DNV·GL

SERVICE SPECIFICATION

DNVGL-SE-0045:2014-08

Certification of subsea equipment and components

DNV GL AS

FOREWORD

The service specifications lay down procedural requirements for obtaining and retaining certificates and other conformity statements to the objects in question.

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

CHANGES – CURRENT

General

This is a new document.

On 12 September 2013, DNV and GL merged to form DNV GL Group. On 25 November 2013 Det Norske Veritas AS became the 100% shareholder of Germanischer Lloyd SE, the parent company of the GL Group, and on 27 November 2013 Det Norske Veritas AS, company registration number 945 748 931, changed its name to DNV GL AS. For further information, see www.dnvgl.com. Any reference in this document to "Det Norske Veritas AS", "Det Norske Veritas", "DNV", "GL", "Germanischer Lloyd SE", "GL Group" or any other legal entity name or trading name presently owned by the DNV GL Group shall therefore also be considered a reference to "DNV GL AS".

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SECTION 1 INTRODUCTION

1.1 General

1.1.1 Introduction

1.1.1.1 This DNV GL service specification (DNVGL-SE-0045) describes the DNV GL certification service for subsea equipment and components (hereafter referred to as subsea components).

1.1.1.2 This document identifies and describes verification activities for subsea components during design and manufacturing.

— This document is tailor made for certification of subsea components designed and manufactured (i.e. manufacturing, workmanship and testing phases) in accordance with DNV GL Standard DNVGL-ST-0035.

1.1.1.3 The verification activities identified and described in this document are mandatory in order to obtain a DNV GL certificate for the subsea component.

1.1.2 Objective

1.1.2.1 The objectives of this document are to:

— describe DNV GL's certification service for subsea components
— specify corresponding DNV GL certification procedures
— define the extent of verification activities required by DNV GL
— provide a common communication platform between contracting parties.

1.1.3 Certification service

1.1.3.1 Product certification is a conformity assessment requiring both design and manufacturing verification activities to be performed. It provides documented evidence that the requirements laid down in DNVGL-ST-0035 are met during design and manufacturing of subsea components.

1.1.3.2 The certification service prescribes the minimum level of DNV GL verification involvement towards suppliers to provide DNV GL certification of subsea components.

1.1.3.3 DNV GL certification of subsea components scope is a Product Certification service limited to the activities at a dedicated manufacturer or sub-contractors' facilities, as applicable.

1.1.3.4 DNV GL certification of subsea components is intended to complement, and not substitute, verification of subsea facilities/systems as defined in DNV-OSS-306 which is a risk based verification service.

Guidance note:
DNV-OSS-306 typically addresses complete installations, facilities and/or integrated systems and not individual components. The service offered through DNV-OSS-306 is normally delivered to the operator of the field.

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1.1.3.5 The following figure illustrates how product certification relates to typical project phases and other DNV GL services.

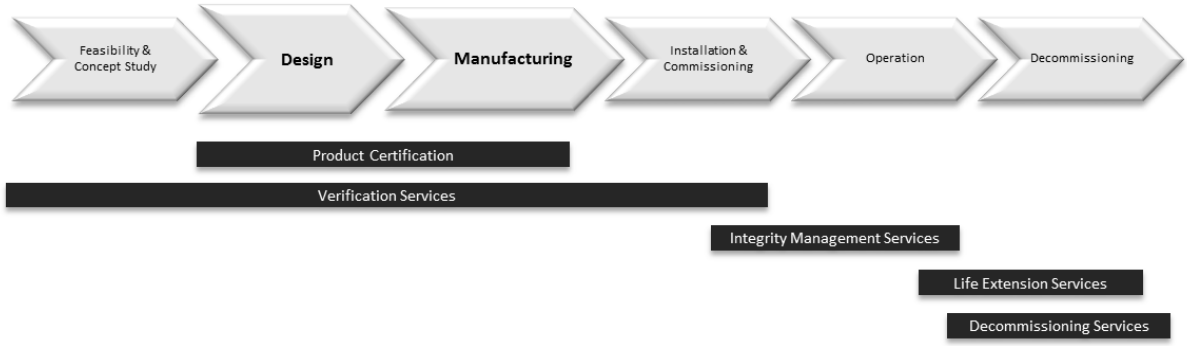

Figure 1-1 Typical subsea project phases

1.1.4 Structure of this document

1.1.4.1 This document consists of three sections and one appendix:

Sec.1 provides the general introduction comprising the objectives, certification service description, structure of the document, definitions and references.

Sec.2 explains the principles and process of certification, outlining the verification activities for each of the project phases during certification, and the corresponding deliverables issued by DNV GL resulting from each of the successfully implemented verification process steps.

Sec.3 explains certification requirements, through certification categories, and tabulated these for the various component elements with corresponding material certification requirements.

App.A defines the documentation types applicable to subsea component certification.

1.2 Definitions and abbreviations

1.2.1 Definitions

Table 1-1 Definitions

Term	*Definition*
Certification (ISO 17000:2004)	Third-party issue of a statement, based on a decision following review, that fulfilment of specified requirements has been demonstrated related to products, processes or systems. Review shall in this context mean verification of the suitability, adequacy and effectiveness of selection and determination activities, and the results of these activities, with regard to fulfilment of specified requirements by an object of conformity assessment.
Certification service	A certification service may be regarded as a verification process which fulfils certain formal requirements. The scope of work is normally standardized and shall be pre-defined in the form of a publicly available service description, either a DNV GL service specification or a nationally or internationally recognized standard which stipulates certification requirements. The final deliverable DNV GL document shall be a certificate.
Component	An assembly of sub-components e.g. valve, tree connector, choke valve, tree frame etc.
Conformity assessment	The process used to show that a product, service or system meets specified requirements.
Equipment	The highest level of an assembly of components e.g. Xmas tree, tubing hanger, control module, manifold, PLEM, PLET etc.
Manufacturer	A company that performs a part of or the complete production that determines the delivered quality of the equipment (i.e. design, manufacturing, workmanship and testing). A manufacturer must take and acknowledge the responsibility for the delivered equipment.
Product	A product is an output that results from a process, i.e. material, components and equipment.
Sub-component	A single item used in a component e.g. valve body, flowspool, seal etc.
Verification (ISO 9000:2005)	Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled.

