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Petroleum and natural gas industries — Specific requirements for offshore structures

Part 5: Weight management

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DNV-GL Oil and Gas
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Part 5: Weight management

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Preface

This Standard was prepared by the Standards Australia Committee ME-092, Materials, equipment, structures and related services for petroleum, petrochemical and natural gas industries.

The objective of this document is to specify requirements for managing and controlling the weight and centre of gravity (CoG) of offshore facilities by means of mass management during all lifecycle phases including conceptual design, front end engineering design (FEED), detail engineering, construction and operations. These can be new facilities (greenfield) or modifications to existing facilities (brownfield).

Weight management is necessary throughout operations, decommissioning, and removal to facilitate structural integrity management (SIM). The provisions of this document are applicable to fixed and floating facilities of all types.

Weight management only includes items with static mass.

Snow and ice loads are excluded as they are not considered to be part of the facility. Dynamic loads are addressed in ISO 19904-1, ISO 19901-6 and ISO 19901-7.

This document specifies the following:

(a) Requirements for managing and controlling weights and CoGs of assemblies and entire facilities.

(b) Requirements for managing weight and CoG interfaces.

(c) Standardized terminology for weight and CoG estimating and reporting.

(d) Requirements for determining not-to-exceed (NTE) weights and budget weights.

(e) Requirements for weighing and determination of weight and centre of gravity (CoG) of tagged equipment, assemblies, modules, and facilities.

This document can be used as follows:

(i) As a basis for costing, scheduling or determining suitable construction method(s) or location(s) and installation strategy.

(ii) As a basis for planning, evaluating and preparing a weight management plan and reporting system.

(iii) As a contract reference.

(iv) As a means of refining the structural analysis or model.

This document is identical with, and has been reproduced from, ISO 19901-5:2021, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 5: Weight management*.

As this document has been reproduced from an International document, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 7, *Offshore structures*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 19901-5:2016), which has been technically revised.

The main changes are as follows:

— part title changed to "Weight Management";

— document restructured and columnization removed;

— weight control classes removed;

— requirements for weight management for all project phases implemented;

— annexes deleted or relocated to body of document:

  — previous Annex A “Weight data sheets – tagged equipment” combined with previous Annex B “Weighing certificates” to create new joined into a new Annex B “Weighing certificates”;

  — previous Annex C “Weight and load budget (WLB) formats and levels” replaced with new Annex C “Control weights”;

  — deleted previous Annex D “Major elements of the weight displacement”;

  — information in previous Annex E “Supplier weighing procedure” relocated to Clause 8;

  — deleted previous Annex F “Guidelines for displacement measurement of floating facilities”;

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  - information in previous Annex G “Requirements for weight control during operations” relocated to Clause 7;
  - information in previous Annex H “Requirements for topsides weight estimation — New builds/green field” relocated to Clause 7;
  - information in previous Annex I “Executive summary description” relocated to Clause 7;
  - replaced previous Annex J “Weighing result uncertainty” with Annex F “Weighing result uncertainty”;
  - previous Annex K “Weight control database structure” replaced with new Annex G “Weight database structure”.
- Annexes added:
  - Annex A “Commentary”;
  - Annex D “Variable weight”;
  - Annex E “Example decision-making RAPID matrix”;
  - Annex H “Weight of concrete structures”;
  - Annex I “Coordinate systems”;
  - Annex J “Weight allowances and reserves”;
  - Annex K “Weight management competencies”.

A list of all parts in the ISO 19901 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The International Standards on offshore structures prepared by TC 67/SC 7 (ISO 19900, the ISO 19901 series, ISO 19902, ISO 19903, ISO 19904-1, the ISO 19905 series, and ISO 19906) constitute a common basis covering those aspects that address design requirements and assessments of all offshore facilities used by the petroleum and natural gas industries worldwide. Through their application the intention is to achieve reliability levels appropriate for manned and unmanned offshore facilities, whatever the type of structure and the nature of the materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, need to be considered in relation to the overall reliability of all offshore structural systems.

