

NORSOK STANDARD

DOCUMENTATION FOR OPERATION (DFO)

Z-001
Rev. 3, December 1997

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

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

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

The purpose of NORSOK standards is to contribute to meet the NORSOK goals, e.g. by replacing individual oil company specifications and other industry guidelines and documents for use in existing and future petroleum industry developments.

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 Subject to implementation into international standards, the NORSOK standard will be withdrawn.

All annexes are normative, except for Annex C which is informative.

INTRODUCTION

Revision 3 of this standard replaces Z-CR-001, revision 2, and is primarily made to include a new Annexes C on Design, Fabrication and Installation resumé. Clause A.7 and A.30 of Annex A has been revised accordingly. Other changes are marked with a vertical line in the margin.

Revision 4 of this standard now includes Annex D. Revision marks from revision 3 is kept for information.

1 SCOPE

This standard defines the extent and details of technical information which shall be available for use in the operational phase. The main objective is to ensure that only necessary information is kept available, to facilitate the safe, effective and rational operation, maintenance and modifications of the installation.

2 NORMATIVE REFERENCES

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

ISO 3511	Process Measurement Control Functions and Instrumentation - Symbolic representation (Part I, II, III and IV).
ISO R538	Conventional signs to be used in schemes for the installation of pipeline systems in ships.
NORSOK S-002	Working environment
NORSOK Z-DP-002	Coding system (next revision will be renumbered Z-002)
NORSOK Z-003	Technical information flow requirements (TIFR)
NORSOK Z-004	CAD Symbol libraries (in preparation)
NORSOK Z-005	2D-CAD drawing standard
NS 2129	Offshore Installations, Weight Engineering. Requirements for weight reports.
NS 5820	Supplier documentation of equipment.

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

As-Built	Documentation where mark-up information has been formally incorporated into a new revision of the original document according to individual requirements for each project.
Article number	Company specific identification code for non-tagged bulk material, pipe components, cable glands etc.
Bulk Component	Unit or item which does not require an individual physical identity. A bulk component shall be identified by manufacturer's name and model/type identification.
Can	Verbal form used for statements of possibility and capability, whether material, physical or casual.
Component	Item which does require an individual physical identity. A component shall be identified by manufacturer's name, model/type identification

	and serial number.
Document	A limited amount of information stored on various types of media, e.g. paper, film, magnetic or optical memory.
Informative references	Shall mean informative in the application of NORSOK standards.
May	Verbal form used to indicate a course of action permissible within the limits of the standard.
Normative references	Shall mean normative in the application of NORSOK standards.
Part	Part is any part of a bulk component/component. Part shall be identified by manufacturer's model/type identification.
Shall	Verbal form used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted, unless accepted by all involved parties.
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 which is preferred but not necessarily required.

3.2 Abbreviations

DFI	Design, fabrication and installation
IDAS	Instrument datasheets
IMR	Inspection, maintenance and repair
ISOs	Isometric drawings

4 REQUIRED INFORMATION

4.1 General

Required information is shown in Annex A, "Detailed Requirements". It shall be noted, however, that information supplied shall be limited to information relevant for the actual installation. Standard documentation will be acceptable when it fulfils this requirement.

Documents specified in this standard shall be provided as individual documents, not combined in mutual documents.

All information shall have As-built status and be available on electronic media.

ANNEX A DETAILED REQUIREMENTS (NORMATIVE)

A.1 DOCUMENT INDEX

The following information shall be included:

- Document type code
- Document number. (Document Identification code)
- Originator code
- File reference. (File name)
- File format. (File type)
- Originators document number
- Document title
- Document format
- Revision code
- Revision date
- Status code
- Area code
- Discipline code
- Reference to tag codes
- Reference to components and bulk components
- System
- Responsible party
- Purchase order identification
- Revision date
- Reference to manufacturer
- Manufacturer's serial number

NOTE: All coding shall be in accordance with NORSOK standard Z-DP-002, Coding system.

A.2 DESIGN AND FABRICATION SPECIFICATIONS

These are design and fabrication specifications especially produced for the development project.
(Standard project specifications are not included)

A.3 PROJECT DESIGN CRITERIAS, PHILOSOPHIES ETC.

This documentation is only related to design criterias, philosophies, methodology and requirements specially produced for the development project.

