm corrosion control by:<br><br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 12 | Confirm correct markings by:<br><br>— inspection of all markings in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S2 |
| 13 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br><br>— pressure tests<br>— valve/choke operation<br>— integration with control system<br>— hydraulic fitness | S1 | S3 | S3 |
| 14 | Confirm correct integration with subsea tools and equipment. Monitor System Integration Tests (SIT) with particular attention to:<br><br>— systems assembly/fit-up<br>— ROV access<br>— ROV tool interface compatibility and function<br>— well intervention tool interfacing<br>— integration with Subsea Control System | S1 | S2 | S3 |
| *Final activities* | | | | |
| 15 | Confirm manifold/template functions by review of:<br><br>— FAT records | I | R1 | R2 |
| 16 | Confirm integration with subsea tools and equipment by review of:<br><br>— SIT reports | I | R1 | R2 |
| 17 | Issue DNV visit / close-out report | H | H | H |

| **Table E4 Flowlines and risers fabrication, manufacturing, sub-unit / unit and integration testing** |
|---|
| Please refer to Table D5 |

| **Table E5 Subsea control umbilicals manufacturing, sub-unit / unit and integration testing** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm critical dimensions. | R1 | R2 | R2 |
| 8 | Confirm cleanliness of hydraulic systems by:<br>— review of cleanliness report | I | R1 | R2 |
| 9 | Confirm pressure integrity of components by:<br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 10 | Confirm corrosion control by:<br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 11 | Confirm correct markings by:<br>— correct application of paint systems<br>— inspection of all markings in accordance with approved drawings | S1 | S2 | S2 |
| 12 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br>— pressure tests<br>— electrical tests for power and signal cables<br>— integration with control system<br>— hydraulic fitness | S1 | S3 | S3 |
| *Final activities* | | | | |
| 13 | Confirm manifold/template functions by review of:<br>— FAT records | I | R1 | R2 |
| 14 | Issue DNV visit / close-out report | H | H | H |

| **Table E6 Subsea production control system fabrication, manufacturing, sub-unit / unit and integration testing** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | - | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br><br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm subsea ESD process safety functions by:<br><br>— witness FAT on all ESD functions to ensure that fail-safe conditions are met | S3 | S3 | S3 |
| 8 | Confirm capacity of UPS and hydraulic accumulator by:<br><br>— review of UPS and accumulator certificates | I | R1 | R2 |
| 9 | Confirm cleanliness of hydraulic systems by:<br><br>— review of cleanliness report | I | R1 | R2 |
| 10 | Confirm pressure integrity of components by:<br><br>— review of pressure test certificates for each component | I | R1 | R2 |
| 11 | Confirm corrosion control by:<br><br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 12 | Confirm correct markings by:<br><br>— tag numbers<br>— delivery protocol<br>— non-conformity records | R1 | R2 | R2 |
| 13 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br><br>— power-up<br>— software operating system<br>— communication<br>— redundancy test and smooth change-over<br>— signal response time<br>— electrical continuity<br>— hydraulic fitness<br>— valve operations<br>— choke position monitoring<br>— DHPT monitoring | S1 | S2 | S3 |
| 14 | Confirm correct integration with subsea control system equipment. Extended Factory Acceptance Tests (EFAT) with particular attention to:<br><br>— systems assembly/fit-up<br>— integration with subsea control system components | S1 | S2 | S3 |
| 15 | Confirm correct integration with subsea tools and equipment. Monitor System Integration Tests (SIT) with particular attention to:<br><br>— systems assembly/fit-up<br>— ROV tool interface compatibility and function<br>— integration with subsea tree/manifold/ processing systems where applicable | S1 | S2 | S3 |
| *Final activities* | | | | |
| 16 | Confirm control system functions by review of:<br><br>— FAT records | I | R1 | R2 |
| 17 | Confirm integration with subsea tools and equipment by review of:<br><br>— SIT reports | I | R1 | R2 |
| 18 | Issue DNV visit / close-out report | H | H | H |