The International Standards on offshore structures prepared by TC 67/SC 7 are intended to provide a wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgement is therefore necessary in the use of these International Standards.

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Petroleum and natural gas industries — Specific requirements for offshore structures

Part 5: Weight management

1 Scope

This document specifies requirements for managing and controlling the weight and centre of gravity (CoG) of offshore facilities by means of mass management during all lifecycle phases including; conceptual design, front end engineering design (FEED), detail engineering, construction and operations. These can be new facilities (greenfield) or modifications to existing facilities (brownfield).

Weight management is necessary throughout operations, decommissioning and removal to facilitate structural integrity management (SIM). The provisions of this document are applicable to fixed and floating facilities of all types.

Weight management only includes items with static mass.

Snow and ice loads are excluded as they are not considered to be part of the facility. Dynamic loads are addressed in ISO 19904-1, ISO 19901-6 and ISO 19901-7.

This document specifies:

a) requirements for managing and controlling weights and CoGs of assemblies and entire facilities;

b) requirements for managing weight and CoG interfaces;

c) standardized terminology for weight and CoG estimating and reporting;

d) requirements for determining not-to-exceed (NTE) weights and budget weights;

e) requirements for weighing and determination of weight and centre of gravity (CoG) of tagged equipment, assemblies, modules and facilities;

This document can be used:

f) as a basis for costing, scheduling or determining suitable construction method(s) or location(s) and installation strategy;

g) as a basis for planning, evaluating and preparing a weight management plan and reporting system;

h) as a contract reference;

i) as a means of refining the structural analysis or model.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

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3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
approved variation
approved scope change affecting the *predicted weights* (3.32) and changing the *control weights* (3.11)

3.2
assembly
designed and fabricated group of *discipline bulks* (3.12) and *tagged equipment* (3.34) that form one unit

EXAMPLE Deck, module, living quarters, bridge, flare, substructure.

3.3
brownfield
modifications made to an existing *facility* (3.16)

3.4
budget weight
weight and *centre of gravity* (3.5) reference values as part of the *control weights* (3.11)

3.5
centre of gravity
CoG
point in a body or system of bodies at which the entire weight is considered to act

Note 1 to entry: For assemblies, the aggregate CoG is the mathematical weighted mean of the CoGs of the individual items (comprising the completed assembly) measured from a common reference point.

3.6
centre of gravity envelope
CoG envelope
defined volume within which the *centre of gravity* (3.5) of an *assembly* (3.2) is constrained for a specified *loading condition* (3.23)

3.7
conceptual design
phase of design during which several concepts are evaluated, and preferred concepts are selected

3.8
conceptual design weight
sum of the *predicted weight* (3.32) and the *conceptual design weight reserve* (3.9)

Note 1 to entry: This weight is used for engineering purposes and for checking fabrication/installation strategies during conceptual design.

3.9
conceptual design weight reserve
provision during conceptual design to allow for reserves when control weights are determined

EXAMPLE Management reserve, planned future reserve and unplanned future reserve.

3.10
consumable
material used and replenished during normal operation of a *facility* (3.16)

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EXAMPLE Potable/service water, diesel fuel, crew provisions, drilling powders for creation of mud and/or cement.

3.11
control weights
budget weight (3.4) [and associated *centre of gravity envelope* (3.6)], *not-to-exceed weight* (3.28) [and associated *centre of gravity envelope* (3.6)] and reserves [e.g. *management reserve* (3.24), *planned future reserve* (3.31), un*planned future reserve* (3.38)] for each *loading condition* (3.23)

3.12
discipline bulks
all dry *weight items* (3.43) excluding *tagged equipment* (3.34)

EXAMPLE Piping, manual valves, structural, cable and trays, etc.