A.4 SYSTEM DESIGN REPORTS AND OPERATION MANUALS

A.4.1 System design reports

The objective of the system design report is to give sufficient details arguing the reason for choice of design related to system parameters. This shall apply to all disciplines within all systems.
Typical content shall be:

- System description
- Operational data and limitations
- Composition of medium
- Material choice
- Corrosion evaluations
- Bases for choice and use of corrosion inhibitors
- Location of injection points
- Location of sampling points for analyses
- Location of areas for corrosion control equipment
- Project specific features and solutions
- Hydraulic analysis (fire protection systems)
- Seabed preparation and intervention work

A.4.2 Operation manuals

One operation manual shall be produced for each installation (e.g. ship, platform, subsea) comprising successive step-by-step procedures for bringing a dead installation to full operation.

Operation manuals shall describe each system's mode of operation. Typical content shall be:

- System summary
- Functional description
- Operation and control data for equipment
- Process and emergency shutdown systems (PSD & ESD)
- Operation in emergency mode
- Equipment data
- Safety procedures
- Start-up and shut-down procedures, system and main equipment

A.4.3 Inspection procedures

Inspection procedures shall be prepared for structural steel, piping and pressure vessel based on DFI-resumé, system design report, criticality analysis and relevant API standards. The procedures shall contain what to inspect, inspection methods and inspection frequency.

The inspection procedures shall include:

- reasons for why inspection shall be done, i.e. stress, erosion, corrosion, API requirements etc.
- inspection methods and reason for choice of such if there is more than one option

Piping inspection procedure shall include:

- inspection isometric drawings with inspection point (welds/components) (see A.24.4)

Hull/structural inspection procedures shall include:

- inspection points with position number marked up on fabrication drawings containing welds

Vendor information for pressure vessels and heat exchangers shall include:

- inspection drawings

- detailed drawings of internals.

A.4.4 Repair procedures

Where repair is foreseen and the repair is not covered in user manuals, and the dismantling is dependent on fabrication yard's solution, special repair procedures shall be produced.

A.4.5 Inspection, maintenance and repair (IMR)

Relevant for subsea only.

Final IMR documentation shall be compiled in accordance with the project IMR strategy.

A.5 USER MANUAL (EQUIPMENT)

The supplier standard User Manual shall be used, ref. NS 5820. If the supplier does not have a standard User Manual, a User Manual shall be specially prepared according to Annex A of NS 5820.

A.6 FABRICATION, INSTALLATION & VERIFYING DOCUMENTATION

A.6.1 General

By fabrication, installation and verifying documentation it is meant construction, manufacturing, installation, testing, reporting and certification documentation required to demonstrate that constructions, equipment, materials and fabricated systems and units are in compliance with the statutory regulations and specified requirements.

Such documentation shall be prepared as specified in this standard to fulfil user requirements for the operational phase.

Certificates retained by contractor/supplier shall be available upon user request during the warranty period or as agreed. Certificates for recertification shall be included in the DFO.

A.6.2 Certificate of conformance

A document shall be prepared to cover the complete contract/purchase order. The contractor/supplier shall confirm that the requirements in the contract/purchase order for design, calculations, fabrication, installation and testing have been met.

All non-conformances shall be stated on the same certificate.

A.6.3 Material Traceability, Weld and NDE Documentation

Documentation for operation shall contain typical certificates or references to NORSOK material datasheet for applied materials. These shall be grouped by article number for each material type and dimension, thereby achieving traceability of components from document (drawing) to relevant groups of certificates.

NOTE: Traceability for welding and NDE to be maintained in accordance with the contractors/suppliers own internal system, and is not required as part of DFO.

A.6.4 List of certificates

List of certificates shall be submitted with reference to model/type/manufacturer and the name of the test institution. Following certificates shall be listed:

- Calibration certificates
- PSV certificates
- Ex-certificates
- Type approval certificates
- Fire protection material test certificates
- Pressure test certificates

A.6.5 Third party verification and certificates

Third party verifications and certification shall be included when required by authority regulations.

A.6.6 Photos of structures and equipment

For risers/J-tubes, subsea structures, submarine pipelines and cables, photos including identification of main components, distances etc. shall be provided. Any video recordings (visual inspection) should also be provided.

A.7 DFI RESUMÉ

The main objective of the DFI resumé is to provide the operations organization with a concentrated summary containing the most relevant data from the design, fabrication and installation phase, including which areas are the most critical and a general description of the installation at the start of the operational phase.

The DFI resumé is intended to be the basic document for the operations organization and shall contain all information required for inspection and maintenance planning throughout the entire lifetime of the installation.

The document should also serve as an aid in the consideration of measures to be taken if the condition monitoring reveals that the installation is damaged or deviates from the acceptance criteria.

In order to achieve a resumé fit for purpose it is important that the preparation of the resumé takes place in parallel with the contract work. The Design-part of the resumé shall be prepared in parallel with the design documentation, preferably as an integrated part of this.

