



Exploration & Production

GENERAL SPECIFICATION

STRUCTURAL

GS STR 107

Offshore Structures decommissioning

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1. Scope

This general specification defines Company requirements related to planning, methodologies and operations for decommissioning offshore structures.

It applies to:

- Fixed structures such as steel piled jackets and topsides
- Gravity Based structures (steel or concrete)
- Drilling or installation templates
- Bridges, articulated columns
- Modules resting on floating structures
- Pier structures such as loading platforms, trestles, mooring or breasting dolphins
- Subsea structures piled or founded on suction anchors
- Piles and conductor pipes
- Risers and appurtenances.

The following items are not covered in this document:

- Hulls and moorings lines/tethers of floating installations
- Jack-ups
- Sealines, umbilical and flowlines
- Casings inside conductor pipes
- Onshore disposal operations.

The present specification shall be read together with the Particular Project Specifications (PPS) for the project, which will in particular state which regional, national and international regulations apply.

Design for lifting, refloating, upending, transportation and seafastening, offshore and onshore backloading shall be to **GS STR 401** criteria unless otherwise specified in the present specification or Particular Project Specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
API RP 2A WSD & LRFD	American Petroleum Institute: Recommended Practice for Planning, designing and Constructing Fixed Offshore platforms
DNV	Rules for Planning and Execution of Marine Operations
BV - NI 183	Towage at sea of vessels or floating units

Reference	Title
NDI Ltd - Report 0030/NDI DnV RP H102	General Guidelines for Marine Transportations Recommended practice - Marine operations during removal of offshore installations, April 2004

Professional Documents

Reference	Title
Not applicable	

Regulations

International conventions

- 1982 United Nations Convention on Law Of the Sea (UNCLOS)
- 1958 Geneva Convention on the Continental Shelf
- 1972 London Dumping Convention (LC72) and 1996 Protocol
- 1989 International Maritime Organisation (IMO) guidelines
- 1989 Basel Convention

Regional Conventions

The list below is not exhaustive. Applicable regional conventions shall be indicated in the PPS:

- Bucharest 1992 (Black sea)
- Cartagena 1983 (Caribbean)
- Nairobi 1985 (Eastern Africa)
- Kuwait 1978 (Red sea and Gulf of Aden)
- Barcelona 1976 (Mediterranean sea)
- Nouméa 1986 (South Pacific)
- Lima 1981 (South Pacific)
- Abidjan 1981 (West and central Africa)
- Helsinki 1974 & 1992 (Baltic Sea)
- OSPAR 1992 & Decision 98/3 (North East Atlantic)

National regulations

The list here below is not exhaustive. Applicable national conventions shall be indicated in the PPS.

UK:

- Prevention of Oil pollution act 1972
- Control of pollution Act 1974

- Food & Environment Protection Act 1985
- Environmental Protection Act 1990
- Radioactive Substance Act 1993
- Petroleum Act 1998

Norway:

- The Pollution Act 1984
- Petroleum Act 1985
- Safety Regulations 1985
- The Law on Cost Sharing of Abandonment 1985
- Norwegian Petroleum Directorate Guidelines 1990
- Pollution Regulations 1994

Codes

Reference	Title
IMO A749 (18)	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 350	External protection of offshore and related structures and equipment by painting
GS GEO 702	Requirements for design and installation of skirted foundations and suction anchors
GS STR 001	Weight monitoring and weighing of offshore units
GS STR 100	Fixed offshore platforms - General
GS STR 101	Design of offshore jackets and subsea structures
GS STR 102	Design of offshore topsides structures
GS STR 201	Materials for offshore steel structures
GS STR 301	Fabrication of offshore steel structures
GS STR 304	Fabrication of welded plate girders (W.P.G.)

Reference	Title
GS STR 401	Load out, sea fastening, transportation and installation of offshore structures
GS STR 402	Anchorage for a support vessel on an offshore site
GS STR 404	Marine aspects for load-out, transportation, and installation of offshore structures
GS STR 431	Installation of piles for offshore steel structures - Driven piles
GS STR 432	Installation of piles for offshore steel structures - Drilled and grouted piles
GS LSO 410	Diving specification
GS STR 485	Remotely Operated Vehicles (ROV)
GS STR 486	Remotely Operated Tools (ROT) intervention systems
GS GEO 501	Metocean Surveys
GS GEO 504	Comprehensive evaluation of environmental conditions
GS GEO 505	Monitoring of Metocean Conditions for Offshore units

3. Involved parties and responsibilities

The Particular Specification will define the Marine Surveyor, the Third Party Authority and/or Certification Authority and their respective responsibilities and scope of work during operations covered by this specification.