3.13
dry weight
weight of a component, *weight item* (3.43) or an *assembly* (3.2) in its dry installed condition including permanent contents in closed systems in *tagged equipment* (3.34)

Note 1 to entry: Examples of permanent contents are gearbox oil, hydraulic oil, filter sand, coolant, etc.

Note 2 to entry: Excludes variable weights.

Note 3 to entry: Dry weight results in permanent actions, defined as G1 and G2 in ISO 19902 and ISO 19901-3.

3.14
estimate to complete
ETC
estimated weight (3.15) of *discipline bulks* (3.12) and/or *tagged equipment* (3.34) with insufficient definition measured by weight take-off

3.15
estimated weight
weight derived by using norm-based calculations or previous experience

3.16
facility
topsides (3.36) and substructure that is built and installed to serve a particular purpose

3.17
front end engineering design
FEED
phase following *conceptual design* (3.7) phase, during which the selected concept is matured, and design parameters normally are fixed

3.18
greenfield
new facilities that are fabricated onshore and installed offshore

3.19
gross weight take-off
gross WTO
net weight take-off (3.27) plus *net weight allowance* (3.26)

3.20
hook-up and commissioning
HUC
installation of components or *assemblies* (3.2) after the *topsides* (3.36) have been installed to complete a functioning *facility* (3.16)

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3.21
lift weight
weight of a component or *assembly* (3.2) at its lift points, including permanent items and *temporary items* (3.35), but excluding the lift rigging

3.22
lightship weight
displacement of the complete floating *facility* (3.16) (i.e. ready for service) with all its machinery, equipment and outfitting, including permanent ballast, required spare parts, constant process fluids and liquids in *tagged equipment* (3.34) and piping at their working levels but without liquids in storage or reserve supply tanks, items of consumable or variable loads, stores or crews and their effects

3.23
loading condition
condition for which the weight and *centre of gravity* (3.5) of an *assembly* (3.2) is required to be managed

Note 1 to entry: See 5.5.

3.24
management reserve
reserve to take account for scope changes after setting the *control weights* (3.11)

3.25
master equipment list
MEL
project specific list for compiling and managing technical data for *tagged equipment* (3.34)

3.26
net weight allowance
addition applied to *net weight take-off* (3.27) to account for weight growth due to item weight uncertainty, design development and construction

Note 1 to entry: Guidance on net weight allowances is given in Annex J.

3.27
net weight take-off
net WTO
weight take-off based on the actual designed data from 3D model, engineering drawings or supplier data

3.28
not-to-exceed weight
NTE weight
maximum acceptable weight and *centre of gravity envelope* (3.6) for the respective *loading condition* (3.23)

3.29
operating reserve
weight difference between the *predicted weight* (3.32) and the *not-to-exceed weight* (3.28) during the operations phase

3.30
operating weight
dry installed weight plus *variable weight* (3.40)

3.31
planned future reserve
reserve to account for planned modifications (e.g. additions, removals or relocations) during the operations phase of the *facility* (3.16)

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3.32
predicted weight
expected (median) weight, the sum of *gross weight take-off* (3.19) and *estimate to complete* (3.14) through all project phases

Note 1 to entry: The median (P50) weight estimate has a 50-50 chance of being lesser or greater than the out-turn weight.

Note 2 to entry: During the conceptual design phase, the net and gross WTO's can be zero.

3.33
reconciled weighed weight
actual weight at the time of the weighing, including any weighing correction(s)

3.34
tagged equipment
equipment identified and tracked in the *master equipment list* (3.25)

3.35
temporary items
items temporarily installed during a *loading condition* (3.23) and removed afterwards

Note 1 to entry: Temporary items do not form part of a structure's permanent dry or operating weight.

3.36
topsides
assemblies placed on a substructure (fixed or floating) to provide some or all of a *facility's* (3.16) functions

Note 1 to entry: For floating facilities and jack-ups, the hull deck is not typically part of the topsides, however, some of the equipment and discipline bulks mounted in or on the hull can be defined as part of the topsides.

Note 2 to entry: A separate fabricated deck or module support frame is part of the topsides.