1.2.2 Abbreviations

Table 1-2 Abbreviations

ASME	American society of mechanical engineers
DVR	Design verification report
ERB	Export riser bases
FRB	Flowline riser bases
ISO	International organisation for standardisation
NDT	Non destructive testing
PLEM	Pipeline end manifold
PLET	Pipeline end termination
PR	Performance rating
PSL	Production specification level
PWHT	Post weld heat treatment
ROV	Remote Operated Vehicle
SIT	System integration testing
SSIV	Subsea isolation valve
TA	Type approval
WBE	Well barrier element
WPQR	Welding procedure qualification record
WPQT	Welding procedure qualification test
WPS	Welding procedure specification
WPT	Welding production test

1.2.3 Verbal forms

Table 1-3 Verbal forms

Term	*Definition*
Shall	Verbal form used to indicate requirements strictly to be followed in order to conform to the document.
Should	Verbal form used to indicate 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.
May	Verbal form used to indicate a course of action permissible within the limits of the document.

1.2.4 References

Table 1-4 References

Reference No.	*Title*
DNV-OS-C401	*Fabrication and Testing of Offshore Structures*
DNV-RP-B401	*Cathodic Protection Design*
DNV Standard for Certification 1.2	*Type Approval*
DNVGL-ST-0035	*Subsea equipment and components*
EN 473	*Non-destructive testing - Qualification and certification of NDT personnel - General principles*
EN 10204	*Metallic products – Types of inspection documents*
IEC 61511	*Functional safety – Safety instrumented systems for the process industry sector*
ISO 8501-1	*Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*
ISO 9712	*Non-destructive testing - Qualification and certification of NDT personnel*
ISO 10474	*Steel and Steel Products – Inspection Documents*

SECTION 2 CERTIFICATION PROCESS

2.1 General

2.1.1 Objectives

2.1.1.1 The objective of this section is to define the procedures for certification of subsea components. Figure 2-1 summaries the certification process.

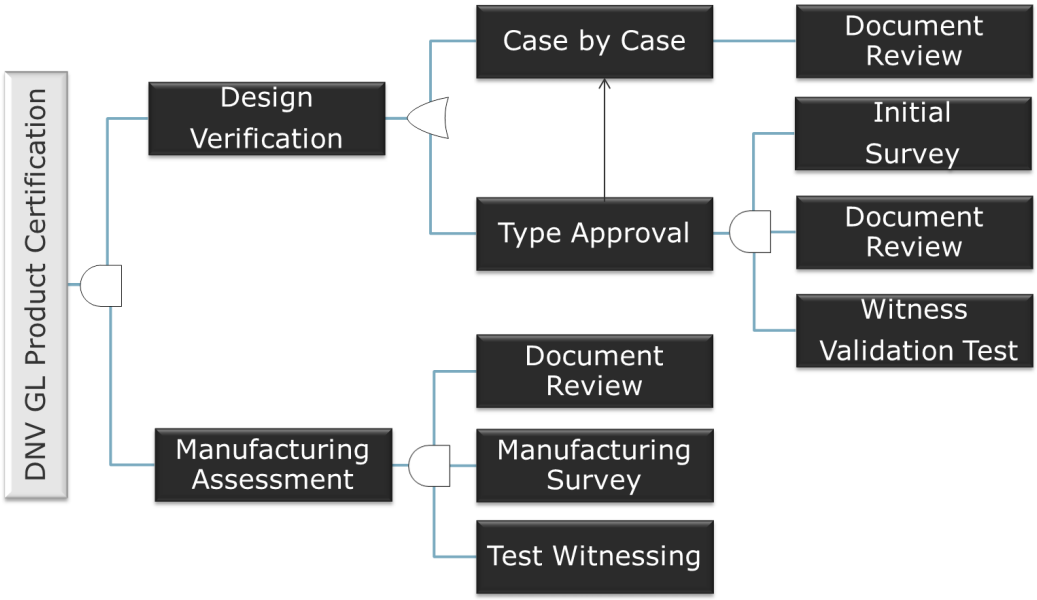

Figure 2-1 Product Certification Process

2.1.2 Scope and categories

2.1.2.1 Generic scopes of work for certification are given in tables in this section.

2.1.2.2 Design verification and manufacturing assessment activities required for the issuance of a certificate for following types of equipment are covered by this document, and corresponds with the requirements stipulated in DNVGL-ST-0035 for the following listed items:

- subsea tree
- subsea wellhead
- tubing hanger system
- isolation plugs
- mudline suspension equipment
- drill-through mudline suspension equipment
- control system
- subsea structures
- ROV intervention equipment
- production and injection manifolds
- modular and integrated single satellite and multiwell templates
- subsea processing and subsea boosting stations
- flowline riser bases (FRB)
- export riser bases (ERB)
- pipeline end manifolds (PLEM)

— pipeline end terminations (PLET)
— T- and Y-connections
— subsea isolation valve (SSIV).

2.1.2.3 Certification categories for the subsea equipment are given in Sec.3.

2.2 Design verification

2.2.1 General

2.2.1.1 Design verification is the examination of the assumptions, methods and results of the design process and is performed to confirm that the requirements to the specific component are fulfilled.

2.2.1.2 Design verification typically comprises:

— reviewing the design process
— reviewing specifications for design
— reviewing design reports and drawings
— performing independent parallel calculations
— reviewing specifications for manufacture and operation.

2.2.1.3 The typical scope of work for verification of design should follow Table 2-1.

Table 2-1 Scope of work for verification of design

Review of the design process by
— review of design quality management documentation
— audit of design quality management system
Review of specifications for design by
— review of the design basis
— evaluation of the design criteria
Review of design reports and drawings by
— review of the main component documentation to confirm that the main operating 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
— evaluation of the main methods used and spot checks of the input data and the calculation results
— detail review of main design reports
Performing independent parallel calculations by
— simplified independent analyses/ calculation(s) performed by spot checks
— advanced independent analyses/ calculation(s) performed by spot checks
Review of specifications for manufacture and operation by
— spot check of critical aspects
— review of main specifications

2.2.2 Case-by-case

2.2.2.1 When the design verification is performed on a "case-by-case" basis, documentation of the design shall be submitted for review for each application / project.