In particular, the following will be defined:

- The Authority responsible for checking/certifying the design of structures
- The Authority responsible for checking/certifying the decommissioning activities
- The Authority responsible for checking/certifying one or all of the following operations:
 - Back loading offshore and onshore
 - Sea-fastening
 - Transportation.
- The authority responsible for checking/certifying lifting and removal operations
- Interface matrix detailing the scope, the interfaces and the documents to be submitted and approved shall be prepared.

4. Design aspects

4.1 General

Structural analyses shall be performed so as to cover step by step all phases of the deconstruction and backloading of offshore structures, namely but not limited to:

- In place (modified structures)
- Transitory phases (such as stability of a jacket with partially cut piles)
- Under foundations overpressuring
- Refloating
- On bottom stability
- Lifting in air and/or water
- Upending in air and/or water
- Back loading offshore (set down on a vessel)
- Seafastening
- Transportation
- Back loading onshore.

For each phase, either Working Stress Design (WSD) or Load Resistance Factor Design (LRFD) philosophies may be used. These approaches shall however not been mixed.

The particular contingency factors shall be specific to each decommissioning project and defined in a Particular Project Specification. In cases where the LRFD approach is used, unless agreed otherwise by COMPANY and MWS, **API RP 2A** coefficients and material factors shall apply.

Unless agreed by COMPANY and Marine Warranty Surveyor (MWS) in a Particular Project Specification, no plastic deformation shall be allowed and design shall aim at remaining within the elastic domain.

In case plasticity design is to be used and accepted by COMPANY and MWS, the failure acceptance criteria shall be defined in details in the PPS and a applied only on specifically identified parts of the structure. Due attention shall be paid to the potential consequences induced by large deformations or plastic hinges (redistribution of load paths shall be identified and effects on unmodeled structures, non-structural elements or equipments shall be assessed).

4.2 Data collection and surveys

The status of the decommissioned objects shall be assessed on the basis of existing As-Built documentation, and shall in particular highlight:

- Original design criteria, applicable codes and specifications
- Original installation procedures
- Potential modifications performed after installation
- Events (such as subsidence, severe boat impact or fatigue cracks) that could have happened in the life of the structures

- Corrosion status
- Excessive scouring
- Accumulation of drill cuttings, debris and deposits (eg LSA scale)
- Presence of grout
- Weight range (with identified contingencies)
- Buoyancy range (with identified contingencies)
- Marine growths status (with identified contingencies)
- Centre of Gravity
- Centre of Buoyancy when applicable
- Material identification (in case old steel cannot be identified to a specific grade, a maximum Yield strength equal to 235 MPa shall be considered)
- Achieved fabrication tolerances
- Low in built redundancy structural areas (to be mapped)
- Possible accidentally flooded elements modifying the entrapped water mass.

The status evaluated from existing documentation shall then be crosschecked by site surveys as required. Where inaccuracy in the survey methodologies may have an impact (for instance marine growth mass measurement) a specific contingency shall be established and accounted for.

Due attention shall be paid to identify the inaccuracy level in the knowledge of the objects weights and buoyancy figures, centre of gravity location / of buoyancy locations as applicable.

An inspection (NDE and/or DE) program shall be submitted for COMPANY and MWS acceptance on a case by case basis, depending on the nature of the decommissioned object and the methodology to achieve it. Requirements for cleaning parts of the structures shall be specified.

As decommissioning activities are generally performed a long time after collecting the Metocean data used originally in the design, consideration should be given to revising the data specifically for decommissioning activities.

4.3 Weighing and weight control

As a general rule and whenever practically feasible, the objects which are to be removed, lifted, floated or handled (modules, topsides, substructures, large equipments, or significant parts of the above) shall be physically weighed.

GS STR 001 shall be referred to for weight monitoring and weighing.

Where weighing using hydraulic jacks and calibrated cells is not practical or when accuracy is not sought or necessary, alternate weighing methods may be used such as:

- Measurement using a crane load indicator (provided it has been calibrated less than one year prior to the operation)
- Measurement by applying an overpressure (for instance under a suction anchor founded structure).

Whatever the method, specific contingencies shall be established (in line with the level of confidence that is expected from the weighing method methodology and calibration) on the values measured so as to allow for the most conservative cases through sensitivity studies.