The Fabrication- and Installation-parts shall mainly concentrate on nonconformances from design/fabrication criteria, specifications etc. Further, areas should be highlighted where special attention in the operational phase is recommended due to f.ex. difficult repairs, unexpected large loads or other unforeseen events. Only a brief description of the work performed shall be included.

The resumé shall reflect the AS-BUILT status of the installation.

DFI resumés for loadbearing structures and subsea pipelines shall be produced in accordance with the requirements of Annex C and D respectively.

A.8 TAG INDEX

A tag index shall be provided, containing information of all tagged bulk components/components installed, irrespective of type. The following information shall be included:

- Tag code
- Tag description, function related
- Area location code
- Discipline ('owner' of the tag)
- Reference to:
 - Manufacturer
 - Model/type
 - Serial number for components
 - Parts list
 - Fire area clarifications

To facilitate efficient traceability and updating of related information, documents describing the design shall be cross-referenced against all relevant tagged functional locations. The following information shall be included:

- Document, tag cross reference
- Document number
- Tag code

A.9 HEALTH, SAFETY AND ENVIRONMENT

A.9.1 General

Health, safety and environment data shall be delivered according to statutory regulations.

A.9.2 Safety data sheet index

A safety data sheet index for the complete installation shall be provided. Material Safety Data Sheets with accompanying index, shall be prepared on OLF approved forms, written in Norwegian.

A.9.3 Work environment area charts

Work environment area charts, ref. NORSOK S-002, shall be included in the DFO.

A.10 WEIGHT DATA INDEX

Weight information shall be supplied according to NS 2129.

A.11 FIRE AREA LOCATION INDEX

The index shall include:

- Area identification code
- Area description
- Area classification (zone 1, 2 or non-hazardious)
- Ventilation condition for the 'fire area' (mechanical or natural ventilation, overpressure, underpressure)
- Personnel occupancy (continuously manned, no occupancy, etc.)
- Area enclosure (open, cladding, etc.)
- Combustible hazard (Hydrocarbon, GAS-H₂, etc.)
- Fire/Gas detection (GAS-Hydrocarbon in area, GAS-Hydrocarbon vent intake, etc.)
- Protection (deluge, water spray, etc.)
- Reference to Cause and Effect diagrams

A.12 SINGLE LINE INDEX

(For equipment Ref. NS 5820, Single Line Diagram)

A single line index, shall be provided for power distribution for all voltage levels and power supply for, instrument and telecommunication. The following information shall be included:

- Distribution board tag code (*)
- Circuit number / incomer number (*)
- Circuit type
- Wiring details for all inline units
- Inline component identification
- Consumer tag code (*)
- Type of consumer (if not identified through tag syntax) (*)
- Spare circuits to be registered as such (type: Spare) (*)
- Description of non-tagged consumers (control circuits etc.) (*)
- Location/address of non-tagged consumers (*)
- Consumer cable number (*)
- Termination details - consumer cable number (*)
- Termination details - tripping relays/contactors (inline component)
- Type of external signal (fire & gas trip signal etc.)

The following related information shall be available in its respective indexes:

- Tag codes in tag register
- Power and current rating (datasheets and/or circuit diagrams) (*)
- Inline components (datasheets for components)
- Cable sizes (from cable list registration) (*)
- Reference drawings, including ref. to circuit diagram for circuit when applicable (cross-referencing requirement) (*)

For deviations from the typical solutions (circuit type's), drawings including all of above information as a minimum, shall be provided. Additionally, all above information marked with (*), shall be registered.

A.13 CABLE INDEX

(For equipment ref. NS 5820 - Cable List)

A common cable index for electrical, telecommunication and instrument shall contain:

- Cable number
- Cable length
- Type and size of cable
- Tag code both ends
- Gland/nipple sizes
- Routing of cables (data input from node diagrams)
- Screens format A (I = individual / C = common)
- Color
- Voltage of equipment connected

Cable ladders and transits shall be given their identifying references on a nodal diagram, which is an isometric representation of a ladder layout. Identifying references shall be marked on the cable ladders and penetration transits. Each end of a cable ladder segment shall be bounded by a node point number to indicate that this is the start or finish of any particular segment.

For the purpose of cable routing and administration, a computerised program shall be used.

A.14 RELAY SETTING INDEX

A relay setting index is required for all high and low voltage protection relays. This index shall include the following information:

- Switchgear tag code
- Cubicle no
- Phase for relay connection
 - Relay
 - Manufacturer
 - Model/type
 - Class
 - Relay range boundaries
 - Relay settings
- Current/voltage ratio
- Relay selectivity reference (as defined in selectivity analysis/relay coordinations study)

Electrical calculations such as short circuit and load flow, model and calculations are to be included in the DFO.

