OFFSHORE SERVICE SPECIFICATION

DNV-OSS-307

Verification of Process Facilities

JUNE 2004

This document has been amended since the main revision (June 2004), most recently in April 2012.
See "Changes" on page 3.

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

DET NORSKE VERITAS AS

FOREWORD

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— *Recommended Practices.* Guidance.

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

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CHANGES

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-307) offers the reader the application of the common framework and overview of processes in risk verification, to process 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.

Amendments April 2012

— The restricted use legal clause has been deleted from the front page.

Amendments October 2011

— A restricted use legal clause has been added on the front page.

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SECTION 1
GENERAL

A. General

A 100 Introduction

101 This DNV Offshore Service Specification (DNV-OSS-307) gives criteria for and guidance on verification of the integrity and function of parts or phases of process 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 process 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 process facilities or selected project phases.

302 Process facilities typically comprise the following systems:

— process safety functions
— pressure relieving devices
— blowdown and flare system
— HIPPS system
— utility systems
— piping
— pressure vessels (not covered by this OSS)
— passive fire protection
— active fire protection
— HVAC systems
— fire and gas detection systems
— shutdown systems
— process equipment
— hazardous area classification.

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 process facility.
— *Appendix A* poses trigger questions to assist in the selection of verification level
— *Appendix B* gives detailed example 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.

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D. DNV Process Facility Statement 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 process 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. An example is given in Appendix C.

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 process 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 and Abbreviations

E 100 General

101 Relevant definitions in ISO 10418 (API RP 14C) also apply to this OSS.

E 200 Abbreviations

PSD = Process Shutdown System
FGS = Fire and Gas System
ESD = Emergency Shutdown System
PCS = Process Control System
DHSV = Down Hole Safety Valve
SSIV = Subsea Isolation Valve
HIPPS = High Integrity Pressure Protection System
SIL = Safety Integrity Level
C&E = Cause and Effect

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 process 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 process 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 process 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 process facilities, fabrication typically refers to the process of assembly or transformation of e.g. plates, profiles and pipes etc into production facilities.

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 process 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 process 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 process 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 process 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 process 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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416 *Verification Plan:* A plan which defines the scope of the work (sow) for verification. It includes; verification objectives, acceptance criteria, elements to be verified, level of involvement by party and type of verification activity. (ref. DNV-OSS-300 Sec.2 C)

F. References

F 100 List of references

— A Guide to Hazard and Operability Studies, 1979, Chemical Industries Association Limited, London
— ISO 8402 Quality – Vocabulary, 1994, International Organization for Standardization, Geneva
— BS 4778 Quality Vocabulary, Part 2 Quality Concepts and Related Definitions, 1991, British Standards Institute, London
— EN 45011 General Criteria for Certification Bodies Operating Product Certification, 1998, European Committee for Standardization, Brussels
— EN ISO 10418 –(API RP14C) Offshore production installations - Analysis, design, installation and testing of basic surface safety systems, International Organisation for Standardization

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 process facilities.

B. Service Process

B 100 General principles

101 The description of the process of DNV's verification of process 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 process facilities
— Manufacturing and fabrication of process facilities components and assemblies
— Installation
— Project completion (pre-commissioning)
— Commissioning
— Issue of as-built and 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:

1) Use trigger questions to assess the overall risk level of the project (or manageable elements thereof).
2) 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.
3) Use the example detailed scope of work tables in Appendix B to make a first draft of a Verification Plan
4) Generate the project specific Verification Plan by including a project specific engineering judgment or risk analysis to adjust the table to suit the project.
5) Perform the verification execution according to the Verification Plan, making revision to the plan if and when necessary.
6) 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)
— *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 process 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 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 a process 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 process facility 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 D1.

Table D1 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 process facility will be achieved.

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

— 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 D2.

Table D2 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 integrity	x	x	x
— simplified independent analysisand and calculation(s) performed by spot checks		x	x
— advanced independent analysis and calculation(s) performed by spot checks			x
Review of specifications for construction and operation by			

Table D2 Scope of work for verification of design (Continued)			
— 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 etc.)			
— 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 and 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 process 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 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:

a) Manufacturing Procedure Specification (MPS).
b) Manufacturing procedures, including test requirements and acceptance criteria, repairs, personnel qualification records etc.
c) Material specifications.
d) Quality plans.
e) Welding Procedure Specifications (WPS) and Welding Procedure Qualification Record (WPQR).
f) NDT procedures.
g) Manufacturing Procedure Qualification Test (MPQT) results.
h) Manufacturer's and 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:

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

408 Definition of scope of work for verification of construction should follow Table D3 and Table D4 for manufacturing and fabrication, Table D5 for installation and Table D6 for final testing and completion.