| **Table E7 Subsea processing system fabrication, manufacturing, sub-unit / unit and integration testing** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br><br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm valve functions by:<br><br>— witness FAT on all valve functions | S2 | S3 | S3 |
| 8 | Confirm rotating machinery function by:<br><br>— witness FAT of rotating machinery | S2 | S3 | S3 |
| 9 | Confirm function of manifold/template instrumentation by:<br><br>— witness FAT on all instrument functions | S2 | S3 | S3 |
| 10 | Confirm cleanliness of hydraulic systems (if applicable) by:<br><br>— review of cleanliness report | I | R1 | R2 |
| 11 | Confirm pressure integrity of components by:<br><br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 12 | Confirm corrosion control by:<br><br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 13 | Confirm correct markings by:<br><br>— inspection of all markings in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S2 |
| 14 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br><br>— pressure tests<br>— valve operation<br>— hydraulic fitness<br>— integration with control system | S1 | S3 | S3 |
| 15 | Confirm correct integration with subsea tools and equipment. Monitor System Integration Tests (SIT) with particular attention to:<br><br>— systems assembly/fit-up<br>— ROV access<br>— ROV tool interface compatibility and function<br>— well intervention tool interfacing<br>— integration with Subsea Control System | S1 | S2 | S3 |
| *Final activities* | | | | |
| 16 | Confirm process system functions by review of:<br><br>— FAT records | I | R1 | R2 |
| 17 | Confirm integration with subsea tools and equipment by review of:<br><br>— SIT reports | I | R1 | R2 |
| 18 | Issue DNV visit / close-out report | H | H | H |

| Table E8 Well intervention/completion/workover system fabrication, manufacturing, sub-unit / unit and integration testing | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br><br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm valve functions by:<br><br>— witness FAT on all valve functions | S2 | S3 | S3 |
| 8 | Confirm function of intervention instrumentation by:<br><br>— witness FAT on all instrument functions | S2 | S3 | S3 |
| 9 | Confirm cleanliness of hydraulic systems by:<br><br>— review of cleanliness report | I | R1 | R2 |
| 10 | Confirm pressure integrity of components by:<br><br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 11 | Confirm corrosion control by:<br><br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 12 | Confirm correct markings by:<br><br>— inspection of all markings in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S2 |
| 13 | Confirm correct control of system by:<br><br>— Workover control system FAT | S1 | S2 | S2 |
| 14 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br><br>— pressure tests<br>— structural loading tests<br>— valve operation<br>— integration with control system<br>— hydraulic fitness | S1 | S2 | S2 |
| 15 | Confirm correct integration with subsea control system equipment. Extended Factory Acceptance Tests (EFAT) with particular attention to:<br><br>— systems assembly/fit-up<br>— integration with subsea workover control system components | S1 | S2 | S2 |
| 16 | Confirm correct integration with subsea equipment. Minitor System Integration test (SIT) with particular attention to:<br><br>— system assembly/fit-up<br>— ROV access<br>— ROV tool interface compatibility and function<br>— Integration with workover control system | S1 | S3 | S3 |
| *Final activities* | | | | |
| 17 | Confirm tree system functions by review of:<br><br>— FAT records | I | R1 | R2 |
| 18 | Confirm integration with subsea tools and equipment by review of:<br><br>— SIT reports | I | R1 | R2 |
| 19 | Issue DNV visit / close-out report | H | H | H |

| Table E9 ROT intervention system fabrication, manufacturing, sub-unit / unit and integration testing | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review quality management system | R2 | R2 | R2 |
| 2 | Quality system audit at relevant manufacturers and sub-suppliers | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of manufacturers documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing. | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Confirm items manufactured according to specifications:<br><br>— review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures<br>— review non-conformance logs | R1 | R2 | R2 |
| 7 | Confirm valve functions by:<br><br>— witness FAT on all valve functions | S1 | S2 | S3 |
| 8 | — Confirm performance of all ROT function including contingency functions:<br>— witness FAT on all ROT functions | S3 | S3 | S3 |
| 9 | Confirm cleanliness of hydraulic systems by:<br><br>— review of cleanliness report | I | R1 | R2 |
| 10 | Confirm pressure integrity of components by:<br><br>— review of pressure test certificates for each component | R1 | R2 | R2 |
| 11 | Confirm corrosion control by:<br><br>— inspection of anode locations in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S3 |
| 12 | Confirm correct markings by:<br><br>— inspection of all markings in accordance with approved drawings<br>— correct application of paint systems | S1 | S2 | S2 |
| 13 | Confirm correct system function. Monitor Factory Acceptance Tests (FAT) with particular attention to:<br><br>— pressure tests<br>— structural loading tests<br>— valve operation<br>— integration with control system<br>— hydraulic fitness | S1 | S3 | S3 |
| 14 | Confirm that all structural, mechanical and control (electric and hydraulic) internal/external interfaces within/between the ROT system and interfacing systems and components are functioning<br><br>— witness FAT | R1 | R2 | R2 |
| 15 | Confirm drop tests of ROT<br><br>— witness FAT | S3 | S3 | S3 |
| 16 | Confirm provisions for surface testing prior to deployment.<br><br>— witness FAT | S3 | S3 | S3 |
| 17 | Confirm dimensions and masses of ROT<br><br>— witness FAT | S3 | S3 | S3 |
| 18 | Confirm safe entry and landing of ROT system at maximum entry angle.<br><br>— witness FAT | S3 | S3 | S3 |
| 19 | Confirm proper calibration of relevant equipment such as sensors, switches, gauges etc.<br><br>— witness FAT | S3 | S3 | S3 |
| 20 | Confirm correct integration with subsea control system equipment. Extended Factory Acceptance Tests (EFAT) with particular attention to:<br><br>— systems assembly/fit-up<br>— integration with subsea components | S3 | S3 | S3 |
| 21 | Confirm correct integration with subsea tools and equipment. Monitor System Integration Tests (SIT) with particular attention to:<br><br>— systems assembly/fit-up<br>— ROV access<br>— ROV tool interface compatibility and function<br>— well intervention tool interfacing<br>— integration with ROT system | S3 | S3 | S3 |