A.15 LOOP INFORMATION

(For equipment ref. NS 5820 - Loop diagram)

Loop information:

- Shall be provided either in electronic format sufficient to enable generation of loop diagrams, or as 2D CAD drawings
- Shall be provided for instrumentation and telecommunication installations as well as for control cabling for electrical power installations
- Shall include the following information:
 - Tag code for all equipment in loop

- Termination details for all cables between tags in the loop (field equipment, junction boxes, Main Distribution Frame's, main equipment terminal boards - external cables)
- Cross-wiring details (junction boxes and Main Distribution Frame's)
- Cable details; like cable number, pair numbers, core colours, cable type
- System programming information as switch number, port number, channel number, signal tag code. etc
- Amplifier number and zone number (Public Address systems)
- Signal type (control signals)
- Process hook-up

A.16 ANODE INDEX

An index shall be provided containing the following information:

- Identification and location of all sacrificial anodes.
- Identification and location of all electrodes and monitored anodes.
- Fabrication data

Typical data shall be:

- Name of contractor
- Inspection and tests
- Material components
- Dimensions and weight characteristics
- Number
- Consumption data

A.17 LINE INDEX

The line index shall contain the following information:

- Line number (Tag code)
- P&ID document number
- Stress ISO number
- Fabrication and inspection ISOs
- Service from' tag code
- Service to' tag code
- Test class
- Test medium
- Test pressure (barg)
- Chemically clean
- Heat tracing degree C
- Insulation class
- Critical line
- Calculation number
- Stress calculation number
- Nominal size
- Density vapour/liquid
- Viscosity vapour/liquid

- Liquid fraction
- Calculation method
- Fluid
- Mass flow
- Compressibility
- Velocity
- Pressure drop calculated and allowed
- Operating pressure
- Design pressure
- Operating temperature
- Min/max design temperatures
- Pipe class

A.18 SYSTEM CONFIGURATION INDEX

This index shall hold information related to the control systems such as primary signals, I/O cards, functions and group alarms in the control systems.

A.19 LUBRICATION INDEX

The lubrication index shall contain the following information:

- Model/type of component
- Lubrication point sequence number
- Lubrication points
- Supplier lubricant (product type)
- Quantity first
- Quantity normal
- Interval

A.20 CONSUMPTION DATA

Consumption data inclusive electrical load list shall be given for all utility, drilling and process consumers.

Electrical load list shall include the following information:

- Tag number
- Service/remarks
- Area
- Rated nameplate power (kW)
- Operating output power (kW)
- Efficiency
- Cos

Should be given for different modes such as normal operation, critical, stabilised and emergency operations.

A.21 FLOW DIAGRAMS

Process and safety flow diagrams for main “process” and auxiliary systems. Process parameters shall be shown on the diagrams as well as on corresponding indexes such as line index and tag index.

The flow diagrams shall, as a minimum, contain the following:

- Flow summary tables for all major process streams
- 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

HVAC flow diagrams (air distribution diagrams) shall be provided per system and include the following information:

- Tag codes for supply and extract fans (air handling units)
- Flowrates for supply and extract fans (air-handling units)
- Flowrates for all serviced areas
- Temperature requirements for all serviced areas
- Area codes and description for all serviced areas
- Notes regarding main design parameters, such as fan stand-by philosophy, emergency operation shall be given under A.4

Typical flow diagram process is shown in Annex B.

A.22 PIPE & INSTRUMENT DIAGRAMS (P&ID)

(For equipment ref. NS 5820)

Fully completed P&ID's shall contain the following details:

- All process and utility equipment shall be shown and tagged
- Equipment data summary with tag number and system
- Elevation of main equipment
- Drip trays
- All instrumentation reflecting the control functions such as control loops, logic functions, pre-alarms, trips, signal types, shut down levels, tag numbers, local instruments, connections to local control, central control room, emergency shutdown system, process shutdown system, pressure safety valve and blowdown valve systems and the system control and data acquisition system when provided
- All instrument locations shall be indicated and completed with tag numbers
- All valves such as isolation valves, control valves, check valves, relief valves, shut-down valves, blow-down valves, block valves, bleed valves size and type shall be indicated and completed with tag numbers
- Mechanical lock and interlocks
- All functional control instruments inside packages with tag numbers
- All process and utility lines including equipment connections, and interconnecting pipework with direction of flow

- Inline equipment and piping items such as straightening vanes, spool pieces expanders, maintenance spools, reducers and temporary strainers
- Clean-out and sample connections
- Piping class breaks
- Labels on entering and leaving lines giving medium and source/destination
- All lines shall be sized and numbered. Material and insulation specification shall be included
- All line number and/or specification changes shall be identified
- All manual valves with size and specification added, correctly shown as normally open/closed
- Fail/open/fail closed position of actuated valves
- Information on lines such as line slope requirements, symmetrical piping requirements etc.
- Packages shall be identified with limit of responsibility between contractor and others
- Connections to other systems
- Connections to other equipment and packages eg. steam out, vent, manholes, drains etc.
- Isolation and spading of equipment
- All flanges and drains in lines
- Winterisation including heat tracing
- Area changes shall be shown on lines
- Utility stations
- Piping special items
- Significant equipment internals, such as vortex breakers, mist extractors etc.