Table D3 Scope of work for verification of manufacturing and fabrication of high risk components

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
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

Table D4 Scope of work for verification of manufacturing and fabrication of components not considered high risk

Verification activity	*Level*		
	L	M	H
Review of manufacturing and fabrication procedures			
— Review manufacturing, fabrication and inspection procedures for confirmation of compliance with the manufacturing specification		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
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
— Visit-based 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 D5 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	x	x	x
— Full time attendance during defined tests and trials		x	x
Review of final documentation	x	x	x

Table D6 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 process facility 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 process facility
— history of the process facility 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 philosophy, schedules and records
— inspection procedures and results as appropriate

105 Definition of verification of the operations phase should follow Table D7.

Table D7 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 process facility continue to meet the Owner's specified requirements.

107 Annual assessments may be carried out to confirm that any deterioration of the process facility are within acceptable limits and that the facility 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 process facility 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 process facility 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:

a) Overall safety and other objectives for the asset.

b) Assessment of the risks associated with the asset and the measures taken to reduce these risks.

c) Degree of technical innovation in the asset.

d) Experience of the contractors in carrying out the work.

e) Quality management systems of the owner and its contractors.

104 Due to the diversity of various process facilities, 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 process facility.

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

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

a) Does the safety objective address the main safety goals?

b) Does the safety objective establish acceptance criteria for the level of risk acceptable to the owner?

c) Is this risk (depending on the process facility 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

a) Has a systematic review been carried out to identify and evaluate the probabilities and consequences of failures in the process facility?

b) 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?

c) Does the extent of the review reflect the risk level of the process facility, the planned operation and previous experience with similar process facilities?

d) Does this review identify the risk to the operation of the process facility and to the health and safety of personnel associated with it or in its vicinity?

e) 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?

f) Has the result of the systematic review of the risks been measured against the owner's safety (or other) objective?

g) Has the result of this review been used in the selection of the appropriate verification activity level?

B 300 Technical innovation

a) Has the degree of technical innovation in the process facility been considered?

b) Has it been considered that risks to the process facility are likely to be greater with a high degree of technical innovation than with a process facility designed, manufactured and installed to well-known criteria in well-known waters?

c) Have factors been considered in the selection of the appropriate verification level such as:

— Degree of difficulty in achieving technical requirements.
— Knowledge of similar process facilities.
— Effect of the new process facility on the surrounding area.

B 400 Contractors' experience

a) Has the degree of risk to the process facility been considered where design, construction or installation contractors are inexperienced?

b) Has the degree of risk been considered where the contractors are experienced but not in similar work?

c) Has the degree of risk been considered where the work schedule is tight?

B 500 Quality management systems

a) Have all parties involved in the process facility implemented an adequate quality management system to ensure that gross errors in the work are limited?

b) Do these parties include the:

— Owner?
— Design contractor?
— Construction contractors?
— Installation contractor?
— Operator?

c) 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 Introduction

101 This appendix gives the format of the detailed scope of work tables that shall be defined for each particular project.

102 For project scenarios or components not covered in this Appendix, similar tables with the same degree of detail shall be made.

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 Scope of Work Tables

B 100 General

101 The following abbreviations have been used. The definitions of which are given subsequently:

A = Audit
S = Surveillance
R = Review

102 These abbreviations are DNV's preferred terms and normally will 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. once per week or sample review 10-20%.
S2 = Surveillance frequency minimum once per day or review of 50-60%.
S3 = Surveillance frequency minimum once per shift or review of 100% of items.

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

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B 400 Review

401 Systematic examination of reports and documentation against a project defined verification basis.

The depth of review will depend both on the type of document and the level of involvement.

402 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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403 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 for review 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.	Project quality management documentation	R1	R2	R2
2.	Project quality management system			A
3.	Sub-contractor control			R2
4.	Interface controls		R1	R2
5.	Methods of information flow			R1

D. Design

D 100 Design verification

101 Table D1 describes the issues to be reviewed and Table D2 identifies the extent of independent analyses and calculations included in the three verification levels.