| Table E9 ROT intervention system fabrication, manufacturing, sub-unit / unit and integration testing (Continued) | | | | |
|---|---|---|---|---|
| 22 | Confirm stability check with and without the replaceable module.<br>— witness FAT | S3 | S3 | S3 |
| 23 | Confirm interfaces tested and verified on all working locations on the SPS<br>— witness FAT on all ROT functions | S1 | S2 | S3 |
| *Final activities* | | | | |
| 24 | Confirm ROT system functions by review of:<br>— FAT records | I | R1 | R2 |
| 25 | Confirm integration with subsea system by review of:<br>— SIT reports | I | R1 | R2 |
| 26 | Issue DNV visit / close-out report | H | H | H |

| Table E10 Downhole system verification during installation and commissioning | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review installation and commissioning quality management system | R2 | R2 | R2 |
| 2 | Quality system audit of relevant installation vessel(s) | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of installer's documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Review installation records, including non-conformance logs, to confirm correct equipment hook-up. | R1 | R2 | R2 |
| 7 | Review pressure test records | R1 | R2 | R2 |
| 8 | Monitor installation to confirm correct equipment hook-up | - | - | S3 |
| 9 | Confirm by review of commissioning records that all actuated valves fail to a safe position as per the P&IDs | R1 | R1 | R2 |
| 10 | Witness operation of tree and choke valves | - | S3 | S3 |
| 11 | Witness testing to confirm that all actuated valves fail to a safe position as per the P&IDs | - | S3 | S3 |
| *Final activities* | | | | |
| 12 | Issue DNV visit / close-out report | H | H | H |

| Table E11 Subsea tree and choke system verification during installation and commissioning | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review installation and commissioning quality management system | R2 | R2 | R2 |
| 2 | Quality system audit of relevant installation vessel(s) | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of installer's documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Review installation records, including non-conformance logs, to confirm correct equipment hook-up. | R1 | R2 | R2 |
| 7 | Review pressure test records | R1 | R2 | R2 |
| 8 | Monitor installation to confirm correct equipment hook-up | - | - | S3 |
| 9 | Confirm by review of commissioning records that all actuated valves fail to a safe position as per the P&IDs | R1 | R1 | R2 |
| 10 | Witness operation of tree and choke valves | - | S3 | S3 |
| 11 | Witness testing to confirm that all actuated valves fail to a safe position as per the P&IDs | - | S3 | S3 |
| *Final activities* | | | | |
| 12 | Issue DNV visit / close-out report | H | H | H |

| **Table E12 Manifold, foundations and template verification during installation and commissioning** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review installation and commissioning quality management system | R2 | R2 | R2 |
| 2 | Quality system audit of relevant installation vessel(s) | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of installer's documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Review installation records, including non-conformance logs, to confirm correct equipment hook-up. | R1 | R2 | R2 |
| 7 | Review pressure test records | R1 | R2 | R2 |
| 8 | Monitor installation to confirm correct equipment hook-up | - | - | S3 |
| 9 | Confirm by review of commissioning records that all actuated valves fail to a safe position as per the P&IDs | R1 | R1 | R2 |
| 10 | Witness operation of all remotely operated valves | - | S3 | S3 |
| 11 | Witness testing to confirm that all actuated valves fail to a safe position as per the P&IDs | - | S3 | S3 |
| *Final activities* | | | | |
| 12 | Issue DNV visit / close-out report | H | H | H |