Typical P&ID is shown in Annex B.

A.23 DUCT & INSTRUMENT DIAGRAM (D&ID)

Air distribution diagrams shall be provided per system and include the following information:

- All HVAC equipment shall be shown and tagged
- Equipment data summary with tag number for all main equipment such as filters, fans, coils
- All ductwork identified with system no., sizes, duct classes, insulation classes
- Air flow to all serviced areas
- Area breaks and duct class breaks
- All areas served to be identified
- All instrumentation reflecting the control functions
- All instrument locations shall be indicated and completed with tag numbers
- Connections to other systems e.g. sea water, heating medium, drain etc.

A.24 ISOMETRIC DRAWINGS

A.24.1 Fabrication ISOs

Piping shall be documented on fabrication ISOs including the following information:

- North arrow
- Line number
- Reference to adjacent ISO-drawings
- All inline equipment with tag code
- Piping class
- Special items with coding

- Penetrations
- Dimensional details
- Platform coordinates (elevations and xy)
- Reference to piping general arrangement & P&ID's
- Weld location and number
- Material type
- Material takeoffs including article number
- Weight and centre of gravity
- Pipe supports with identification
- Field welds
- Welded attachment
- Orientation of valve operators
- Flow arrow
- Sloping lines to be identified with gradient

A.24.2 Heat tracing ISOs

Heat tracing installation shall be documented on fabrication ISO's including the following information:

- Graphical presentation of heat tracing cable (where installed)
- Heat tracing cable numbers
- Power supply cable numbers
- Junction boxes with tag code
- End seal of heat tracing cable
- Splice of heat tracing
- Type and length of heat trace cables

A.24.3 Stress ISOs

- Line number
- Stress summary, reports and calculation
- Restraint/anchor loading and displacement
- Spring summary
- Total load

A.24.4 Inspection ISOs

Inspection isometric drawings shall have sequential numbering of piping components (pos numbers) and all shop and field welds shall have cross reference to weld summary index.

A.24.5 System ISOs (for firewater systems only)

System ISOs are normally prepared to for firewater system to document hydraulic calculations. This document should include the following information:

- North arrow
- Linde number

- Reference to adjacent system ISO
- All inline equipment and pipe fittings
- Piping-class
- Special items
- All dimension and dimensional details
- Reference to P&ID's
- Material type
- Spray nozzle data details (boxes)
- All line sizes

A.25 DATA SHEETS

Datasheets shall be provided for systems, components and bulk components. NORSOK standard data sheets shall be used.

A.26 GENERAL ARRANGEMENT

General arrangement drawings shall be prepared for packaged units in accordance with NS 5820.

A.27 LAYOUT DRAWINGS

To the extent CAD modelling has been applied in the design phase, layout drawings shall preferably be replaced by isometric views, plan views and related crosssectional drawings from the model.

Layout drawings shall be supplied for:

- All main equipment
- HVAC ducts(minimum dimension to be agreed)
- Cable ladders/cable trays(minimum dimension to be agreed)
- Lighting and small power
- Safety
- Telecom
- Architectural
- Instrument

Layout drawings shall include:

- Tag code
- Location
- Dimension and geometrical form of main equipment
- Main dimensions for the area and the equipment as such
- Main and escape routes
- Lay down areas with load capacity
- Crane coverage
- Location of safety signs
- Location of firefighting and safety equipment
- Location of rescue and lifesaving equipment
- Area classification (with source of release schedule)

- Noise area location
- Fire area location

For areas heavily equipped, such as control rooms, equipment rooms, telecom centre, individual layout drawings shall be provided per discipline. Cross-sectional views shall be provided when required for accurate identification of location.

A.28 LOCATION DRAWINGS (PLOT PLANS)

All main and field equipment shall be included, one per area and discipline, identified by:

- Tag code
- Type of equipment (relevant symbol)

Normally, location drawings are based on layout drawings without dimensional details.

All lifting lugs shall be shown on separate location drawings coordinated by area. Supplier provided lifting lugs with capacity are shown on supplier general arrangement drawings and identified in the parts list.