102 Table D3 describes the issues to be verified in relation to flow assurance as an additional verification service.

D 200 Low level design verification

201 The initial *Low* level design verification consists of a detailed document review of the design basis, risk assessment and 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.

202 The subsequent verification consists of document review of the calculations and 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.

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

D 300 Medium level design verification

301 *Medium* level design verification consists of a review of all main design documents related to 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.

302 Implementation of the conclusions from design calculations and reports into drawings and specifications will be included on a spot check basis.

D 400 High level design verification

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

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

403 The main specifications are also checked for clearness and ambiguity.

Table D1 Verification of process facilities design

Item	*Description*	*Level*		
		Low	*Medium*	*High*
General				
1.	Safety objective	I	R1	R2
2.	Description of process facilities and overall project organisation	I	I	I
3.	Design basis	I	R1	R2
4.	Risk assessment and or Emergency Preparedness Analysis and identification of critical aspects	R1	R1	R2
5.	Document register	I	I	I
Specifications for design:				
6.	Design philosophies for the facilities, typically; Active and Passive fire protection, Safety systems (FGS/ESD/PSD/PCS), Shutdown logic, Process design, Piping design, Relief and Blowdown, Material choice etc.	R1	R1	R2
Process safety functions:				
7.	P&IDs and associated documentation to confirm: — appropriate safety devices are specified (typically in accordance with API RP 14C/ISO 10418) — adequate margins between operating and design conditions — trip settings are suitable for the intended level of protection — the status or position of valves does not impair system safety (locked open/ closed; fail open/close/fixed; interlocking; etc.)	R1	R2	R2
8.	P&IDs to confirm that shutdown valves are located such that systems can be clearly segregated and give suitable segment boundaries and conforms to the assumptions and basis of the risk analysis.	R1	R2	R2
9.	P&IDs showing block valves, isolating devices, etc. required for maintenance operations.	I	R1	R2
10.	Process and Safety Shutdown C&E Diagrams or equivalent have appropriate shutdown logic.	I	R1	R2
Pressure relieving devices:				
11.	Data sheets to confirm sizing case, set pressure, backpressure and valve type.	R2	R2	R2
12.	Process design calculations for the relieving devices (relief valve, rupture disc, etc.) to confirm the sizing case (full flow, gas blowby, fire, thermal relief, etc.) is appropriate and the specified capacity adequate.	I	R1	R2
13.	Process design calculations focusing on relieving device inlet line pressure drop, outlet line size and backpressure.	I	R1	R2
Blowdown and flare [1] design:				
14.	P&IDs to confirm that isolatable sections are provided with remote operated blowdown possibilities as required by the flare and blowdown philosophy	R1	R2	R2
15.	Flare and blowdown documentation to confirm that: — time to depressurise is appropriate [2] — calculated flow rates do not exceed the system capacity — calculated backpressures do not exceed the system limits — flare system is separated into appropriate systems (e.g. high and low pressure, hot and cold, wet and dry flare systems) — minimum temperature and material choice is acceptable	I	R1	R2
16.	P&IDs to confirm that flare, relief and blowdown lines are self draining, and where low points are unavoidable these have an appropriate drain connection with locked open isolation valve.	R1	R2	R2