3.37
uncertainty allowance
allowance, based on risk analysis or experience, to account for the immaturity of the conceptual design scope

3.38
unplanned future reserve
reserve to account for the addition of unplanned modifications during the operations phase of the *facility* (3.16)

EXAMPLE Equipment upgrades, process and non-process system modifications (including new flowlines), additional supporting structures, etc.

3.39
upper bound weight constraint
maximum weight during *conceptual design* (3.7) phase

3.40
variable weight
weights of fluid and powders in *tagged equipment* (3.34) and piping, including process and non-process fluids (e.g. brine, potable water and diesel storage), drill pipe, drill casing, drilling *consumables* (3.10) (e.g. fluids and powders), scaffolding, laydown areas and storage areas, that occur coincidently

Note 1 to entry: A more comprehensive list of variable weight is given in Table D.1.

Note 2 to entry: Variable weight results in variable actions, defined as Q1 in ISO 19902 and ISO 19901-3.

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3.41
weight database
database containing the *net weight take-off* (3.27), *gross weight take-off* (3.19) and/or *estimate to complete* (3.14) for each *weight item* (3.43) that sums to the *predicted weight* (3.32) and *centre of gravity* (3.5) for each *loading condition* (3.23)

Note 1 to entry: See Annex G.

3.42
weight database custodian
WDC
organization tasked with the responsibility for maintaining the *weight database* (3.41) during operations phase

Note 1 to entry: The weight database custodian should be appointed at the start of operations.

3.43
weight item
individual or group of *discipline bulks* (3.12) and/or *tagged equipment* (3.34), *variable weights* (3.40) or *assembly* (3.2) identified for weight reporting purposes

3.44
weight management objective
set of engineering goals necessary to fulfil weight and *centre of gravity* (3.5) requirements

3.45
weight sensitive
predicted weight is 95 % or more of the capacity of the transport and installation (T&I) marine equipment or the predicted weight is 95 % or more of the *not-to-exceed weight* (3.28)

4 Abbreviations

CAD computer assisted design

MoC management of change

NTE not-to-exceed

PoB personnel on board

RAPID recommend, agree, perform, input and decide

SIM structural integrity management

T&I transport and installation

3D three dimensional

5 Principles of weight management

5.1 General

Weight management is the set of processes and activities performed by all disciplines and project groups to achieve the weight management objectives set out during the life cycle phases of the facility.

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5.2 Weight management during project lifecycle phases

Weight management shall apply at all phases of a facility:

a) conceptual design;

b) FEED;

c) detail engineering;

d) construction;

e) installation and HUC;

f) operation;

g) decommissioning.

Different weight estimating techniques are typically used at different phases of the facility lifecycle:

h) analogue-based or norm-based estimates (conceptual design and FEED);

i) WTO-based estimates (FEED and detail engineering);

j) weighed weights of equipment/ assembly (detail engineering and construction);

k) as-built weights (operations and decommissioning).

Weight items that form part of the 3D CAD model should include the 3D CAD model reference of the item in the weight database.

Weight items that do not form part of the 3D CAD model shall be stored as individual items in the weight database. Example attributes are shown in Annex G.

5.3 Weight management objectives

5.3.1 Objectives during conceptual design phase

Weight management objectives during the concept design phase of a facility should:

a) set an upper bound weight constraint and associated CoG of the facility;

NOTE The upper bound weight is typically set early in the conceptual design phase, so the concept options for the facility and the installation options (that depend on operating limits for marine equipment) can be developed in accordance with the project strategy.

b) develop facilities weight data for T&I marine equipment capacity;

c) prepare weight data that is suitable for cost estimation and procurement processes;

d) prepare facilities loads for in-place topsides structural and substructure studies;

e) prepare facilities weights and centres of gravity (CoG) for transport and installation studies;

f) confirm feasibility of project design weight assumptions to determine sensitivity of concept to future weight growth and associated CoG shifts;

g) identify major mitigation options available to combat future weight growth and CoG shifts that could impact the feasibility of a concept option;

h) protect the concept option in accordance with the design basis;

i) identify weight risks and opportunities;

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j) track, monitor and review all weight changes before they are incorporated into the weight database.