2.2.2.2 A design verification report (DVR) will be issued to the customer on satisfactory completion of the review.

2.2.3 Type approval

2.2.3.1 The DNV GL type approval (TA) process for the design verification of subsea components may be used as an alternative to the design verification "case-by-case" and shall be according to DNV Standard for Certification 1.2

2.2.3.2 The DNV GL TA procedure should normally be used for verification of standard design of components produced in series.

2.2.3.3 A type approval certificate will be issued and sent to the TA applicant on satisfactory completion of the review.

2.3 Material certification

2.3.1 General

2.3.1.1 Certification of materials will be based on compliance with all tests and inspections specified in the relevant design code or standard. Unless otherwise approved, certification shall take place at the manufacturer's works. The scope of witnessing and document review by the surveyor shall be according to an agreed inspection and test plan (ITP).

2.3.1.2 The objective of the testing and inspection is to verify and document that the materials are in compliance with the written material specification and the standard accepted as part of the design verification.

2.3.1.3 When a material is not produced at the works at which it is rolled or forged, a certificate shall be supplied by the maker stating the process of manufacture, the cast number and the chemical composition of ladle samples.

2.3.1.4 The minimum level of material certification required for subsea components is given in Sec.3.

2.3.1.5 Where a specific component is not listed, the following principles shall apply (ref. to Table 2-2 for definition of certification types):

- Inspection certificate type 3.2 is required for material for pressure containing and retaining components and primary structural elements (including pad-eyes).
- Inspection certificate type 3.1 is required for material for structures in other categories except primary structures.

2.3.2 Written material specification

2.3.2.1 For all metallic and non-metallic pressure-containing and pressure-retaining components a written material specification, prepared by the manufacturer, is required.

2.3.2.2 Sacrificial materials for use in cathodic protection systems shall comply with the requirements of DNV-RP-B401 *Cathodic Protection Design*.

2.3.3 Material certificates

2.3.3.1 Certification of materials shall be documented on an inspection certificate. Material inspection certification types are given in Table 2-2.

2.3.3.2 In order to ensure traceability between the material and the certificate issued for the material, all materials shall be clearly marked for identification.

Table 2-2 Material inspection certification types

Material inspection certification types	*ISO 10474 (EN 10204)*
Test report Confirmation by the manufacturer that the supplied products fulfil the purchase specification, and test data from regular production, not necessarily from products supplied	2.2
Inspection certificate Test results of all specified tests from samples taken from the products supplied. Inspection and tests witnessed and signed by QA department	3.1
Inspection certificate As work certificate, inspection and tests witnessed and signed by QA department and an independent third party body	3.2

2.3.3.3 Inspection certificates of type 3.2 shall be issued/endorsed by the end-users authorized inspection representative, an IACS member or a notified body under the pressure equipment directive.

2.3.3.4 Separate inspection certificates shall be issued for each grade of material and each product form.

2.3.3.5 Unless additional information is required in order to comply with the relevant code/standard, the inspection certificate shall include following particulars:

- purchaser's name and order number
- manufacturer's name
- description of the product, dimensions, weight, etc.
- identification of specification or grade of material (with specific reference to the approved written material specification)
- identification of the cast and product
- ladle analysis for specified elements
- results of all specified inspections and mechanical tests
- condition of supply and where appropriate, details of heat treatment.

2.3.3.6 The surveyor shall carry out the inspections and witness the testing according to an agreed inspection and test plan.

2.4 Manufacturing assessment

2.4.1 General

2.4.1.1 Manufacturing assessment shall be carried out by means of full time attendance, audits, inspections or spot checks of the work, as appropriate, in sufficient detail to confirm that the specified requirements of the subsea component are fulfilled.

2.4.1.2 DNV GL surveyor shall have safe access to the works at all reasonable times, insofar as the work affects certification. The customer shall ensure, through contracts with the parties concerned or otherwise, that such access is granted, and that DNV GL is notified as to when and where the surveyor's attendance is needed.

2.4.1.3 The objective of the surveys carried out by the DNV GL surveyor during the manufacture, is to verify and document that the final component is in compliance with the approved design documentation.

2.4.1.4 If the product for any reason has not been manufactured in accordance with the approved design or if any repairs need to be done, DNV GL shall be notified and further actions shall be agreed upon.

2.4.1.5 Manufacturing assessment typically comprises:

- reviewing the manufacturing processes
- reviewing manufacturing procedures
- reviewing qualification process
- surveillance during manufacture
- reviewing final documentation.

2.4.1.6 The typical scope of work for manufacturing assessment should follow Table 2-3.

Table 2-3 Scope of work for manufacturing assessment of subsea components

Review of the manufacturing process by
— review of manufacturing management systems
— audit of the quality management system
Review of manufacturing procedures by
— review manufacturing procedures for confirmation of compliance with the manufacturing specifications
Review of qualification process by
— review the manufacturing procedure specification, (MPS) and manufacturing procedure qualification test (MPQT), if applicable
— review of welding and welder qualifications
— review of NDT inspection and inspector qualifications
Surveillance during manufacture by
— visit-based or full-time attendance during manufacturing to confirm that the delivered component has been produced in accordance with the manufacturing procedures
— visit-based attendance during testing, to confirm that the delivered component has been tested in accordance with the test procedures
— review of final documentation

2.4.2 Manufacturing processes

2.4.2.1 The manufacturer shall operate a quality management system applicable to the scope of their work. The system shall be documented and contain descriptions and procedures for quality critical aspects.

2.4.2.2 Quality control of subsea equipment, components and materials shall be traceable and documented. Further, quality control shall be carried out by qualified personnel at facilities and with equipment suitable for that control.

2.4.2.3 Measuring and test equipment used in services by manufacturer, builder, repairer or owner, where the results may form the basis for the surveyor's decisions, shall have a documented calibration status.