When weighing is not practically feasible and weight figures result from a weight control report (WCR), **GS STR 001** shall apply (in particular contingencies and tolerances given in its Appendix 1).

4.4 In place analyses

In place status of offshore structures may be modified while the decommissioning activities are ongoing, and need therefore to be rechecked. Due attention shall be paid to following scenario (in particular but not limited to):

- Removal of part of the topsides or substructures may affect the load path of the remaining loads
- Topsides weight reduction is also likely to make possible an increase of potential tension in jacket piles (for instance on a jacket left in place for unrestricted weather conditions)
- Topsides weight modification may affect the platform period and its dynamic response to waves
- Removal of part of topsides is likely to induce impact loads on remaining structure (typically reversed topsides floatover or lifting of a module from existing topsides)
- Mooring of barge or vessel to a platform during removal operation.

Steel jacket in place design checks shall refer to **GS STR 101**.

Topsides in place design shall refer to **GS STR 102**.

Whenever guides and bumpers are required, design shall refer to **GS STR 401**.

Earthquake cases shall not be considered unless otherwise stated by COMPANY (in case of very long operations in areas of high seismic activity).

4.5 Transitory phases

Transitory phases are numerous during decommissioning activities. The integrity of the object shall be checked step by step for any relevant phase.

For each situation, the maximum weather criteria for which the object is considered safe must be identified, and a contingency plan in case this limiting criteria is exceeded shall be established.

Typically transitory phases may include but are not limited to:

- Stability of a jacket once partial cutting of piles has been performed
- On bottom stability of the jacket without piles with increased wave loading due to marine growths)
- Modified platform dynamic response to waves due to period modification (partial removal of topsides)
- Overpressuring under foundations (removal of a bucket foundation structure)
- Raising of a refloated structure (hydrodynamic behaviour, stability)

- Behaviour of the object placed or loaded onto a barge or vessel prior completion of seafastening.

Low redundancy areas may sometime require temporary reinforcements, in particular when the deconstruction methodology differs from reverse installation sequence, or when a reverse installation sequence is followed, but with modified loads (for instance weight increase due to marine growths on a jacket, or added weights on topsides when removed by lifting).

4.6 Lifting and subsea lifts

Design for lifting shall refer to **GS STR 101**, **GS STR 102**, **GS STR 401** as relevant.

Due attention shall be paid to aspects such as suction that could occur between a jacket mudmat and soil, or possible presence of grout or drill cuttings, underestimated marine growths or any other cause that could induce unexpected or uneven lift forces.

When initial “old” padeyes or trunnions are to be used for removal, they shall be inspected and reengineered as required so as to demonstrate that they are fit for purpose.

4.7 Refloating and/or upending

Design against upending shall refer to **GS STR 101** and **GS STR 401** as relevant.

Due attention shall be paid to possible suction between foundation and soil, possible presence of grout or mud that could fall from the structure during the operation, hence modifying the weight/CoG/CoB in an unplanned manner.

4.8 Back loading offshore

When a decommissioned object is lifted by crane vessel (or other means), during set down to either the lifting vessel itself or a cargo barge, due attention shall be paid to the impact loads that are applied by the module on the deck of the transportation vessel (placement forces).

- When the object is back loaded to the lifting vessel deck itself, impact factors given in **GS STR 401** § 6.2.5.2 shall apply unless otherwise agreed by COMPANY and Marine Warranty Surveyor
- When back loading is done by a lifting vessel to another barge or vessel, a particular study accounting for the actual motions responses (i.e. relative different responses of lifting vessel and transportation vessel or barge) of the vessels used during the offshore back loading operations shall be performed according with permitted weather conditions so as to determine specific applicable impact factors.

The removed object, the vessel hull, the grillage and the bumpers shall be checked against the above impact loads, without one third increase of the basic allowable stresses.

Attention shall be paid to unexpected weights or CoG position that could affect the heel, trim, draft or stability of the transportation vessel/barge.

The minimum sea fastening used to secure the object to be transported at set down stage, and the weather limiting criteria used for its design, shall be clearly identified, and submitted to COMPANY & MWS for approval.

4.9 Transportation

4.9.1 Transportation on cargo barge or vessel

Design for transportation shall refer to **GS STR 101**, **GS STR 102**, **GS STR 401** as relevant.

As a general rule, friction loads shall not be included in sea fastening design, even though they may be evaluated to enhance potential redundancy in particular for transitory phases (for instance if it is accepted by COMPANY & MWS to proceed to transportation prior completion of the sea fastening).