Additional guidelines on weight management for concrete structures is provided in Annex H.

5.3.2 Objectives during FEED, detail engineering and construction phases

The weight management objectives during the FEED, detail engineering and construction phases of a facility should:

a) set the NTE weight and associated CoG of the facility for the in-service operating conditions;

NOTE 1 NTE weight and CoG envelope for the in-service operating condition is typically set in the FEED phase so that the design of the topsides and substructure can progress with confidence.

b) set NTE weights and CoG envelopes of the facility and its assemblies for the pre-service load-out, transport and installation loading conditions;

NOTE 2 This allows T&I marine equipment to be identified and reserved at an early stage of the project.

c) prepare a weight report at the end of construction together with supporting data, including explanations of weight changes, weighing reports and weight certificates;

d) prepare a facility weight database containing weight data available at the end of the installation phase that is documented, summarized, auditable and traceable.

Additional guidelines on weight management for concrete structures is provided in Annex H.

Monte Carlo simulations may be used to calculate weight risks and opportunities based on their perceived probability of occurrence and consequence (if they were to occur).

5.3.3 Objectives during operations and decommissioning phases

The weight management objectives during the operations and decommissioning phases of a facility should:

a) maintain a facility weight database;

NOTE 1 This is typically performed by recording weight and CoG changes in the weight database due to brownfield projects.

b) track weight and associated CoG changes against the NTE weight and associated CoG.

NOTE 2 This is typically performed to confirm NTE weight and associated CoG envelope are not exceeded or to initiate an assessment to confirm structural capacity or strengthening requirements.

5.4 Illustration of weight versus time

Figure 1 illustrates the weight terms used and their relationship versus the life of the facility.

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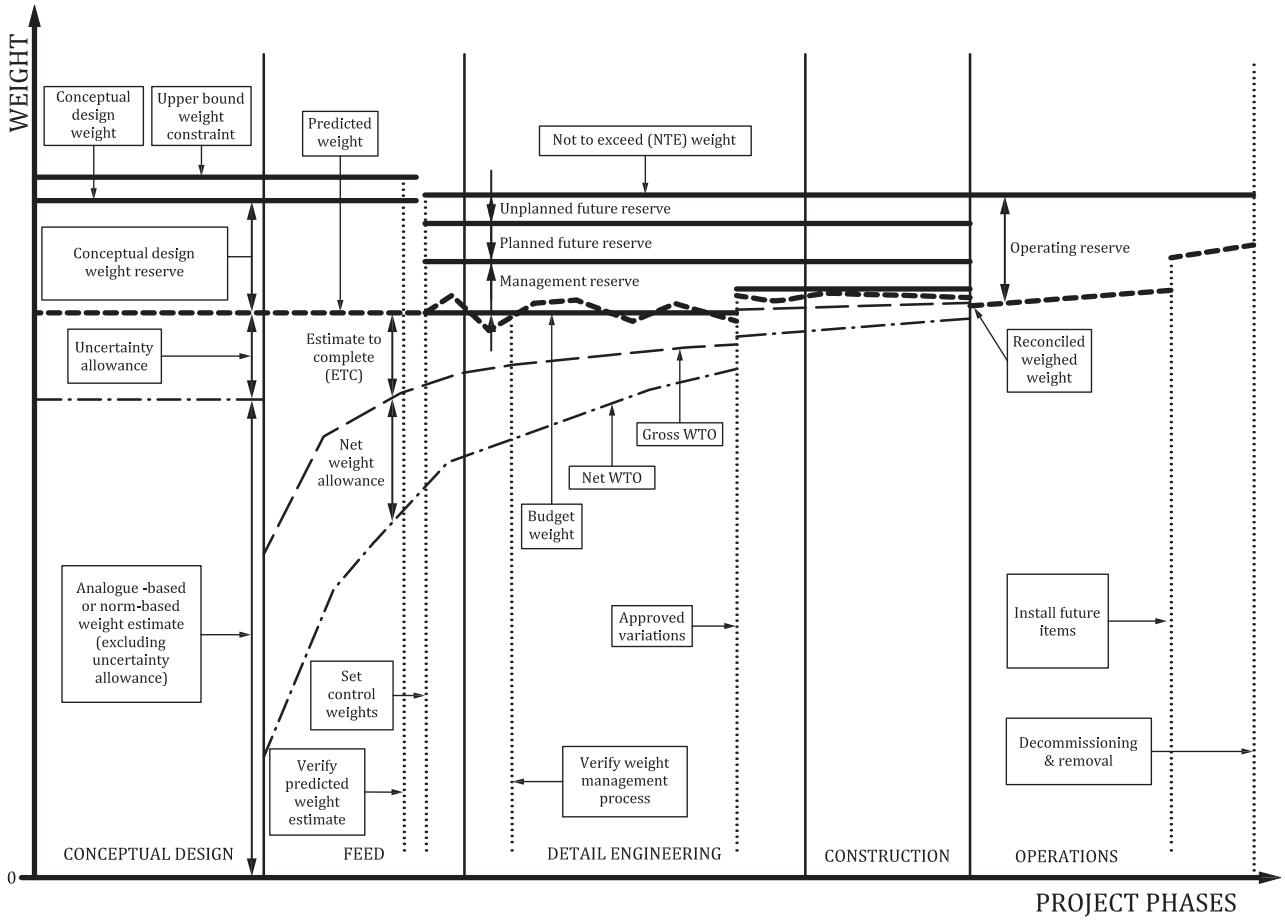