Table D1 Verification of process facilities design (Continued)				
17.	Flare K-O drum sizing calculations and drawings to confirm that there will be no unacceptable liquid carry over to the flare tip.	I	R1	R2
18.	P&IDs to confirm a suitable purge gas system to prevent air ingress is specified for the flare system (including alarms for low flow, back-up systems, etc.)	R1	R1	R2
19	Flare radiation calculations (for worst case flow and wind conditions) to confirm these are acceptable	I	R1	R2
20.	Flare noise calculations to confirm compliance with noise requirements of the verification basis (as applicable).	I	I	R1
21.	P&IDs to confirm 'snuffing' package is specified for cold vent tip where appropriate	I	R1	R2
22.	Flare Ignition system to confirm that acceptable reliability of ignition will be achieved during all possible scenarios.	I	R1	R2
HIPPS systems				
23.	HIPPS application in accordance with the requirements of the verification basis.	R1	R1	R1
24.	Reliability documentation to confirm that the HIPPS system is independent of other systems and have the same or better safety reliability as a pressure relief device system. Alternatively, confirm compliance with IEC 61508 and that specified SIL level is achieved in accordance with HIPPS specification	R1	R1	R2
25.	System documentation to confirm that requirements for testing have been accounted for.	I	R1	R2
26.	Process design calculations to confirm that the specified response times of protective systems are sufficiently short to prevent unacceptable process conditions.	I	R1	R2
Utility systems				
27.	P&ID's to confirm that adequate safety requirements are implemented for utility systems interfacing hydrocarbon systems such as e.g. heating medium, cooling medium, drains systems, pneumatic system, hydraulic systems, chemical injection systems.	I	R1	R2
Piping				
28.	Pipe stress analysis guidelines/philosophy/work instructions in order to identify needs for additional information/guidelines not outlined in the specified piping code or project standards.	R1	R1	R2
29.	Selection of pipe stress analysis reports and pipe stress isometrics in order to ensure that the analysis meet the requirement outlined in the specific piping code, project standards and project pipe stress analysis philosophy. A typical selection may be based on large pipe size, large temperature differential and piping with high pressure. Piping/process line list, piping critical line list and project P&ID's will normally be used as basis for this selection.	R1	R2	R2
30.	Review of a selected number of piping classes in the piping material specification. Typical this work will consist of spot check of tabulated wall thickness against temperature, pressure, corrosion allowance, impact testing and "fit for service". Relevant Material Data Sheets (MDS) will also be considered. If present, the selection may be based on sophisticated materials not widely used (known) outside the offshore-industry. Typical are piping made of Super Duplex, 6Mo, Titanium and GRP.	I	R1	R2
Passive fire protection				
31.	PFP on vessels, piping, supports and structure and withhold this with assumptions in Risk Analysis (if relevant), design accidental loads in each specific area, vessel integrity requirements, blowdown time etc.	R1	R1	R2
32.	PFP drawings versus specified criteria for heat loads and exposure time, and withhold this against material approval certificates w.r.t thickness and application requirements.	I	R1	R2
33.	Separation by fire divisions of individual process areas (if relevant) for compliance with project requirements and withhold this with assumptions in Risk Analysis (if relevant) and active fire fighting philosophy (firewater demand).	R1	R1	R2
34.	Requirements for passive fire protection resulting from the project specific design philosophy and Risk Analysis	R1	R1	R2
Active fire protection				
35.	Layout drawings to confirm adequacy of firewater main routing and adequate number and location of manual fire fighting equipment such as fire extinguishers, hydrants, hoses and monitors.	R1	R1	R2

Table D1 Verification of process facilities design (Continued)				
36.	Adequacy of selected manual fire fighting equipment.	R1	R1	R2
37.	Sizing basis for firewater demand to cover process areas.	R1	R1	R2
38.	Firewater P&ID's to confirm requirements for supply to equipment and areas, separation of supplies, bypass and isolation possibilities.	R1	R1	R2
39.	Firewater hydraulic calculations to confirm adequate capacity and pressure to all discharge points.	I	R1	R2
40.	Layout drawings to confirm adequate location of deluge valves, choice of areas to be protected and identification of dedicated equipment protection.	R1	R1	R2
41.	Nozzle type and density in each area.	I	R1	R1
42.	Foam and other fire extinguishing systems w.r.t. application, type, concentration and capacity.	R1	R1	R2
Fire and gas detection				
43.	Type (suitability), number and location of detectors taking into account voting philosophy and alarm levels. Review location and number of manual fire alarm stations.	R1	R1	R2
Shutdown logic				
44.	Cause and Effect diagrams, or similar, covering the following aspects: — PSD; shutdown according to API RP 14C/ISO 10418 — PSD; avoid unacceptable cascading effects — PSD; high level shutdown to include lower levels/individual shutdown levels — FGS; initiation of relevant fire extinguishing systems, shutdown actions, ignition prevention, alarm systems, blowdown (as applicable) — ESD; shutdown of production plant, DHSV's/SSIV's as appropriate and initiation of blowdown.	I	R1	R2
Process equipment				
45.	Specifications and data sheets for equipment like pressure vessels, valves, heat exchangers, pumps, compressors and turbines.	-	R1	R2
46.	Manufacturers design documentation to verify that project specifications and applicable standards are implemented correctly w.r.t. integrity.	-	I	R1
Materials				
47.	Systems description manual and PFD's	I	I	I
48.	— Materials selection report — corrosion protection report — coating and insulation specification (e.g. coating procedures).	R1	R2	R2
49.	— Internal corrosion assessment, calculation and assessment of corrosion rate where applicable (or spot check) — corrosion monitoring system.	I	R1	R1
50.	— Materials specification — welding specification — NDT-specification for critical components	R1	R2	R2
Hazardous area classification				
51.	Hazardous area classification drawings and source of release schedule (as applicable) to verify extent and type of zones, location of ventilation inlets/ outlets, overpressure/air locks for local equipment rooms. Cross check against P&ID's to confirm classification of vents, segregation of drainage system etc.	R1	R2	R2