Whenever friction forces needs to be evaluated, the friction coefficients shall be taken from **DnV RP H102** § 2.4.2 (only the wet condition shall be considered) unless they can be documented; the possibility of the presence of oil, oily water or grease on contact surfaces shall be carefully assessed.

The impact of deformation loads induced by transportation barge/vessel hogging or sagging, simultaneously with the restraints imposed by sea fastening and the transported object own stiffness, shall be accounted for in verifications of the transported object, the grillage, sea fastening and deck of the transportation vessel/barge itself.

Transportation fatigue analysis shall be performed for transportations durations more than ten days.

The use of heading controlled transportation criteria is subject to COMPANY & MWS approval and acceptable only if sufficient redundancy of propulsion system is provided.

One third increase shall not be allowed unless accepted by COMPANY and MWS.

4.9.2 Alternate methods

In case where a self floating transport method is used , the transported structure (and its additional buoyancy tanks if any) shall be designed so as to withstand hydrostatic, hydrodynamic, slamming forces, as well as fatigue effects exerted by environmental loads.

Towage shall consider conservative drag forces due to the presence of marine growths.

One third increase shall not be allowed unless accepted by COMPANY and MWS.

4.10 Back loading onshore

This phase consists more or less of a reverse loadout for the decommissioned object onshore. **GS STR 101**, **GS STR 102** and **GS STR 401** shall apply as relevant.

4.11 Sensitivity studies

As a general principle, sensitivity studies shall be performed on parameters which may be critical for personnel safety during decommissioning activities, where misestimation could lead to environmental issues, major damage or loss of the object or of other existing fixed or floating installation.

Such parameters are commonly identified as (but shall be specifically identified on each decommissioning project) weight, buoyancy, CoG and CoB locations as relevant, trapped water, weather conditions, amount of marine growths or amount of grout/soil remaining stuck on a substructure foundations during removal, risk of brittle fracture in partially damaged elements, wind induced vortex during transportation, additional fatigue induced on the object during transportation, risk of loss of pollutants (diesel stored in tanks LSA scale etc.).

4.12 Accidental loads or situations

Due consideration shall be paid to accidental loadings induced by:

- Vessel impacts due to loss of DP control or mooring failure
- Mooring loads redistribution on an existing structure in case of mooring failure
- Impact of a lifted module on an existing structure during its removal (for instance bridge on topsides during its removal)
- Loss of buoyancy or stability
- Exceedence of allowable weather criteria in a transitory phase
- Dropped objects
- Mishap during cutting
- Lifting equipment failure
- DP system failure
- Mooring failure
- Object failure during removal operations or during transportation
- Sea fastening system failure
- Unplanned delay in operations.

The above situations shall be mitigated by both engineering (sensitivity studies), inspections, and operational procedures (contingency plans).

In particular, the case where an object shall be left in position, for instance in place with reduced strength, or in stand by on a barge for a repair or awaiting for favourable weather conditions, shall be addressed and considered as an accidental condition.

The one third increase of basic allowable stresses may be used for accidental conditions. Plastic design shall not be used unless agreed by COMPANY.

In case no backup system is available for the duration of the operation, the object shall withstand unrestricted weather condition for the repair duration or it must be proven that any consequence of a 100 year period event will not prevent a safe removal of the object later.

4.13 Damaged structures

Whenever the inspections reveal existing damage, or cracks in the existing structure due to corrosion or fatigue, the strength of the object is affected and require specific analysis and risk assessment.

Damaged elements shall be accounted for by partial to total reduction of their strength and taking due care to secondary bending that might be induced by possible out of line neutral axis.

When a crack is identified in a critical joint, assessment of brittle fracture and sudden rupture of the joint shall be addressed.

Due attention shall be taken of the behaviour in fatigue (for instance during transportation phase) of a joint node which was identified cracked during inspections.

5. Operational aspects

5.1 General

As a general **GS STR 401** and DnV Rules for Planning and Execution of Marine Operations & Noble Denton Guidelines for Marine transportations 0030/NDI shall apply, whichever is the most stringent unless agreed otherwise by COMPANY. In the event there is a conflict between different codes and standards, COMPANY shall be consulted for clarification.

