Base Load Power Hub (BLPH)

Weight Control Procedure

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

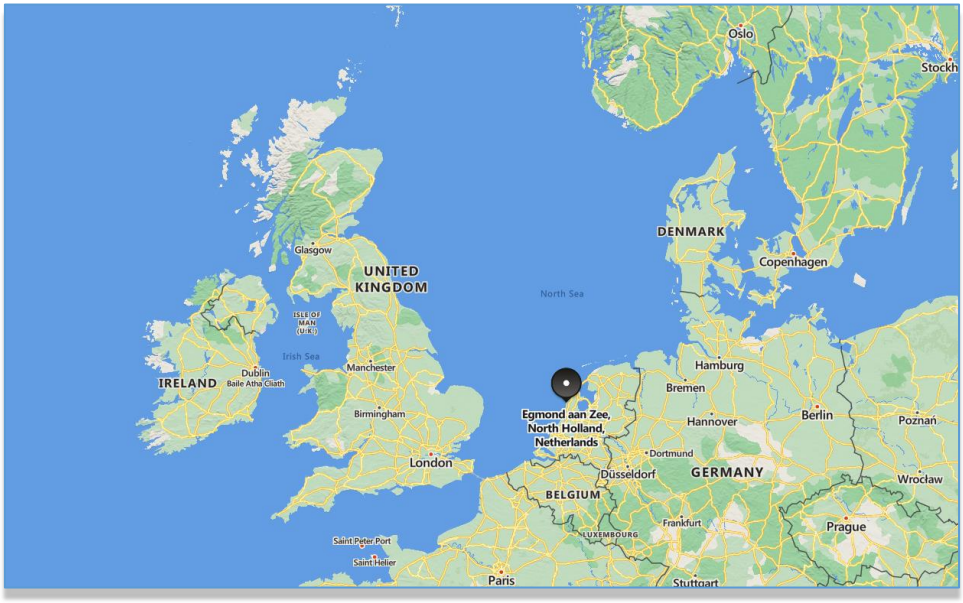


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

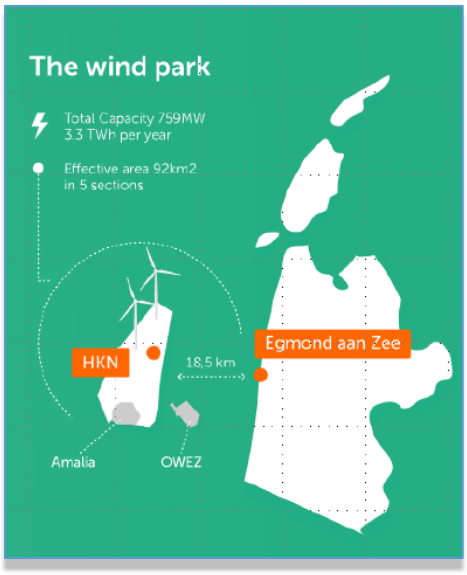


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

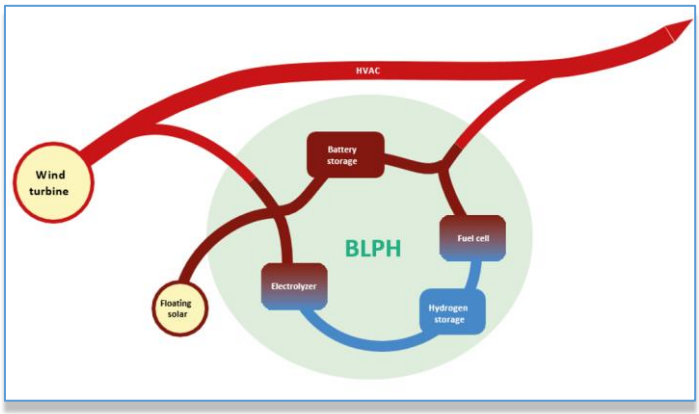


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

Scope of this report is to present the procedure to be followed for the preparation of the BLPH topside weight control report.