Abbreviations used in the table:

PSD = Process Shutdown System
FGS = Fire and Gas System
ESD = Emergency Shutdown System
PCS = Process Control System
DHSV = Down Hole Safety Valve
SSIV = Subsea Isolation Valve
HIPPS = High Integrity Pressure protection System
SIL = Safety Integrity Level
C&E = Cause and Effect

1) The majority of the following activities are also applicable to cold vent systems.

2) This will include a cross-check against the results of the individual blowdown orifice sizing and timing calculations, relief valve capacity calculations, piping backpressure calculations reviewed as part of other verification activities.

Table D2 Independent analyses and calculations					
Item	*Activity*	*Description*	*Level*		
			Low	*Medium*	*High*
1.	Blodown analysis.	Prepare a simplified model of the process plant in order to review critical blowdown design features such as the flare headers, flare KO Drum and flare radiation.			x
2.	Piping flexibility analysis	Prepare a model of critical lines to evaluate pipe stress and support layout in accordance with ASME B31.3 Part 5 Flexibility and Support.			x
3.	Analysis of pressure vessels	Prepare a structural model of important pressure vessels to evaluate the structural capacity of critical areas for normal and/or accidental loads as found critical during the design of design review.			x
x = analysis and check will be included in the scope of work (if relevant)					

Table D3 Flow assurance or other functional requirements				
Item	*Description*	*Level*		
		Low	*Medium*	*High*
1.	Design documentation and analyses with respect to planned and unplanned shutdowns and the effect this may have on hydrate- and wax-formation.	I	R1	R2
2.	Design strategy implemented with respect to avoidance of hydrate- and wax formation.	I	R1	R2
3.	Plant vulnerability to erosion effects, e.g. inlet arrangement (chokes, headers, inlet separator), sand jetty system and produced water system.	I	R1	R2

E. Construction

E 100 General

101 Construction consists of a number of different site activities and their associated documentation.

102 Table E1 and E2 give the scope of work for construction and commissioning respectively.

103 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 the typical documentation to be submitted before, during and after construction.

202 Verification of process facilities construction activities includes:

— initial activities
— inspection activities
— 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 *inspection activities* are the site attendance and the *final activities* are the (continuous) review of production results and 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 high risk items and 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 For the qualification of procedures and personnel DNV will visit the main qualifications and review the results.

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

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

503 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 high risk items and aspects as identified in the detailed scope of work tables.

504 Verification of the final activities will be by detailed review of the production records including the non-conformance log, 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 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 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. In such 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.

604 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, but is intended as a reminder to the DNV (or others) inspection personnel that a final report on their verification activities is required to finish the work.

Table E1 Verification of process facilities construction

Item	*Description*	*Level*		
		Low	*Medium*	*High*
Initial activity				
1.	Management system documents	R1	R2	R2
2.	Quality system audit at relevant manufacturers and sub-suppliers.	-	A	A
3.	Specifications and Procedures	R1	R2	R2
4.	Technical Meeting/Kick-off Meeting and review of manufacturing documents	R1	R1	R2
Inspection activities				
Availability of process safety functions by:				
5.	Process instrumentation with PSD/ESD/HIPPS functions installed as per the P&IDs	S1	S2	S3