A.29 STRUCTURAL

A.29.1 Main structural steel drawings

- Arrangement
- Main dimensions
- Main/critical welds with reference to weld summary index
- Reinforcement
- Embedded items

A.29.2 Secondary and outfitting steel

- Arrangements
- Main dimension

A.29.3 Structural fire protection

Drawings should include the following minimum information:

- Extent and thickness of fireproofing, including description of coating/paint for fire protection systems
- Blast/firewalls

A.29.4 Acoustic/thermal insulation

Acoustic insulation, thermal insulation and fire protection details as follows shall be included:

- All doors and windows
- All insulation in ceiling, floors and walls

A.30 FREE SPAN CALCULATION

Clause deleted with reference to Annex D.

A.31 SYSTEM TOPOLOGY AND BLOCK DIAGRAM

- Control system topology (overall system block diagram) shall show configuration of systems and subsystems to give a functional understanding. Typical contents shall be:
 - All related systems and subsystems represented by blocks
 - Location
 - Interface and wiring between blocks shall be indicated
 - Subsystem block diagram showing relation between functional units within a subsystem. Typical information shall be:
 - The function of each unit (block): Short description, supplied with function identification code if applicable.
 - Interface between blocks and interface to other equipment: Signal type and function (typ. RS232, control signal) if applicable.
- Location of the equipment, either by text labelling of each block or by blocks located in dotted area boxes
- Heat tracing block diagram

Typical system topology and block diagram is shown in Annex B.

A.32 SINGLE LINE DIAGRAM

(For equipment ref. NS 5820)

Overall single line diagrams for all voltage levels shall be provided, including all power distribution units (generators, switchgears, transformers, distribution boards, rectifiers, batteries etc.) throughout the distribution system.

Power distribution throughout both the electrical, automation and telecommunication installations shall be included. End consumers shall be included for high-voltage switchgears only.

Separate earthing single line diagrams, including all main equipment, shall be provided for the electrical, instrument and telecommunication installations. The general earthing principles shall be included to ensure correct earthing of systems, equipment and cables.

Typical single line diagram is shown in Annex B.

A.33 CIRCUIT DIAGRAM

(For equipment ref. NS 5820)

Diagrams (switchgears/-boards) for all feeders and control circuits shall include:

- All internal connections for control, alarms, protection, interlocks, trip functions, monitoring etc.
- Range of timers, thermal overload and protection relays
- Internal wire numbers
- Terminal numbers
- External wire and cable numbers
- Component list for inline, control and protection components

- Switchgear/-board tag code
- Cubicle number
- Consumer tag code
- Type of consumer (if not identified through tag syntax) spare cubicles or part of cubicles to be registered as such (type: Spare)
- Consumer cable number
- Termination details - consumer cable number
- Type of external signals (fire & gas trip signal etc.)
- Power and current rating
- Reference drawings

Typical circuit diagram is shown in Annex B.

A.34 LOGIC DIAGRAM

(For equipment ref. NS 5820)

The Logic diagrams shall be available as graphical reports, or program listings documenting the function of the program. Modes of operation like starting, shut down, alarm and trip functions shall be indicated in the diagram.

To clarify the overall system logic a System control diagram may be used.

Typical logic diagram is shown in Annex B.

A.35 LEVEL DIAGRAM

Level diagrams shall be made for:

- The feeder arrangement of all radio systems including transceiver ports and antennas.
- Interconnection signal lines between subsystems and to other systems.
- External lines where signal level is not set by standard.

Levels shall be given in dBm in conjunction with standardised impedances. If impedance is non standard or undefined, voltage levels shall be given. Where applicable, impedances and wire configuration should be indicated (2W, 4W, coax, E&M, etc.).

A.36 CAUSE & EFFECT

(For equipment ref. NS 5820, Logic diagram)

Cause and effect information shall be provided either in electronic format sufficient to enable the generation of graphical reports from the control systems indexes or as 2D CAD drawings.

Typical cause & effect diagram is shown in Annex B.

A.37 WIRING DIAGRAMS

The termination diagram for external connections shall include:

- Terminal block/socket number
- Terminal/pin number (including spares)

- External cable numbers with pair and core colour details
- Destination for external cables
- Earthing details
- Equipment and equipment connections

Typical wiring diagram is shown in Annex B.