2.1 REFERENCES

Doc. No.	Description
K559-2254-WC-PRO-001-01	Weight control report
K559-2254-ST-REP-001	Structural Topsides Analysis Report
K559-2254-ST-PHI-001	Structural Topsides Design & Installation Philosophy

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR) :	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
BESS:	Battery Energy Storage System
BfD:	Basis for Design
BLPH	Base Load Power Hub
CoG:	Centre of Gravity
CW:	CrossWind
EPCI:	Engineering Procurement Construction and Installation
FEED:	Front End Engineering Design
F&G:	Fire and Gas
HKN:	Hollandse Kust Noord
HLV:	Heavy Lift Vessel
HSE:	Health, Safety and Environment
HUC:	Hook-Up and Commissioning

ISO:	International Standards Organisation
LAT:	Lowest Astronomical Tide
NA:	Not applicable
NTE:	Not-to-Exceed
P&ID:	Piping and Instrumentation Diagram
PV:	Photovoltaic
QA:	Quality Assurance
SGSI:	Shell Global Solutions International
SWL:	Safe Working Load
TP:	Transition Piece
TSO:	Transmission System Operator
WCC:	Weight Control Class
WGF:	Weight Growth Factor
WLB:	Weight and Load Budget
WTG:	Wind Turbine Generator
WR \WCR:	Weight Report\ Weight Control Report

Table 2 - Definitions and Abbreviations

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3 REGULATIONS, CODES AND STANDARDS

3.1 INTERNATIONAL CODES & STANDARDS

1. ISO 19901 ISO/DIS Specific Requirements for offshore structures: 19901 Part 5 - Weight control during engineering and construction

3.2 PROJECT SPECIFICATIONS APPLICABLE

2. Shell "Basis for Design Base Load Power Hub (BLPH)", Rev. F, 26 Sept 2022.
3. KBR "Structural Analysis Report of Topsides Facilities", Doc. No. K559-2254-ST-RPT-001, not yet issued.
4. KBR "Topsides NTE Weight and Topsides Level", TQ-0016, 8 November 2022.
5. Shell Basic Design Engineering Package, K559-2254-PM-PLN-003 Rev. 2 dated 6/7/2023

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4 ORGANIZATION

4.1 PROJECT ENGINEERING MANAGER

The Project Engineering Manager is responsible for ensuring that all persons involved throughout the Project team have weight control criticality knowledge.

4.2 WEIGHT MANAGER

The Project Weight Manager is responsible for:

- Defining the weight control organization and execution plan,
- Highlighting to all parties involved the criticality of weight control,
- Compliance with Company's weight targets and other company requirements
- Defining of Not-To-Exceed weights,
- Anticipating weight and CoG changes when critical (deviations from budget weights / not to exceed weight values)
- Monitoring weight implications due to design changes,
- Following the approved contingencies
- Eliciting weight data from all parties involved.
- Developing and maintaining fallback options in case of weight overrun.
- Liaise with Company to advise weight results and trends

4.3 WEIGHT CONTROLLER

The Weight Controller is responsible for:

- Collate, prepare, verify by disciplines, compile in overall and issue to Company the Weight Control Report every month, starting from the first emission.
- Utilize the data of the project equipment list and list of materials indicated on ELE\I&C rooms layout for all itemized equipment
- Coordinate and receive weight data from engineering disciplines, vendors, sub-contractors and contractors.
- Assess the accuracy of CAD 3D models transferred data
- Administrate the computerized weight database.
- Verify and check weight data consistency from engineering disciplines, sub-contractors and contractors.
- Ensure values are provided for all items (including bulk) and by all disciplines.
- Back up input data for traceability throughout the project. The Weight Controller shall maintain a historical file which contains all pertinent working data and previous estimates so that the evolution of weight and centre of gravity estimates can be traced

The weight controller is acting also as weight manager on the project supported by engineering disciplines

4.4 ENGINEERING DISCIPLINES

Each Lead Discipline Engineer duties include, but are not limited to, the following:

- Set weight budgets for Vendors.
- Coordinate and collect weight data from Vendors.
- Calculate / estimate weight for bulk material.
- Monitor discipline weight development against budgets and notify the Weight Controller immediately of any adverse weight deviations.
- Provide weight values for all items (i.e. 100%) falling in the discipline's area of responsibility. In the absence of detailed data, bulk provisions and provisions shall be initially used.
- Weight distribution: Unless specifically stated otherwise, the "weight" terminology implies also Centre of Gravity. Centre of gravities must be reported in their correct locations as well as fluid contents where applicable.
- Ensure that no contingencies are added to the net weights.
- Ensure that provision is clearly included in the net weights
- Establish contingency factors to be applied to the various items, in relation with the contingency plan
- Provide weight data to the Weight Controller, in due time and in accordance with the project predefined format, weight breakdown and required level of details.
- Identify and report the discipline weight changes (item weight and/or centre of gravity) and their origin for the tracking list.
- Assess weight consequences of engineering change requests.
- Back-up discipline's information and documentation pertaining to weight control for traceability throughout the project.
- Monitor the Not-To-Exceed weights
- Where changes (weight increase, change of CoG location) can impact discipline or fundamental subjects such as barge stability, lifting crane capacity, jacking etc.. Consequently, has to define\propose actions to be taken.