2.4.2.4 For safety instrumented functions the manufacturer shall comply with the requirements in IEC 61511.

2.4.3 Manufacturing procedures

2.4.3.1 Prior to commencement of construction work, the manufacturer’s materials control, NDT program, job instructions, specifications and procedures for welding, workmanship, testing etc. shall be reviewed by DNV GL.

2.4.3.2 The manufacturer shall produce and submit an ITP for approval by DNV GL. The ITP shall be developed and finalized as early as possible. Any subsequent changes to the ITP require formal re-approval by DNV GL.

2.4.3.3 The heat treatment procedure in connection with forming/bending and/or welding shall be independently reviewed if not covered by the applied code or standard.

2.4.4 Welding and welder qualification

2.4.4.1 Welding procedure qualification record (WPQR) shall be according to DNV-OS-C401 with applicable testing-requirements.

2.4.4.2 For components of welded construction and for repair welding, full details of joints shall be given and relevant welding procedure specifications shall be available and recorded. WPS shall be within range of approval with supporting WPQR, and shall be approved by DNV GL.

2.4.4.3 A welding production test (WPT) may be required by the surveyor during manufacture to verify that the produced welds are of acceptable quality.

2.4.4.4 Welding repairs shall be performed according to a repair procedure approved by DNV GL.

2.4.4.5 Local PWHT may be performed on simple joints when following a procedure approved by DNV GL.

2.4.4.6 The heat treatment procedure in connection with forming and/or welding shall be verified as part of the WPT and approved by DNV GL.

2.4.5 NDT inspection and inspector qualification

2.4.5.1 Methods of NDT shall be evaluated with due regard to the sensitivity of the method and the method's ability to detect defects likely to occur as a consequence of the chosen manufacturing process.

2.4.5.2 All NDT shall be properly documented in such a way that the performed examination can be duplicated. The reports shall identify all defects exceeding the acceptance criteria unless more stringent reporting requirements have been agreed.

2.4.5.3 Personnel performing NDT and interpretation of examination results shall be certified according to a recognised certification scheme, e.g. EN 473, ISO 9712. The certificate shall state the qualifications as to which examination method and within which category the operator is certified.

2.4.6 Surveillance during manufacture

2.4.6.1 The intention of DNV GL's involvement during manufacture is to ensure that the subject equipment / components are manufactured according to the approved documentation and the requirements of the applied design code.

2.4.6.2 Attendance for manufacturing activities shall be agreed in advance and documented in an inspection and test plan.

2.4.6.3 Suitable traceability and marking of materials and sub-components shall be confirmed prior to manufacture of equipment or components.

2.4.6.4 A test programme shall be prepared by the manufacturer. The programme shall specify equipment and components to be tested, and the testing procedure. The tests shall give evidence of satisfactory operation in accordance with the design basis.

2.4.6.5 All testing shall be performed according to approved test procedures which shall be made available to the attending surveyor.

2.4.6.6 In order to ensure traceability between the component certified by DNV GL and the certificate issued for the component, all components shall be clearly marked for identification.

2.4.6.7 Final documentation for the component, including all records of manufacture, shall be presented to the attending surveyor for review.

2.4.6.8 The manufacturer shall issue an asbestos-free declaration, or equivalent, covering all components included in the product.

SECTION 3 CERTIFICATION REQUIREMENTS

3.1 Equipment categorisation

3.1.1 General

3.1.1.1 Categorisation is used in order to identify the certification requirements for subsea equipment.

3.1.1.2 Categorisation of equipment depends on importance for safety or reliability and takes operating and environmental conditions into account. Once assigned, the category of equipment defines the scope of activities required for certification.

3.1.1.3 If there is any other equipment which is not defined in the following tables, categorisation of the same shall be decided on a case by case basis.

3.1.1.4 Replacement parts shall be certified in accordance with the requirements of the parts it will be replacing.

3.1.1.5 Equipment categorisation for subsea equipment is as follows:

I = equipment important for safety and reliability for which a DNV GL product certificate shall be issued.
II = equipment for which a certificate prepared by the manufacturer may be accepted, in lieu of a DNV GL product certificate.

3.1.1.6 The issuance of a DNV GL product certificate for each individual sub-component for which there will be a DNV GL product certificate issued at a higher level (e.g. a valve block in a subsea tree), then it may not be necessary to issue a separate DNV GL product certificate for that sub-component. The requirements for material certification, design and manufacturing assessments of that sub-component however remain valid and shall be documented accordingly.

3.1.2 Equipment category I

3.1.2.1 For equipment category I, the following procedure shall be followed:

— design assessment, documented by a design verification report (DVR) or type approval certificate.
— manufacturing survey, documented by issuance of a product certificate.

3.1.3 Equipment category II

3.1.3.1 Equipment of category II is normally acceptable on the basis of a certificate prepared by the manufacturer. As a minimum, the certificate shall contain the following data:

— equipment specification or data sheet
— equipment traceability information
— operating limitation(s) of the equipment
— statement from the manufacturer to confirm that the equipment has been constructed and manufactured according to recognised methods, codes, and standards

Guidance note:
Independent test certificates or reports for the equipment, or approval certificate for manufacturing system, are also acceptable.