- Marine operations for decommissioning offshore structures shall be based on proven techniques generally used for installation purpose. It is expected that due consideration is given in priority to reverse installation scenario.
- As an alternate, unconventional methods may be used, provided that they are engineered and supported by tests subject to COMPANY and MWS acceptance.
- Operational procedures shall aim at limiting diving and ROV operations as far as possible.
- Some parts or whole of the structures have a potential for reuse. When applicable, due attention shall be paid to minimize risks of damage during removal & dismantling.

5.2 Procedures

The operational procedures shall state in detail:

- The methodologies used to dismantle offshore installations, perform offshore backloading, sea fastening, transportation, onshore backloading operations
- Description of lifting or handling methods, vessels, barges and tugs, cutting tools used during the operations
- The operations shall be described step by step, identify point of no return situations, each step being associated to limiting weather criteria
- Particular requirements related to diving assisted operations, ROVs interventions shall be clearly highlighted together with corresponding limiting weather criteria.

5.3 Weather criteria

Limiting weather conditions applying at any step of the decommissioning works shall be duly identified, in particular when the following activities are involved:

- Heavy lifting
- Personnel transfer
- Back loading offshore
- Back loading onshore
- Set down of removed object on a vessel
- ROV interventions
- Diving
- Interventions/works on vessels or cargo barges (set down, sea fastening welding)

- Towage with partial sea fastening
- Towage with complete sea fastening.

The selected design weather condition shall be agreed with COMPANY and Marine Warranty Surveyor for each particular case, in line with **GS GEO 504** (Comprehensive evaluation of environmental conditions).

This design condition shall be based on the duration of operational critical phases.

Particular Project Specification (PPS) shall define if particular operations require a real time monitoring of metocean conditions. In that case, monitoring shall be performed accordingly with **GS GEO 501** (Metocean surveys) and **GS GEO 505** (Monitoring of Metocean Conditions for offshore units).

The applicable weather conditions shall be in general based on the following classification:

- Weather restricted operations (duration less than 72 hours)
Unless otherwise agreed by COMPANY and MWS, the design weather condition shall not be less than $H_s = 2$ m (North Sea case)
- Unrestricted weather operation (duration less than 120 hours)
Reduction of environmental condition obtained by statistical method may be considered and agreed by COMPANY on a case by case basis. Such reduction proposal by CONTRACTOR shall be supported by proven reliability of weather forecasts, available contingency, sensitivity studies evaluating the consequences of exceeding the limiting weather criteria and associated contingency plan.

Typically, the following could be considered:

- Half the 10 year return period environmental conditions for manned operations for the actual month of the operation plus one month
- Half the 1 year return period environmental conditions for unmanned operations for the actual operation month plus one month.
- Unrestricted weather operation (duration more than 120 hours and less than one month)
Typically, the following could be considered:
 - 10 year return period environmental conditions for manned operations for the actual month of the operation plus one month
 - 1 year return period environmental conditions for unmanned operations for the actual operation month plus one month
- Operation duration larger than one month
100 year return period environmental condition for the season of the operation shall be considered.

5.4 Contingency plans

In addition to sensitivity studies performed on critical parameters as per § 4.11, contingency plans defining corrective actions to be taken on a step by step basis shall be elaborated whenever the level of confidence attached to surveys cannot give full evidence that the parameters will be within the envelope considered in the sensitivity studies.



5.5 Diving

The requirements for diver intervention at any step of the operations (including contingency plans) shall be highlighted and minimized as far as possible. All diving operation shall comply with **GS LSO 410** (Diving specification).

5.6 ROV spreads

Depending on the criticality of ROV operations and ROV reliability, the requirements and availability of back up spreads and qualified operators shall be established on a case by case basis.

5.7 Material and Fabrication

The material steel used for new built elements shall refer to **GS STR 201** and **GS STR 301** specification.

Weldability between new material with new consumables to the old one shall be carefully checked and welding procedures prepared and qualified. When qualifying these welding procedures, the “old” material steel shall be clearly identified by traceability or testing of cut coupons.

For assemblies considered of major importance by COMPANY (special category as per **GS STR 201** definitions), even if document traceability allows clear identification of the “old” material, COMPANY reserves the right to request for material testing.

5.8 Site cutting

- The use of explosives shall be prohibited unless otherwise stated by Particular Project Specifications
- “Cold” cutting techniques should be employed wherever possible
- Cutting members submitted to live loads shall be subject of particular design and procedural assessment
- Whenever cutting is performed, the means proposed to control the effectiveness of cutting prior to proceed to further operations shall be identified
- Pile cutting actual level shall be specified in a particular project specification (PPS).