| **Table E13 Flowlines and risers verification during installation and commissioning** |
|---|
| Please refer to Table D5 |

| **Table E14 Subsea control umbilicals verification during installation and commissioning** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review installation and commissioning quality management system | R2 | R2 | R2 |
| 2 | Quality system audit of relevant installation vessel(s) | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of installer's documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Review installation records, including non-conformance logs, to confirm correct equipment lay route and hook-up. | R1 | R2 | R2 |
| 7 | Review pressure/electrical test records | R1 | R2 | R2 |
| 8 | Monitor installation to confirm correct equipment hook-up | - | - | S3 |
| *Final activities* | | | | |
| 9 | Issue DNV visit / close-out report | H | H | H |

| **Table E15 Subsea production control system verification during installation and commissioning** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review installation and commissioning quality management system | R2 | R2 | R2 |
| 2 | Quality system audit of relevant installation vessel(s) | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of installer's documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Review installation records, including non-conformance logs, to confirm correct equipment hook-up, e.g.<br><br>— control module<br>— jumper installation | I | R1 | R1 |
| 7 | Monitor installation to confirm correct equipment hook-up | - | - | S3 |
| 8 | Review loop check records and calibration/trip setting records to confirm that process instrumentation with a PSD/ESD function is set in accordance with the P&IDs | R1 | R1 | R2 |
| 9 | Confirm by review of commissioning records that all actuated valves fail to a safe position as per the P&IDs | I | R1 | R2 |
| 10 | Witness testing to confirm that all actuated valves fail to a safe position as per the P&IDs | - | S3 | S3 |
| 11 | Confirm by review of commissioning records that ESD system functions in accordance with Cause & Effect Diagrams | I | R1 | R2 |
| 12 | Witness testing to confirm that ESD system functions in accordance with Cause & Effect Diagrams | S1 | S3 | S3 |
| 13 | Witness response time tests | - | S2 | S3 |
| 14 | Witness operation of injection valves | - | S2 | S3 |
| 15 | Witness operation of isolation valves | S1 | S2 | S3 |
| 16 | Witness operation of choke valves | - | S2 | S3 |
| 17 | Witness commissioning of DHPT, flowmeter etc. | - | S2 | S3 |
| 18 | Witness switching of redundant systems, e.g. hydraulic, power, data link, etc. | - | S2 | S3 |
| *Final activities* | | | | |
| 19 | Issue DNV visit / close-out report | H | H | H |

| **Table E16 Subsea processing system verification during installation and commissioning** | | | | |
|---|---|---|---|---|
| *Item* | *Description* | *Level* | | |
| | | *Low* | *Med* | *High* |
| *Initial activities* | | | | |
| 1 | Review installation and commissioning quality management system | R2 | R2 | R2 |
| 2 | Quality system audit of relevant installation vessel(s) | - | A | A |
| 3 | Review of specifications and procedures | R1 | R2 | R2 |
| 4 | Technical / kick-off meeting and review of installer's documents | R1 | R1 | R2 |
| 5 | Verify the performance and testing during the procedure and personnel qualification testing | R1 | S1 | H |
| *Surveillance and review activities* | | | | |
| 6 | Review installation records, including non-conformance logs, to confirm correct equipment hook-up. | R1 | R2 | R2 |
| 7 | Review pressure test records | R1 | R2 | R2 |
| 8 | Monitor installation to confirm correct equipment hook-up | - | - | S3 |
| 9 | Confirm by review of commissioning records that all actuated valves fail to a safe position as per the P&IDs | R1 | R1 | R2 |
| 10 | Witness operation of subsea separation system, confirmation separation is within specification | S1 | S2 | S3 |
| 11 | Witness operation of subsea boosting system, confirmation boosting is within specification | S1 | S2 | S3 |
| 12 | Witness operation of all remotely operated valves | S1 | S2 | S3 |
| 13 | Witness testing to confirm that all actuated valves fail to a safe position as per the P&IDs | S1 | S2 | S3 |
| *Final activities* | | | | |
| 14 | Issue DNV visit / close-out report | H | H | H |

# APPENDIX C
# EXAMPLES OF VERIFICATION DOCUMENTS

## A. Verification documents

### A 100 Validity of verification documents

**101** Verification documents are, in principle, documents confirming that an examination has been carried out, and are valid only at the time of issue.