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3.1.4 Categorisation of subsea equipment and components

Table 3-1 Categorisation of subsea equipment and components

Equipment	*Component*	*Sub-Components*	*Material Certificate ISO 10474 (EN 10204)*	*Category*	*Notes*
Subsea tree				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
	Flanged end and outlet connections		3.2	I	May be accepted as category 2 if fully in compliance with referenced standard
	ISO clamp hub-type connections		3.2	I	May be accepted as category 2 if fully in compliance with referenced standard
	Threaded connections		3.2	I	
	Other end connectors		3.2	I	
	Studs, nuts and bolting		3.2	I	May be accepted as category 2 if fully in compliance with referenced standard
	Ring gaskets		3.2	I	May be accepted as category 2 if fully in compliance with referenced standard
	Completion guidebase		3.2	I	
	Tree connectors and tubing heads		3.2	I	
	Tree stab/seal subs for vertical tree		3.2	I	
	Valve assembly			I	If valve is NOT intended to function as part of the system barrier philosophy may be accepted as category 2
		Body	3.2	I	
		Bonnet	3.2	I	
		Stem	3.2	I	
		Seat	3.2	I	
		Gate	3.2	I	
		Seals	3.2	I	
	Actuator		3.2	I	If valve is NOT intended to function as part of the system barrier philosophy may be accepted as category 2
	TFL wye spool and diverter		3.2	I	
	Re-entry interface (where separate to upper valve block)		3.2	I	
	Non-pressure-containing tree cap		3.1	II	
	Pressure-containing tree cap		3.2	I	
	Tree-cap running tool		3.1	II	

Table 3-1 Categorisation of subsea equipment and components (Continued)

Equipment	*Component*	*Sub-Components*	*Material Certificate ISO 10474 (EN 10204)*	*Category*	*Notes*
	Tree-guide frame		3.2	I	Primary structure, secondary structure, locking mechanism
	Tree running tool		3.2	I	
	Tree piping		3.2	I	Including Piping, Tees, Elbows, Spacers, Blind flanges etc.
	Flowline connector systems			I	
		Flowline connector support frame	3.2	I	
		Flowline connectors	3.2	I	
	Ancillary equipment running tools		3.1	II	
	Tree-mounted hydraulic/electric/ optical control interfaces			I	
		Pipe/tubing/hose	3.2	I	May be accepted as category 2 if fully in compliance with referenced standard
		Optical cables and cable penetrations	3.2	I	
		Small bore tubing and connections	3.2	I	May be accepted as category 2 if fully in compliance with referenced standard
		Electrical connectors	3.2	I	
		Optical connectors	3.2	I	
		Control line stabs/ couplers	3.2	I	
		Alignment/ orientation mechanism	3.1	II	
		Transducers	3.2	I	Non-critical transducers may be accepted as category 2
	Subsea choke			I	
		Body	3.2	I	
		Bonnet	3.2	I	
		Insert	3.2	I	
		Seals	3.2	I	
		Actuator	3.2	I	
	Test stumps		3.2	I	Test stumps intended to only be used onshore may be accepted as category 2
	Equipment used for shipping		3.2	I	
Subsea wellhead				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure

Table 3-1 Categorisation of subsea equipment and components (Continued)

Equipment	*Component*	*Sub-Components*	*Material Certificate ISO 10474 (EN 10204)*	*Category*	*Notes*
	Temporary guidebase		3.1	II	
	Permanent guidebase		3.2	I	
	Conductor housing		3.2	I	
	Wellhead housing		3.2	I	
	Casing hangers		3.2	I	
	Annulus seal assemblies		3.2	I	
	Casing hanger lockdown bushing		3.2	I	
	Bore protectors and wear bushings		3.1	II	
	Non-pressure containing corrosion cap		3.1	II	
	Pressure containing corrosion cap		3.2	I	
	Running, retrieving and testing tools		3.2	I	
	Trawl protective structure		3.2	I	
	Wellhead inclination and orientation devices		3.1	II	
	Submudline casing hanger and seal assemblies		3.2	I	
Tubing hanger system				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
	Tubing hanger		3.2	I	
	Running tool		3.2	I	
Isolation plugs			3.2	I	E.g. tubing hanger and internal tree cap plugs
Mudline suspension equipment				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
	Mudline suspension-landing/elevation ring		3.2	I	
	Casing hangers		3.2	I	
	Casing hanger running tools and tieback adapters		3.2	I	
	Abandonment caps		3.1	II	
	Tubing-head		3.2	I	
	Tubing hanger system — mudline conversion equipment for subsea completions		3.2	I	Same as for 'normal' tubing hangers

Table 3-1 Categorisation of subsea equipment and components (Continued)

Equipment	*Component*	*Sub-Components*	*Material Certificate ISO 10474 (EN 10204)*	*Category*	*Notes*
Drill-through mudline suspension equipment				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
	External drill-through casing hangers (outside of the hybrid casing hanger housing)		3.2	I	
	Hybrid casing hanger housing		3.2	I	
	Internal drill-through mudline casing hangers		3.2	I	
	Annulus seal assemblies		3.2	I	
	Bore protectors and wear bushings		3.1	II	
	Tubing hanger system — drill-through mudline equipment for subsea completions		3.2	I	Same as for 'normal' tubing hangers
	Abandonment caps		3.1	II	
	Running, retrieving and testing tools		3.2	I	
Cathodic protection system					
	Anodes		3.2	I	
	Electrical continuity straps		3.1	II	
Control system	Hydraulic power unit (HPU)		3.1	I	
	Chemical injection unit (CIU)		3.1	I	
	Master control station (MCS)		3.1	I	
	Distributed control system (DCS)		3.1	I	
	Electrical power unit (EPU)		3.1	I	
	Modem unit		3.1	I	
	Uninterruptable power supply (UPS)		3.1	I	
	Umbilical		3.1	I	
	Subsea control module (SCM)		3.1	I	
	Subsea distribution system		3.1	I	
	Subsea and downhole sensors		3.2	I	May be accepted as 3.1 if the sensor does not impact on a well barrier element

Table 3-1 Categorisation of subsea equipment and components (Continued)

Equipment	*Component*	*Sub-Components*	*Material Certificate ISO 10474 (EN 10204)*	*Category*	*Notes*
	Control fluids		3.1	II	
	Control buoy		3.1	I	
	Flying Lead		3.1	I	
Subsea structure - general				I	E.g. of tree frame, guidebases, manifolds, protective structures, gratings, foundations etc.
	Primary structure		3.2	I	Load carrying and supporting frames and load carrying panels. Specific categorisations for components shall be agreed based on intended function and consequence of failure.
	Secondary structure		3.1	II	Parts that are not considered as load carrying for the purposes of the design calculations. Specific categorisations for components shall be agreed based on intended function and consequence of failure.
ROV intervention equipment					
	Panel		3.1	II	Except where the panel is also considered as a primary structural element
	Hot stab receptacle		3.1	II	
	ROV intervention buckets		3.1	II	
	Multibore/hot stabs		3.1	II	
Other pressure equipment					
	Pressure retaining or containing components		3.2	I	E.g. subsea processing equipment
	Process wetted components		3.2	I	E.g. pressure boundary penetrations
Production and injection manifolds				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
Modular and integrated single satellite and multiwell templates				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
Subsea processing and subsea boosting stations				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure

Table 3-1 Categorisation of subsea equipment and components (Continued)

Equipment	*Component*	*Sub-Components*	*Material Certificate ISO 10474 (EN 10204)*	*Category*	*Notes*
Flowline riser bases (FRB)				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
Export riser bases (ERB)				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
Pipeline end manifolds (PLEM)				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
Pipeline end terminations (PLET)				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
T- and Y-connections				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure
Subsea isolation valve (SSIV)				I	Specific categorisations for components shall be agreed based on intended function and consequence of failure

3.2 Documentation requirements

3.2.1 General

3.2.1.1 The purpose of the documentation requirements is to ensure that a sufficient level of information is provided to verify that the requirements of the standard (DNVGL-ST-0035) have been complied with during the design and manufacture of the subsea components.

3.2.1.2 A satisfactory document review is a prerequisite for assignment of DNV GL Product Certificates.

3.2.1.3 The document review shall be complemented by applicable surveys and reviews of the customer's quality system.

3.2.1.4 Documentation media shall be clear, legible, reproducible and retrievable.

3.2.1.5 Documentation shall be retained and in a retrievable format for the entire life cycle of the product.

3.2.1.6 Documentation requirements are based on standardised documentation types. Definitions of such are given in App.A.

3.2.2 Design

3.2.2.1 Design documentation requirements for specific components shall be according to, but not limited to, that of the relevant design code or standard. Design documentation requirements will be provided upon request for certification services.

3.2.2.2 Documentation of design shall include design requirements, methods, assumptions and calculations.

3.2.2.3 Design documentation requirements shall include, but not be limited to, those criteria for size, test and operating pressures, material, environmental and other pertinent requirements on which the design is based.

3.2.3 Manufacture

3.2.3.1 Manufacturing documentation and record requirements for components to be certified shall be according to, but not limited to, that of the relevant design code or standard. Manufacturing documentation requirements will be provided upon request for certification services.

3.2.3.2 Manufacturing documentation shall include all relevant details and acceptance criteria relating to how the component shall be manufactured. This will typically include details of manufacturing, welding and inspection processes.

3.2.3.3 Manufacturing records shall provide traceability to confirm that the delivered component or equipment has been manufactured in accordance with the approved design documentation.

3.2.3.4 The manufacturing record shall include a traceable record of non-conformities and agreed corrective actions.

APPENDIX A STANDARDISED DOCUMENTATION TYPES

U100 – Document register

A register containing the document number and title for all documents that are planned to be issued during a project.

The document register should be a living register also containing information on planned and real issue dates and revision control.

U110 – Project plan / Schedule

A document describing the key milestones of a project. Particular emphasis should be on where DNV GL involvement is required.

U120 – Quality plan

A document specifying which processes, procedures and associated resources will be applied by whom and when, to meet the requirements of a specific project, or product.

U130 – Inspection and test plan

A document that:

— Identifies the relevant inspection and test requirements for a component.
— Assigns each requirement to a responsible section/shop or to a step in the manufacturing process.
— Describes/specifies the acceptance criteria for each requirement.
— Documents the agreed verification activities (hold, witness, monitor or review points) that the manufacturer, customer and certifying authority shall perform throughout the manufacturing process.

U140 – Safety assessment

A systematic evaluation of safety involving identification and evaluation of hazards and events that could result in loss of life, property damage, environmental damage, or the need to evacuate.

The term safety assessment refers here to a design tool, and should not be considered purely as a documentation exercise. In this sense, safety assessment provides input to design through systematic consideration of:

— the hazards that can occur
— role and performance of structure and facilities in preventing and protecting against hazards
— the effects of hazards on safety of personnel, the environment or assets.

These steps are applied to ensure that the safety of personnel, and any other aspects such as environment, meet minimum safety level. The safety levels are defined through safety targets and criteria.

Safety assessment is intended to be complementary to, and integrated with, the application of recognized design standards. The guidance and requirements of engineering standards will provide the basis for detailed engineering design that can be optimised by the application of, and findings from, the assessment (e.g. establishing optimum dimensioning accidental loads).

The scope of the safety assessment may also include business critical items (e.g. reliability and availability)

U150 – Functional design specification

A document providing a summary of:

— rules, regulations, standards and codes applied with assigned priorities
— applied loads, static and dynamic, operational, accidental and installation
— ratings with respect to pressure, temperature, service, etc.
— environmental conditions (including where applicable soil conditions, metocean data etc.)
— performance requirements for the component in order to maintain an acceptable level of safety
— Documentation provided to demonstrate the technical realisation of the design requirements (e.g. summary of calculations / checks performed to demonstrate suitability of the component for the

prescribed design conditions)

- all interfaces towards other systems, including their technical realisation
- how the component/system will be manufactured, tested, transported, installed, operated, serviced and decommissioned.

U160 – Assembly or arrangement drawing

A drawing showing how the parts of the component are arranged together.

U170 – Detailed drawing

A drawing showing geometric dimensions of the final component. The drawing shall cover the following aspects:

- material specifications
- dimensional tolerances
- pre-weldment machining details
- details of welded joints and welding procedure specification to be applied
- final machining level details
- extent of NDT.

U180 – Design analysis

An analysis of the ability of a component to withstand the specified design conditions, presented in a report including:

- objective and scope of work
- design basis, design loads and description of load application
- geometry properties, e.g. cross-referenced to relevant detailed drawings
- boundary conditions.

for FE-calculations

- description of the finite element (FE) model
- description of element types
- calculations results and FE-result plots, including detailed plots of peak stresses
- discussion of the results
- conclusion
- reference documents.

U190 – Design validation test record

A document providing evidence that the extent of validation testing required to be performed on a component/product has been satisfactorily completed.