Figure 1 — Weight terms and activities vs life of the facility (weight development graph)

5.5 Loading conditions

5.5.1 General

Loading conditions are used during FEED, detail engineering and construction to distinguish between the facility/ assembly weight at each phase of its life.

Each loading condition shall:

a) identify and quantify the weight and CoG;

b) have corresponding control weight (including CoG envelope), see Clause 6.

5.5.2 Typical loading conditions

Loading conditions should include:

a) dry installed condition;

NOTE 1 This is the weight and CoG of the facility after HUC, complete and ready for service but excluding variable weight (except for pre-commissioning variable weight).

NOTE 2 For floating facilities, the lightship weight is typically used for the dry conditions. The lightship weight can vary between project phases (e.g. bare hull, hull with topsides installed).

b) operating condition;

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NOTE 3 This is the dry installed weight plus variable weight. The locations and fill-level of the variable weight represent maximum weight conditions typically experienced during the operations phase.

NOTE 4 The location and fill-level of the variable weight is documented in the weight management procedure. See D.1 and D.3 for examples.

NOTE 5 Drilling weights are typically included in combination B in Table D.2.

NOTE 6 The weight database does not reflect the worst topsides loading condition, as this requires the application of variable and environmental loads used for structural design. D.3 shows examples of variable loads.

NOTE 7 For floating facilities, the hull tank loading conditions and associated displacements are not part of the weight management as per this document but are covered in class rules and International Standards. These rules and standards include the intact and damaged stability requirements for various types of facilities, their loading conditions, operating modes and project phases.

c) pre-service conditions:

1) fabrication (including assembly during fabrication);

2) load out (including float-on);

3) transport;

4) installation (including launching, float-off, upending, float-over, lifting).

NOTE 8 Fabrication weight typically includes the weight of any frames and temporary items (including pre-installed lift rigging if applicable) that are attached to the facility / assembly during the main steps of construction of the facility / assembly.

NOTE 9 Load-out weight typically includes the weight of any load-out frames and temporary items (including pre-installed lift rigging if applicable) that are attached to the facility / assembly during the movement and set-down with the facility / assembly on the transport vessel.