Table E1 Verification of process facilities construction (Continued)				
6.	Pressure relieving devices installed as per the P&IDs	S1	S2	S3
7.	Process and Safety Shutdown Valves (ESDVs/PSDVs) installed as per the P&IDs	S1	S2	S3
8.	Block valves, isolating devices, etc. installed as per the P&IDs.	-	-	S1
Availability of pressure relieving devices:				
9.	Test records to confirm that relieving devices are of the correct type, sizing (e.g. orifice size for relief valves) and set pressure	S1	S2	S3
10.	Inlet pipework to relieving devices located satisfactorily in relation to potential restrictions (e.g. above liquid levels, vessel internals, etc.)	S1	S2	S3
Availability of blowdown and flare [1)] *system:*				
11.	Each isolatable section provided with an automatic blowdown valve as specified in the P&IDs	S1	S2	S3
12.	Flare, relief and blowdown lines are self draining, and low points have an appropriate drain connection with locked open isolation valve	-	S1	S2
13.	Mechanical completion records to confirm that blowdown orifices are installed in accordance with the design (size and location)	R1	R2	R2
14.	Blowdown orifices installed in accordance with the design (size and location)		S1	S2
15.	Confirm by review of mechanical completion records, fabrication isometrics, etc. that flare and blowdown pipework have been installed in accordance with P&IDs	R1	R2	R2
16.	Flare and blowdown pipework installed in accordance with P&IDs and blowdown calculations (incl. free draining lines)	-	-	S1
17.	Inlet pipework to blowdown valves located satisfactorily in relation to potential restrictions (e.g. above liquid levels, vessel internals, etc.)	S1	S2	S3
18.	Manufacturer's as-built drawings to confirm that flare K-O drums have been fabricated in accordance with design documentation	R1	R2	R2
19.	Inspection and/or review of mechanical completion records to confirm that purge gas system is installed as per P&IDs (incl. alarms, back-up systems, etc.)	S1	S2	S3
20.	Manufacturer's as-built drawings to confirm that flare tip has been fabricated in accordance with design documentation	R1	R2	R2
21.	Mechanical completion records to confirm that a 'snuffing' package has been installed on the cold vent as per P&IDs3)	R1	R2	R2
22.	'Snuffing' package installed on the cold vent as per P&IDs			S3
23.	Mechanical completion records to confirm that a flare ignition system has been installed as per P&IDs	R1	R2	R2
24.	Flare ignition system installed as per P&IDs	-	-	S3
HIPPS systems				
25.	Mechanical completion records to confirm that the HIPPS system has been installed as per P&IDs	R1	R2	R2
26.	HIPPS system installed as per P&IDs	-	-	S3
Piping				
27.	Review of the welding and NDE/NDT specifications related to piping to ensure that the specifications meet the minimum requirements of the relevant piping code, project standards and national regulations.	-	R1	R2
28.	Review of the pressure test philosophy to ensure that the pressure test philosophy meet the minimum requirements of the relevant piping code, project standards and national regulations.	-	R1	R2
29.	Mechanical completion records to confirm that pressure tests have been performed according to philosophy.	-	R1	R2
Open drains system				
30.	Open drain boxes located according to appropriate hazardous areas.	S1	S2	S2
31.	Water seals installed in accordance with design drawings.	S1	S2	S2
Passive fire protection				
32.	Quality surveillance system in place to document that thickness measurements are systematically performed.	R1	R2	R2
33.	Application Manual	-	R1	R2
34.	Application performed in accordance with the Application Manual	-	S1	S1
Active fire protection				

Table E1 Verification of process facilities construction (Continued)				
35.	Location of deluge valves and manual fire fighting equipment such as fire extinguishers, hydrants, hoses and monitors are in accordance with design drawings.	S1	S2	S3
36.	Deluge nozzles appropriately located in relation to obstructions and specific equipment protection.	S1	S2	S3
37.	Mechanical completion records to confirm that the firewater main system has been installed as per P&IDs.	R1	R1	R2
38.	Appropriate access provided to all manual isolation valves in the firewater system.	S1	S2	S3
Fire and gas detection				
39.	Location of fire and gas detectors. Mechanical completion records to confirm that type is in accordance with design drawings.	S1	S2	S3
Hazardous area classification				
40.	Hazardous area classification as shown on drawings is appropriate and not changed by alterations in equipment location. Follow-up that assumptions in design are correctly implemented.	S1	S2	S3
Final activities				
41.	Manufacturing and testing records	R1	R2	R2
42.	Issue of DNV Visit Report			
1) The majority of the following activities are also applicable to cold vent systems.				