### A 200 Statement of compliance

**201** A Statement of Compliance can be issued on completion of each particular project phase, or natural part thereof, and shall be based on a dedicated verification report.

**202** A Statement of Compliance shall be issued as a formal statement confirming that verification of documents and/or activities, has found that the subsea facility, a part thereof, or a verification activity, complies with the requirements applicable for that particular project phase.

**203** The technical information on a Statement of Compliance shall contain:

— subsea facility description and item number, if relevant,
— application (operational limitations and conditions of use) for which the subsea facility is intended,
— codes and standards with which the subsea facilities have been found to comply,
— level of verification,
— an appendix containing the accompanying dedicated verification report.

**204** A Statement of Compliance shall be signed by the DNV Project Manager.

An example of a typical Statement of Compliance is shown at the end of the document.

### A 300 Verification reports

**301** Verification Reports are issued to confirm that the relevant product or service has been completed in accordance with specified requirements.

**302** The report shall include information such as:

— product or service description and item number, if relevant,
— application (operational limitations and conditions of use) for which the product or service is intended,
— codes and standards with which the product or service has been verified against,
— clear statement of the conclusion from the verification (does it or does it not meet the specified requirements),
— codes and standards used as reference.,
— documentation on which the verification report is based (documents, drawings, correspondence, including revision numbers),
— project-specific scope of work tables
— any comments,
— identification of any non-conformances.

**303** The Verification Report shall always be dated and have two signatures, the originator and the DNV internal verifier.

### A 400 Verification comments

**401** Reviews of documents shall be reported using Verification Comment Sheets (often called VerComs). These documents give details to the client of aspects of subsea facilities design and construction that DNV:

— Considers do not meet the specified requirements.
— Does not have enough information to make a decision.
— Offers advice based on its own experience.

**402** Only in the first two instances does DNV expect a response from the Owner or its contractors.

**403** An example of a typical Verification Comment sheet is shown at the end of the document.

### A 500 Audit report

**501** Audit reports are issued to confirm that a company's quality management system has been reviewed to confirm compliance (or not) with the nominated standard and project requirements. In addition, the audit reports confirm compliance with the documented procedures and that these procedures are effective.

**502** Audit reports shall contain information such as whether:

— the company has a documented quality system.
— this quality system been certified by an accredited Certification Body *for the product (or service) in question.*
— the quality system covers the following quality assurance elements adequately for the product:
  — organisation,
  — authority/responsibility,
  — job descriptions for key persons,
  — internal quality audits,
  — documentation change control,
  — job instructions/procedures,
  — non-conformance/corrective action,
— there are adequate procedures for activities such as:
  — calibration of equipment,
  — material identification and marking,
  — control of special processes such as welding, NDT, PWHT,
  — non-conformance identification and handling,
  — inspection status,
  — final inspection,
— the company's facilities are, in general, considered adequate for the scope of supply,
— a quality plan been prepared for the order concerned,
— the purchaser or their appointed inspection agency are planned to attend the works,
— there are any problem areas identified.

**503** An example of a typical audit report is shown at the end of the document.

### A 600 Visit reports

**601** Visit reports are documentation/recording of attendance activity by DNV.

**Guidance note:**

Visit reports are and may be called by different names. Examples are Inspection Release Note, Survey Report, Inspection Certificate, Site Report, etc.

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**602** A visit report shall contain enough information to identify clearly the product or service that has been examined, the operating conditions or specifications to which it has been examined and the conclusion reached by DNV.

**603** The visit report shall be printed on the relevant form and shall contain as much information as possible in accordance with the standard headings in the form. In addition, the report number shall be shown.

**604** An example of a typical Visit Report is shown at the end of the document.

## B. Use of Quality Management Systems

### B 100 General

**101** The assurance of subsea facility integrity and function requires that gross errors during design, construction and operation be minimised. The likelihood of gross errors shall be reduced in a systematic manner by the operation of a quality management system adequate for the work being carried out.