A.38 PNEUMATIC/HYDRAULIC CONNECTION DRAWING

The hook-up drawing shall indicate all details of the actual installation for the relevant instrument tag number, such as:

- All instrument/bulk material installed
- Connections and dimensions of signal lines/tubing
- Indicate split of responsibility instrument/piping

A.39 TELECOMMUNICATION NETWORK SCHEDULE

- Transmission budgets for radio links, satellite hops and fibre optical cables.
- Commissioning test results for:
 - Radio systems
 - Public address (PA) central systems
 - Audio and video distribution network

A.40 PIPING SUPPORTS

- Detail drawing/support standard
- Location
- Identification
- Pipe support index

ANNEX B TYPICAL DOCUMENT EXAMPLES (INFORMATIVE)

Flow diagram process (Dwg no. A21)

P&ID (Dwg no. A22)

System topology and block diagram (Dwg no. A31)

Single line diagram (Dwg no. A32)

Circuit diagram (Dwg no. A33)

Logic diagram (Dwg no. A34)

Cause & effect diagram (Dwg no. A36)

Wiring diagram (Dwg no. A37)

Denne side erstattes med et
diagram

Denne side erstattes med et
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ANNEX C DFI RESUMÉ FOR LOADBEARING STRUCTURES (NORMATIVE)

C.1 INTRODUCTION

C.1.1 General

This Annex describes the requirements regarding data and information to be included in the Design, Fabrication and Installation (DFI) resumé for loadbearing structures.

DFI resumés shall be prepared for Loadbearing structures, such as: Jackets, Gravity Based Structures, Tension Leg Platforms, Semisubmersibles, Ships, Jack-Ups, Spars, Subsea structures, Module Support Frames, Modules, Living quarters, Integrated Topsides, Derricks, Flares, Riser support systems and Mooring systems.

Independent resumés to be made for each major unit or system of the installation, dependant of size and complexity (such as the jacket, the MSF, a module, the mooring system, a wellhead platform or a template).

A detailed list of content required for the resumé and comments explaining the content for each heading are found in Clause C.2 of this Annex. The comments do not always describe the complete content for a heading, but in some cases only list a few items as a guideline.

C.1.2 Purpose/Scope

DFI resumés are short but precise summary documents containing information extracted from the design, fabrication and installation phases. The DFI resumé shall contain all information (as described in clause C.2 Structuring and Content of DFI resumé) needed for:

- The planning of the in-service inspection and maintenance activities throughout the entire lifetime of the installation.
- Evaluation of the condition and functioning of the structure.

This implies a detailed description of:

- Highly utilized areas, statically and in fatigue.
- Structures for which structural integrity, functional integrity or fatigue life is sensitive to design assumptions or exact functioning of specific structural elements.
- Prototype structures.
- Structural elements subject to progressive collapse/non-redundancy.
- Materials selection and corrosion protection.
- Recommendation for what should be inspected and which methods may be used. (Procedures for planned replacement and repair shall be contained in separate Operation Manuals.)

The DFI resumé shall also enable an overall understanding of the structural behaviour of the object by giving basic information about:

- Statical system

- Design conditions
- Loads and load combinations
- Governing load conditions
- Structural response

The DFI resumé shall provide a reference key to the detail technical documentation.

C.2 STRUCTURING AND CONTENT OF DFI RESUMÉ

1 Introduction

1.1 General

1.2 Objective

1.3 User Manual of DFI-Resumé

2 Description of the object

2.1 Main Functions of the Object

Describe the overall facility (location, orientation, main elements) and the functions of the object in relation to this.

2.2 Interfaces

2.3 Geometry, Weight & Centre Of Gravity

(Give reference to chapters 4.1 and 5.1)

2.4 Materials Selection and Corrosion Protection

2.4.1 Material Grades

Description with key parameters of the different materials used, where they are used and reasoning behind the selection of each material.

2.4.2 Corrosion Protection

Description with key parameters of the protective systems, where the systems are used and reasoning behind the selection of each system. Problem areas to be highlighted.

- Coating systems (Type and layer thicknesses)
- Cathodic protection system
- Corrosion allowance.

2.5 Structural Fire Rating/Fire Protection System

2.6 Identification System

- Describe the system used to identify areas, members, welds etc.
- Describe the structural marking system.

3 Design

3.1 Design Basis

3.1.1 Specifications, Codes, Standards, Regulations

3.1.2 Design philosophy

Describe the design philosophy guiding the choice of design methods and sequence.

3.1.3 Design Criteria and Loads

- Design lifetime
- Airgap
- Environmental conditions
- Drag and inertia coefficients
- Geotechnical information incl. subsidence
- Marine growth
- Ship impact
- Dropped objects
- Fire and explosion
- Seismic data
- Future loads, reserve capacity

3.1.4 Live Load Diagrams

To be illustrated by separate drawings floor by floor.