Note:
Design validation is performed to ensure that the specific operational requirements have been met. In certain cases, it is necessary to perform wet-simulation testing to prove correct functioning of components and systems under water.

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Tests should include simulations of actual field and environmental conditions for all phases or operations, from installation through maintenance. Special tests can be required for handling and transport, dynamic loading, and backup systems. Performance tests can be appropriate and can supply data on response-time measurements, operating pressures, fluid volumes, and fault-finding and operation of shutdown systems.

U200 – Operation manual

A document providing information on:

- operation modes
- operating instructions for normal and degraded operating modes

— details of the user interface
— transfer of control
— redundancy
— test facilities
— failure detection and identification facilities, automatic and manual
— special areas requiring user attention
— procedures for start-up
— procedures for restoration of functions.

U210 – Installation manual

A document providing information about the installation procedures for the component or system. This document shall typically include details of key interfaces and phases of the installation and commissioning phases for systems which are relevant to the definition of the load cases to be considered for the design verification of components.

Installation requirements may include some or all of the following items:

— loadout
— transportation to site
— buoyancy capability
— ballast/flooding system
— system for lowering to seabed
— positioning and repositioning capability
— levelling system
— foundation interface
— commissioning test procedures.

U220 – Maintenance manual

A document providing information on:

— maintenance and periodical testing to be performed
— acceptance criteria
— fault identification and repair.

U230 – Capacity analysis

A report presenting for a system:

— calculation of the capacity of the system
— comparison of the results with corresponding capacity requirements.

U240 – Temperature calculations

Calculation of extreme temperatures in systems and where within the components these may occur. The calculations shall document correct choice of piping and valve materials.

U250 – Pipe stress analysis

A calculation of stresses in the pipes and their supports due to for example expansion, water hammering and surge. An assessment of the pipes and their supports' adequacy is with respect to structural strength and fatigue.

U260 – Thermal stress analysis

A calculation of stresses in the pipes and their supports due to thermal effects. An assessment of the pipes and their supports' adequacy is with respect to structural strength and fatigue.

U270 – Heat balance calculation

An analysis comprising calculations of heat input and heat loss in e.g. piping systems and tanks.

U280 – Specification of piping, valves, flanges and fittings

Note:
(USE ONLY FOR PURCHASED 'off the shelf' ITEMS)

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Specification of piping, valves, flanges and fittings is a document describing for each system type of pipe or component:

— pipe or component design standard.
— dimensions (for pipes, outside diameter and wall thickness)
— design pressure
— design temperature
— materials
— corrosion protection
— test pressure.

U290 – Material summary report

A summary of the materials of construction of pressure containing / controlling or main load bearing parts including details of minimum specified yield strength and Charpy impact values.

U300 – Flow diagram

A diagrammatic drawing including the following:

— flow summary tables for all major process streams, including heat and mass balances
— all major control loops
— all major equipment
— pressure and temperature in major streams and equipment
— duty of drivers and heat exchangers
— tag numbers of equipment.

U310 – Sizing calculations

Sizing calculations are for e.g. relief valves, bursting disks and restriction orifices.

U320 – Piping and instrumentation diagram (P & ID)

A diagrammatic drawing including the following:

— outside diameters and wall thicknesses of pipes
— materials used in pipes, valve bodies and fittings
— components including reference identification (tag numbers)
— size of pressure vessels equipment and piping
— piping with line numbers
— pump type and capacity
— type of valves, connections and fittings
— type of expansion elements
— design pressure if exceeding 7 bar, and design temperature if exceeding 60ºC
— location of shutdown and isolation valves
— failure mode of control and shutdown and isolation valves
— hydrostatic test pressure after installation on board, where required
— instrumentation, including safety devices, control and monitoring equipment
— signal lines, sufficient to describe the function
— heat-tracing cables and insulation for pipelines, valves, instruments, vessels, equipment etc.
— maximum differential pressure across centrifugal pumps
— maximum flow through pumps and compressors

— set points for all shutdown and isolation valves and rupture disks
— design and operational data for the components
— input and output signals from safety systems.

U330 – Structural categorization plan

A drawing showing the material categorization of the main load bearing structure.

U340 – Structural inspection plan

A drawing showing the inspection categorisation of the main load bearing structure.

U350 – Site investigation report

A report providing a description of the soil investigations performed on a specific location. An interpretation of the results of the investigation towards soil design parameters, such as general classification parameters, shear strength parameters, deformation properties and other parameters for the design of the subsea foundation".

U360 – Pile/foundation design report

A document describing:

— the soil resistance models for axial and lateral resistance
— axial and lateral capacity
— pile response to imposed loads, with consideration to interaction effects.

U370 - Overall single line diagram

A diagrammatic drawing showing:

— power system layout with identification of all generators, transformers, switchboards, distribution boards, frequency converters, filters, battery systems and major consumers.
— system voltages and system earthing.
— rating of generators (kVA/kW). If a prime mover is also used for driving other machinery, this shall be stated on the overall single line diagram
— rating of all transformers (kVA) in the distribution system
— ratings of any major consumers (kVA/kW).

U380 – Control system philosophy

A document describing:

— requirements for distribution/allocation/segregation of sub-systems and functions
— description of functions to be implemented as automatic control, manual control, remote control, local control, safety functions or functions with a safety function. control
— specification of data exchange between systems
— specification of failure handling and safe states
— physical requirements and limitations such as cabinet location, cable routing, etc.
— description of power distribution principles

U390 – Control system functional description

A document describing:

— system configuration
— scope of supply
— what is controlled and monitored and how
— safe state(s) for each function implemented
— switching mechanisms for systems designed with redundancy.

U400 – Cause and effect diagram

A matrix showing all inputs (causes) to a system and all corresponding outputs (effects). Where more than one sheet is necessary for the matrix, the cause and effect diagram shall be organized either according to physical areas of the equipment or by natural splits of the corresponding safety system.

U410 – Schematic description of input and output circuits

For each type of input and output device, a typical electrical schematic drawing. For each individual input and output device, information about fail-safe mode, i.e. normally energised (NE) or normally de-energised (NDE) operation and what kind of line monitoring that is implemented, e.g. line break, short circuit or earth fault.