**102** Quality management systems frequently are documented at three levels:

— the quality manual and related procedures document how the organisation, as a whole, manages the quality of all its products and services,
— the quality plan documents the specific procedures related to a particular project,
— the inspection and test plan documents how the quality control activities for a particular project shall be carried out and recorded.

### B 200 Quality plans

**201** The basic function of a quality plan is as a memory aid in the management of a project. In an organisation with many quality procedures for a variety of functions the quality plan states those that are applicable to that particular project. The quality plan acts as a route map through the complexities of management of the project and highlights those activities relevant to quality management.

**202** The project quality plan normally consists of two parts; firstly, a narrative description of the means of controlling the project, and secondly, a tabular description of the inspections and tests to be carried out during the work.

**203** The quality plan should address:

— organisational details of the project,
— authorities and responsibilities of key personnel,
— interfaces between, the client, contractors, sub-contractors and third parties,
— quality assurance activities placed on sub-contractors,
— cross references to existing company procedures.

**204** The narrative part of the quality plan should include a description of:

— the applicable standards,
— project organisation and responsibilities,
— review of the contractual requirements,
— project planning and progress reporting,
— procedures for such activities as design control, purchasing, construction, installation, commissioning, interface control and auditing ,
— procedures for inspection and maintenance as well as normal operation
— emergency response issues.

**205** Additionally, the narrative part of the plan should describe the documentation requirements. It should be specified:

— what documents are required,
— at what stage these documents are required,
— who is responsible for preparing the documents,
— relevant parties to whom documents are submitted,
— how any necessary approvals are acquired,
— who has originals and who has copies,
— if copies have to be certified copies,
— the length of time documents are to be retained and by whom.

### B 300 Inspection and test plans

**301** The tabular description of the inspections and tests to be carried out during the work is frequently known as the inspection and test plan.

**302** The following items should be checked for inclusion within the inspection and test plan:

— each inspection and test point and its relative location in the production cycle should be shown,
— the characteristics to be inspected and tested at each point should be identified,
— the use of sub-contractors should be indicated and details of how the verification of sub-contractor's quality shall be carried out should be shown,
— hold points established by the constructor, the operator or a third party, where witness or review of the selected inspection or test is required, should be shown.

### B 400 Review of quality management programme

**401** The contractor's quality manual shall be reviewed for compliance with ISO 9001 or 9002 as appropriate. The contractor's operations should be audited to establish compliance with the documented system.

**402** If the contractor has a quality system certified by an accredited third party certification body, this may be taken as evidence of a satisfactory quality system provided the certificate is relevant to the contractor's scope of work for the project. However, the last two years' periodical audit reports shall be reviewed to identify if any recurring non-conformities have been revealed.

**403** Any weaknesses revealed during this audit, or review of periodical audit reports, shall be considered when planning the contractor monitoring activities.

**404** Surveillance of the continuing acceptability of the contractor's quality management system is carried out by observing a selection of audits carried out by the contractor as part of its internal audit system. The audits to be observed should be selected over the length of the project at suitable intervals and should cover as wide a selection of activities as possible.

**405** Contractors' inspection and test plans for the various activities undertaken during their scope of work for the pipeline shall be reviewed and accepted, if adequate.

## C. Document forms

### C 100 Introduction

**101** The end of this appendix includes example forms for use by DNV in verification.

**102** The following forms are included:

— Statement of Compliance
— Verification Comments Sheet
— Audit Report
— Visit Report

**C 200 Statement of compliance**

**Statement No.:**
**…..**

# DET NORSKE VERITAS

# STATEMENT OF COMPLIANCE

| | |
|---|---|
| **NAME OF OWNER:** | ….. |
| **NAME OF SUBSEA SYSTEM:** | ….. |
| **LOCATION:** | ….. |
| **DESCRIPTION:** | ….. |
| **OPERATIONAL LIMITATIONS:** | PRESSURE: …..<br>TEMPERATURE: …..<br>SERVICE: ….. |
| **THIS IS TO STATE THAT:** | The above mentioned ….. has been verified, by appropriate methods, to comply with the requirements of the (code reference). , for the operational limits stated above, with the exceptions noted in DNV Verification Report Number ….. |
| **VERIFICATION INVOLVEMENT:** | The verification of the above mentioned ….. has been performed in accordance with DNV Offshore Service Specification for Verification of..., DNV-OSS-3nn at Level ….. with the detailed scope of work described in DNV Verification Report Number …..<br><br>This verification level has been accepted by DNV to be satisfactory for the risk to the …(integrity or other project goals) of the subsea system identified for the above mentioned ….. . |
| **REFERENCE DOCUMENTS:** | DNV Verification Report Number: ….. |