NOTE 10 Transport weight typically includes the weight of temporary items (including pre-installed lift rigging), internal sea fastenings and voyage protection added for transport, plus any variable weights for equipment or discipline bulk items that are required for subsequent installation operations.

NOTE 11 Installation conditions typically include the weight and CoG of the facility / assembly when transferred from its transport condition to its permanent installed position.

NOTE 12 Lift weight of the facility / assembly typically includes the weight of the sea fastening and temporary items remaining after freeing of the facility / assembly from the transport grillage.

NOTE 13 Lift weight typically excludes the weight of the lift rigging (e.g. slings, shackles and spreader bars).

d) future operations.

NOTE 14 Future operations include management reserve, planned future reserve and unplanned future reserve.

6 Control Weights

6.1 General

Control weights (see Annex C) shall:

a) consist of budget and NTE weights (including reserves and associated CoG envelopes);

b) be used to manage weight growth and CoG shifts for each loading condition from FEED to the end of construction;

c) be set after verification of the predicted weight (see 7.2.5 and 7.3.5);

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d) be managed under a MoC process.

A decision-making process shall be established for weight management decisions. An example RAPID decision matrix is shown in Annex E.

The control weights should be set during FEED at the transition from norm-based estimates (or analogue-based estimates) to WTO-based estimates.

Organizations that are contracted to supply sub-components of the facility may be allocated respective budget weights.

6.2 Purpose

Control weights should be used for:

a) weight and CoG control;

b) control of costs and schedule;

c) confirming loading conditions are within load-out, transport and installation capacities;

d) confirming loading conditions are within the structural capacities for topsides assemblies and substructures;

e) confirming loading conditions are within the bearing capacity and stability of the facility (temporary or permanent).

6.3 Budget weights and NTE weights

6.3.1 Budget Weights

Budget weights, including CoG envelopes, shall be established for each loading condition (see 5.5).

The CoG envelopes may be two-dimensional or three-dimensional depending on the facility or assembly.

Budget weights are typically used as a target that predicted weights are unlikely to exceed throughout FEED, detail engineering and construction phases.

$$\text{Budget weight} \geq \text{Net WTO} + \text{Net weight allowance} + \text{ETC} + \text{variable weight (for applicable loading conditions)}$$

6.3.2 Reserves

Reserves shall include:

a) management reserve;

b) planned future reserve;

c) unplanned future reserve.

Management reserve shall apply for each loading condition.

NOTE 1 Management reserve is typically used to manage weight increases due to change in scope.

Planned future reserve and unplanned future reserve shall only apply to the future operations loading condition.

NOTE 2 Planned future reserve and unplanned future reserve are typically used to design the facility for future operations.

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6.3.3 NTE weights

NTE weights, including CoG envelopes shall be established for each loading condition (see 5.5).

CoG envelopes may be two-dimensional or three-dimensional depending on the facility or assembly.

NTE weights are typically based on budget weight, management reserve, planned future reserve and unplanned future reserve as applicable.

$$\text{NTE weight} \geq \text{budget weight} + \text{management reserve} + \text{planned futures reserve} + \text{unplanned futures reserve}$$

NTE weights for pre-service loading conditions (construction, loadout, transport, installation, HUC) should only include management reserves.

6.4 Loading conditions and parameters

Revisions to the control weights shall take place under MoC procedures.

Weight increases due to scope changes that have been approved by MoC procedure may be drawn down from the management reserve.

Weight increases that exceed the control weights (including excursions outside the CoG envelopes) and have been rejected by MoC procedure shall be subject to corrective action.

Corrective action shall be applied to reduce weight or amend CoG shifts (e.g. revision to layout of equipment or discipline bulks, weight shedding, reassessment of allowances) to stay within the limits of the control weights.

A decision-making process is typically established for weight management decisions that are controlled by MoC. An example RAPID decision matrix is shown in Annex E.