U420 – Control diagram

A schematic diagram showing hydraulic or pneumatic control lines and associated components as actuators, valves and similar. The operational mode that is shown, e.g. normal operation with pressure applied, shall be stated. The failure mode of the components, e.g. close on loss of power, shall be stated.

U430 – Materials selection report

A document describing:

1) Fluid corrosivity evaluation
   Based on design data, the potential corrosivity of all fluids associated with production or processing of oil and or gas shall be assessed.
2) Special measures for control and monitoring of internal corrosion and erosion
   This may include e.g. use of internal coatings or linings, chemical treatment, corrosion probes and fluid analyses.
3) External corrosion protection
   Use of paint coatings shall be specified by reference to generic type, thickness (total and individual layers) and surface preparation.

U440 – Material specification, metals

A document describing the following, along with accept/reject criteria where applicable:

— scope, references and definitions
— physical property requirements
— chemical composition
— allowable melting practice(s)
— forming practice(s), including hot-working and cold-working practices
— heat-treatment procedure, including cycle time, quenching practice and temperatures with tolerances and cooling media
— heat-treating equipment calibration
— mechanical property requirements
— non-destructive examination (NDE) requirements
— inspection and non-destructive testing requirements
— dimensions and tolerances
— surface protection
— certification and marking requirements
— material qualification records.

U450 – Material specification, non-metallic materials

A document describing the following, along with accept/reject criteria where applicable:

— scope, references and definitions
— physical property requirements
— chemical composition

— delivery conditions
— production process
— testing and requirements
— inspection and non-destructive testing
— dimensions and tolerances
— certification and marking
— storage and age-control requirements
— material qualification records.

U460 – Cathodic protection detailed design report

A document including the following items:

— design premises (incl. reference to all relevant project specifications, codes and standards)
— surface area calculations (incl. reference to all relevant drawings, incl. revision numbers)
— current demand calculations (initial/final and mean)
— current drain calculations (if applicable), (initial/final and mean)
— calculations of minimum required net anode mass
— anode resistance calculations (initial and/or final, as relevant)
— calculations of minimum number of anodes required (incl. anode current output and anode capacity for initial and final life of system)
— calculation of net anode mass based on required number of anodes (if higher than required net anode mass)
— calculation of total current output based on number and type/size of anodes to be installed
— tentative anode design (incl. any special provisions for structural integrity and electrical continuity)
— anode distribution drawings
— provisions for electrical continuity, including verification by testing.

U470 – Coating specification

A document describing as applicable:

— coating types, material and manufacturer's technical data sheets comprising requirements to surface preparation and application, and safety data sheets
— definition of coating system, including number of coats and minimum and maximum variation in dry film thickness
— surface preparation, including preparation of edges and welds, surface cleanliness standard (e.g. blast cleaning to Sa 2.5 as defined by ISO 8501-1. Preparation of steel substrates before application of paint and related products visual assessment of surface cleanliness) and roughness/profile
— removal of contaminations such as oil, salts, dust etc.
— maximum allowable air humidity in relation to air and steel temperatures during surface preparation and coating application
— control and inspection procedures, including acceptance criteria, tests (e.g. surface cleanliness, film thickness and temperature control) and handling of deviations from specified quality
— coating procedure qualification records
— allocation scheme, describing what type of coating to be applied where, including colours.

U480 – Welding tables

A document defining the general weld types that shall be used. Weld types and dimensions shall be included.

U490 – Welding procedure specification (WPS)

A document describing all the essential, nonessential and supplementary essential (if required) variables, such as:

— reference to base metal groupings
— consumables
— preparation of weld
— preheating requirements
— method and control of welding
— post-weld heat treatment
— necessary equipment to be used.

U500 – Welding procedure qualification record (WPQR)

A document recording all essential, and supplementary essential (if required), variables of the weld procedure used for the qualification test weld. This shall be supplemented by the results from the performed non-destructive and mechanical testing.

U510 – Non-destructive testing (NDT) plan

A document describing the methods, extent and criteria for the non-destructive testing that shall be performed.

U520 – Manufacturing procedure specification (MPS)

A document describing:

— qualification and acceptance of manufacturing procedures and personnel
— correct identification, documentation and use of materials
— inspection of preparatory work (assembly, fit-up form work, reinforcements, preheating, etc.)
— manufacturing sequence
— inspection of completed work for compliance with specifications and procedures
— manufacturing tolerances
— repairs and inspection of repairs
— methods for ensuring the functionality of examination and testing equipment and of recording and measuring devices vital for the correct functioning of equipment and machinery used in manufacture.

Guidance note:
MPS are required for special processes such as bending, forming, forging of materials etc. where there may be an effect on the specified material properties after processing.

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U530 – Test procedure at manufacturer

A description of test configuration and test simulation methods. Based upon the functional description, each test shall be described specifying:

— initial condition
— how to perform the test
— what to observe during the test and acceptance criteria for each test.

The tests shall cover all normal modes as well as failure modes identified in the FMEA, including power and communication failures where applicable.

U540 – Factory acceptance test (FAT) procedure

A document detailing a comprehensive acceptance test programme undertaken at the manufacturing site to ensure that components have been manufactured in accordance with specified requirements. Typically it will include the following:

— purpose/objective
— scope
— requirements for fixtures/set-ups, facilities, equipment, environment and personnel
— performance data

— acceptance criteria
— reference information

Guidance note:
Factory acceptance testing is generally a multi-tiered approach, involving individual component checks, subsystem checks (e.g. control system), interface checks and unitized system checks.

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U550 – Manufacturer record book

A document containing traceable records required for the component. Typically,

— material certificates
— welding and additional treatment records
— NDT reports
— coating test reports (during production)
— FAT records.

U560 – Report from test at manufacturer

A document describing all results, and limitations to the tests performed.

U570 – Measurement report

A document providing:

— a reference to a measurement procedure
— a description of what has been measured
— a description of when, where and by whom the measurements have been performed
— the results of the measurements.

DNV GL

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