**PLACE:**_____ **DATE:** _____

_____
Project Manager

## C 300 Verification comments sheet

| VERIFICATION COMMENTS SHEET | | | | |
|---|---|---|---|---|
| Project Title: | | | | DNV Project No.: |
| Document title: | Prepared by: | Date: | Sign: | Document No.: |
| | Verified by: | Date: | Sign: | Revision: |
| Have all previous comment to this document been satisfactory solved or repeated below? | | | | YES / NO / N/A |
| **VERIFICATION COMMENTS:** | | | | |

| VerCom. No.: | Description: | Category [1] | Status [2] |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

NOTES:

**Category [1]**

**NC = Non-Conformance**

The information contained in the document is not accepted as complying with the applicable requirements due to outstanding areas of concern.

**TQ = Technical Query**

The review of this document cannot be completed until the information requested is submitted.

**A = Advice (reply not needed)**

The information contained in the document is accepted as complying with the applicable requirements but DNV offers certain advice based on its experience

**Status [2]**

O = Open

C = Closed (requires a reference)

## C 400 Audit report

| | |
|---|---|
| DNV Work Order No.: | Report No.: |
| Vendor: | Date of Visit: |
| Item: | Purchase Order No.: |

This form is to be used as checklist and report for reviewing the quality system of companies supplying items subject to inspection by DNV. It should be appended to the first visit report.

1 Does the organisation have a documented quality system? Yes/No

Quality Manual: Ref..... Rev. No.....

Based upon: ISO 900.. /Other standard .....

2 Has the quality system been certified by an accredited Certification Body for the product (range) in question? Yes/No

Body.....

Certificate No..... Valid to date.....

Most recent periodical audit carried out on (date).....

N.B. If the answer to this question is YES go to item 5.

3 Based on reviews and checks, does the quality system cover the following quality assurance elements adequately for the product in question:

- Organisation Yes/No
- Authority/Responsibility Yes/No
- Job Descriptions for key persons Yes/No
- Internal Quality Audits Yes/No
- Documentation Change Control Yes/No
- Job Instructions/Procedures Yes/No
- Non-Conformance/Corrective Action Yes/No

For areas that are inadequate give brief details attached.

4 Are there adequate procedures for following activities as appropriate:

- Calibration of Equipment Yes/No
- Material Identification & Marking Yes/No
- Control of Special Processes like Welding, NDT, PWHT Yes/No
- Non-conformance Identification & Handling Yes/No
- Inspection Status Yes/No
- Final Inspection Yes/No
- Others - Specify Yes/No

For procedures found to be inadequate give brief details attached.

page 1 of 2

**Audit report page 2**

| | | |
|---|---|---|
| 5 | Are organisation's facilities in general considered adequate for the scope of supply? | Yes/No |
| 6 | Has Quality Plan been prepared for the order concerned?<br>Ref:.....rev..... | Yes/No |
| 7 | Are ..... or their appointed inspection agency in attendance?<br>Which inspection agency?..... | Yes/No |
| 8 | Are any problem areas identified - Give details | |

NAME: STATION:
SIGN: DATE:
Separate sheets attached Yes/No

page 2 of 2

## C 500 Visit report

| | |
|---|---|
| DNV Work Order No.: | Report No.: |
| Vendor: | Date of Visit: |
| Item: | Purchase Order No.: |

A visit report is to be prepared after every surveillance visit. It shall be faxed to DNV ..... within 3 days of the visit. If required, please give further details on separate sheet.

1 Are quality system procedures adhered to? Yes/No
If no, please give details.

2 Are fabrication/inspection requirements defined in vendor's quality plan being met
- By the vendor?
- By ..... or their appointed inspection agency?
- Other parties, if any (specify.....)

If no, please give details.

3 Is documentation being completed and collated as required?
If no, please give details.

4 Are there any outstanding non-conformances/corrective action required?
If yes, please give details.

5 Give brief details of completion status and purpose of visit:
Vendor Q-Plan reference: .....

6 Give brief details of work anticipated for next visit:
Vendor Q-Plan reference: .....

7 Indicate areas of concern or information requested from other parties not yet available:

NAME: STATION:
SIGN: DATE:
Separate sheets attached Yes/No