3.2 Statical System

3.3 Design Conditions

3.4 Load Combinations

3.5 Analyses

Description of the analyses hierarchy and a brief description of each analysis:

- Purpose
- Model and program system
- Loads
- Result

3.6 Governing Load Conditions/Structural Response

Give an explanation of how the structure responds to the governing load conditions and why these conditions are governing.

3.7 Design Verification.

- Model tests
- Load/response monitoring. Description of monitoring programs. Time schedule. Results.
- Key results from third party verifications where significant differences from design documentation are observed.

3.8 Nonconformances

Describe all cases of non-conformance in the design and the consequences of these.

3.9 Important Areas

(For symbols to be used for the presentation please refer to Clause C.3 at the end of this annex.)

3.9.1 Fatigue life

Areas, members, welds with fatigue life less than 5 times the design life for accessible members (ref. NPD regulations for loadbearing structures). shall be presented in detail on specially prepared drawings and using the identification numbers system described in 2.6. A verbal description shall also be given to assure exact and easy location.

3.9.2 Static utilisation

Areas, members, welds with a utilisation ratio higher than 0.80 shall be presented on sketches followed by a verbal description. The corresponding utilisation ratio for the operational phase shall be given.

3.9.3 Progressive collapse

Elements causing progressive collapse if failing. All such elements to be listed with their max. utilisation ratio during operation and shown on sketches.

3.9.4 Sensitive Areas/Structural Elements

Items for which structural integrity, functional integrity or fatigue life is sensitive to design assumptions or the exact functioning of specific structural elements. (E.g. sensitive to the assumed value of a coefficient of friction/assumed thickness of marine growth or e.g. the correct functioning of a bearing being governing for the fatigue lifetime). (Present on sketches).

3.9.5 Prototype Structures

Structures or parts of structures for which operational experience is missing or very limited. Give a description of the largest uncertainties in performance with respect to structural response and integrity.

3.10 Inspection

Condition Monitoring Philosophy used in design.

Overview of areas designed to be non-accessible (ref. NPD regulation concerning loadbearing structures).

Proposal of what should be inspected during the service life of the object based upon an evaluation, section by section, of the state of design as described in 3.9.

Describe access and methods available for the performance of this inspection.
Problem areas and areas with limited access to be highlighted.

3.11 Design Documentation

Give references to the complete documentation.

Key documents and main drawings to be listed separately under each clause,.

4 Fabrication

The information given in the 4.2 - 4.8 shall concentrate on non-conformances from design criteria, specifications, codes, standards and regulations.

The complete documentation shall be referred to, and not included in the document.

4.1 Weight & Centre Of Gravity

As-Built values.

4.2 Specifications, Regulations, Codes, etc.

(Refer 3.1.1)

4.3 Materials

Describe traceability of certificates.

4.4 Welding

Joints classified as "Design class 1" (ref. NORSOK N-001, Structural Design) shall be given special attention.

4.5 Tolerances (interfaces)

4.6 Inspection and Non-destructive Testing

4.7 Surface Protection

4.8 Fire Proofing

4.9 Identification System

Describe the Identification System used for Areas, Structural parts, Welds etc.

4.10 In-service inspection

Items recommended for inspection in the operational phase.

4.11 Fabrication documentation

(List of content for As-Built Documentation Level 1)

(Cross reference to fabrication records dossiers).

4.12 Fabrication Summary

Brief description of the work performed. Fabrication and assembly sequence.

Unexpected loads and events during fabrication.

5 Transportation and Installation

The information given in the 5.2 - 5.6 shall concentrate on nonconformances from design criteria, specifications, codes, standards, regulations.

The complete documentation should be referred to, and not included in the document.

5.1 Weight & Centre of Gravity

As installed values.

5.2 Specifications, Regulations, Standards, Codes, etc.

5.3 Materials

5.4 Welding

5.5 Tolerances (interfaces)

5.6 Surface Protection

5.7 Grouting

5.8 Identification System

Information about the identification system used.

5.9 Installation Documentation

(List of content for As-Built Documentation Level 1)

(Cross reference to fabrication records dossiers).

5.10 Transportation and Installation Summary

Brief description of the work performed. Installation and assembly sequence.

As installed information concerning location, orientation, penetration depth, scouring, etc.

Unexpected loads and events during installation.

Items recommended for inspection in the operational phase.

6 Input by company

(As applicable)

C.3 SYMBOLS

Symbols to be used in the resumé are as follows:

★	High stress
⊗	Yield
○	Buckling
□	Punch
▽	Fatigue
■	Complex welds
#	Fabrication problems/repairs
●	Corrosion/erosion
⬠	Progressive collapse

ANNEX D DFI RESUMÉ FOR PIPELINES (NORMATIVE)

Will be provided later. (Estimated March 1998)