6.5 Control weights during operations phase

Weight and CoG changes, due to brownfield projects, should be managed by keeping within the NTE weight and CoG envelope during the operations phase.

The NTE weight and CoG envelope (i.e. the control weights for the operating loading condition) may be revised in the operations phase by structural assessment of the topsides or substructure.

NOTE Structural assessment of the facility is typically used for brownfield projects with significant weight increases.

7 Weight management during project execution phases

7.1 Conceptual design

7.1.1 General

Weight management during conceptual design shall:

a) develop weight estimates for each facility option;

b) prepare the weight estimates for the following preferred configuration(s):

   1) predicted weights for dry and operating (i.e. dry weight + variable weight) loading conditions;

   2) conceptual design weights for dry, operating, load-out, transport and installation loading conditions;

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3) upper bound weight constraints for design, construction and installation;

c) carry weight estimates for the preferred configuration(s) forward into FEED.

A predicted weight and conceptual design weight should exist for each loading condition.

The upper bound weight constraint typically depends on the planned installation method.

Weight estimating in the conceptual design phase is norm-based but is typically also reliant on experience-based judgement. See Annex K for example weight management competencies.

7.1.2 Predicted weight

The predicted weight shall:

a) include specific equipment weights, discipline weights (based on historical norms) and items known to exist;

NOTE There is a possibility that available historical norms include or exclude items such as flares, cranes, stair-towers, cantilevers, roof equipment, hose handling, etc.

b) include an uncertainty allowance (see guidance in Annex J);

c) be equally likely to overestimate or underestimate the out-turn weight, i.e. is a median (P50) weight.

Predicted weights should be used for cost estimation and benchmarking purposes.

7.1.3 Conceptual design weight

Conceptual design weight shall include the predicted weight and the conceptual design weight reserve.

Conceptual design weights shall be used for conceptual design engineering and to determine technical feasibility (e.g. analysis of topsides and substructures and checking construction, transport and installation strategies).

Conceptual design weight reserve shall be based on degree of confidence in the predicted weight and is the provision for weight reserves used in FEED, detail engineering and construction.

7.1.4 Upper bound weight constraint

Upper bound weight constraints are typically the weight limitations due to:

a) construction methods capability;

b) transport route;

c) transport barge capacity and stability;

d) installation methods capability;

e) load carrying capacity of supporting structures.

Upper bound weight constraints are typically used to avoid the risk of above limitations being exceeded.

7.1.5 Weight estimating

Weight estimating during conceptual design should be based on:

a) defined facility geometry

b) definition of major tagged equipment and MEL;

c) equipment layouts;

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d) itemized weight and CoG of assemblies (i.e. by equipment, structural and discipline bulks);

e) estimate of the variable weights;

f) itemized structural weights by type (i.e. primary, secondary and tertiary/outfitting);

g) itemized discipline bulks weights (e.g. piping, electrical, instrumentation);

h) provision of separate topsides and substructure weights;

i) defined coordinate systems;

j) specified uncertainty allowances;

k) conceptual design weight reserve;

l) defined upper bound weight constraints.

7.1.6 Key documentation

7.1.6.1 General

The following documentation shall be used as input:

a) MEL;

b) facility layout.

The following documentation shall be prepared:

c) weight management procedure;

d) potential weight variation register.

7.1.6.2 MEL

MEL should include the dry weight and variable weight for each item of equipment.

7.1.6.3 Facility layout

Facility layout should include:

a) topsides geometry;

b) size and location of tagged equipment listed in the MEL;

c) equipment position, orientation and elevation to meet production and process safety requirements;

d) space allocation for maintenance, operations and mechanical handling;

e) routing for piping, electrical, instrumentation and HVAC;

f) main accessways and escape routes;

g) stair-towers and cantilevers;

h) structural framing (e.g. main columns, girders, bracing);

i) appurtenances (e.g. flares, booms, cranes);

j) buildings and enclosures;

k) laydown and storage areas;

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