Table E2 Verification of process facilities commissioning				
Item	*Description*	*Level*		
		Low	*Medium*	*High*
Inspection Activities				
Operability of process safety functions by:				
1.	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	R2	R2
2.	Commissioning records to confirm that isolation valves are positioned such that they can not prevent operation of safety devices (locked open/ closed; interlocking; etc.) as per P&IDs	R1	R2	R2
3.	Isolation valves positioned such that they can not prevent operation of safety devices (locked open/closed; interlocking; etc.) as per P&IDs	S1	S2	S3
4.	Commissioning records to confirm that all actuated valves with a safety function (PSD, ESD, HIPPS, blowdown, etc.) fail to a safe position as per the P&IDs	R1	R2	R2
5.	Witness testing to confirm that all actuated valves with a safety function (PSD, ESD, HIPPS, blowdown, etc.) fail to a safe position as per the P&IDs	S1	S2	S3
6.	Commissioning records to confirm that PSD system functions are in accordance with SAFE Charts or PSD Cause and Effect Diagrams	R1	R2	R2
7.	Witness testing to confirm that PSD system functions in accordance with SAFE Charts or PSD Cause and Effect Diagrams	S1	S2	S3
Operability of blowdown and flare[1)] *system:*				
8.	Commissioning records to confirm that blowdown valves are initiated and timing sequences are in accordance with the blowdown report and Cause and Effect Diagrams	R1	R2	R2
9.	Witness testing to confirm that blowdown valves are initiated and timing sequences are in accordance with the blowdown report and Cause and Effect Diagrams	S1	S2	S3
10.	Commissioning records to confirm that purge gas low flow alarms and back-up systems functions satisfactorily	-	R1	R2
11.	Witness testing to confirm that purge gas low flow alarms and back-up systems functions satisfactorily	-	-	S1
12.	Commissioning records to confirm that flare tip ‘flame-out’ alarms function satisfactorily	-	R1	R2
13.	Witness testing to confirm that flare tip ‘flame-out’ alarms function satisfactorily	-	-	S1

Table E2 Verification of process facilities commissioning (Continued)				
14.	Commissioning records to confirm that the cold vent 'snuffing' package functions satisfactorily	-	R1	R2
15.	Witness testing to confirm that the cold vent 'snuffing' package functions satisfactorily	-	-	S1
HIPPS system				
16.	Commissioning records to confirm that the HIPPS system functions satisfactorily	R1	R2	R2
17.	Witness testing to confirm that HIPPS system function satisfactorily	-	S1	S2
Active fire protection				
18.	Commissioning records to confirm that the active fire protection systems functions satisfactorily	R1	R2	R2
19.	Witness testing to confirm that active fire protection systems function satisfactorily	S1	S2	S3
Fire and Gas detection				
20.	Commissioning records to confirm that F&G system functions are in accordance with Cause and Effect Diagrams	R1	R2	R3
21.	Witness testing to confirm that FGS system functions in accordance with Cause and Effect Diagrams	S1	S2	S3
Final Activities				
22.	Fabrication Records	R1	R2	R2
23.	Testing Records	R1	R2	R2
24.	Issue of DNV Visit Report			
1) The majority of the following activities are also applicable to cold vent systems.				

F. Operations

F 100 General

101 No tables are provided for the operation phase. The project specific tables will be based on the work performed leading up to the verification report and the contractual arrangement for the project.

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 process 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:

— process facility description and item number, if relevant
— application (operational limitations and conditions of use) for which the process facility is intended
— codes and standards with which the process 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 this appendix.

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 process facilities design and construction that DNV:

a) Considers do not meet the specified requirements.

b) Does not have enough information to make a decision.

c) 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 this appendix.

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 and responsibility
  — job descriptions for key persons
  — internal quality audits
  — documentation change control
  — job instructions and procedures
  — non-conformance and 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.

An example of a typical audit report is shown at the end of this appendix.

A 600 Visit reports

601 Visit reports are documentation and 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.

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

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 this appendix.

B. Use of Quality Management Systems

B 100 General

101 The assurance of process 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 to be 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 Contractor's 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:

a) Statement of Compliance.
b) Verification Comments Sheet.
c) Audit Report.
d) 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: …..
TEMPERATURE: …..
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 …..

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 <u>for the product (range) in question</u>? 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? Ref:.....rev.....	Yes/No
7	Are ..... or their appointed inspection agency in attendance? 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