4.5 PROJECT EQUIPMENT LIST

Update project Package and Equipment Tag numbers in conjunction with the discipline's instructions.

The Project Equipment List is under the responsibility of the Mechanical Engineer.

During the Detail Engineering phase, the equipment data will be based on the project datasheets and vendor data if available.

4.6 VENDOR RESPONSABILITIES

All assemblies and eventual subassemblies shall be weighed prior to delivery. All packages shall be weighed by their VENDOR and all bulk materials shall be supplied with weight data. The weighing procedures and check lists required from suppliers and manufacturers shall be according to MOTS-35

VENDORs shall provide the weight and CoG of supplied item in both Dry and Operative (if applicable) conditions, indicating the supply stage (estimated, preliminary design, final design, weighed, etc.) and the eventual contingency considered.

5 SCOPE

Scope of this report is to present the procedure to be followed for the preparation of the BLPH topside weight control report.

The following picture presents the BLPH topside and its component:

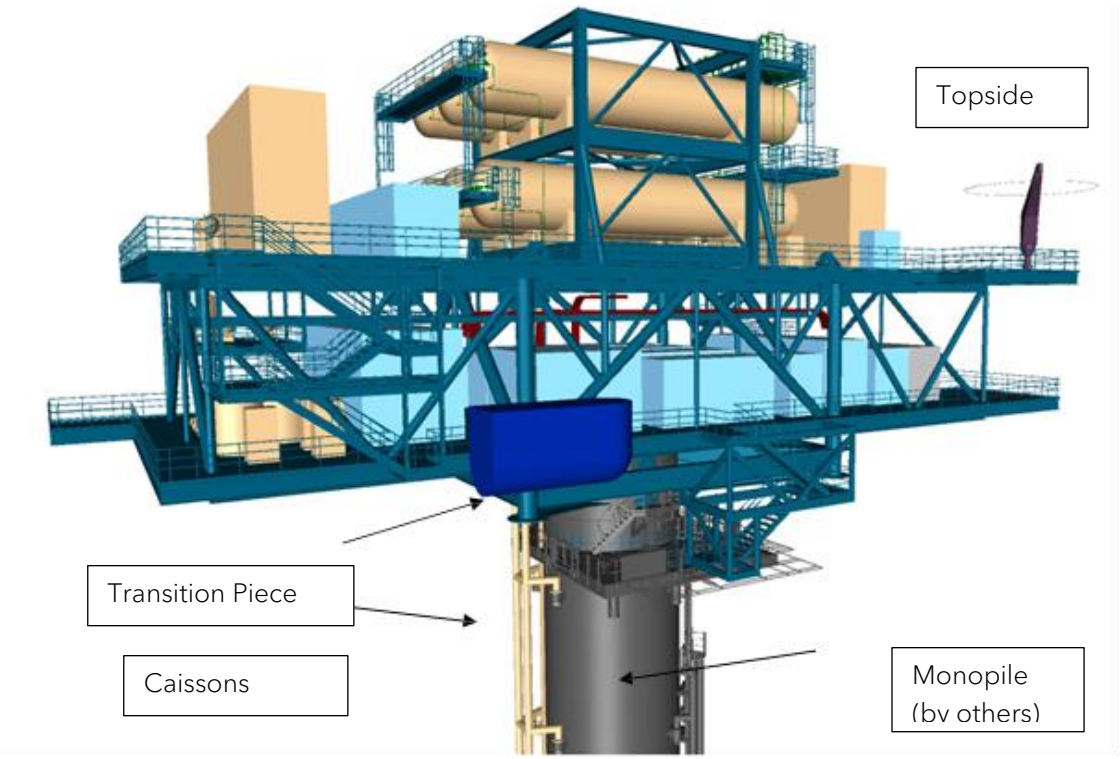


Figure 4 – BLPH Topsides

5.1 GENERAL-WEIGHT CONDITIONS

The following weight conditions will be defined and reported:

5.1.1 Lift Weight

Lift weight is that condition in which single weight item or a collection of items is ready for lifting, excluding all lifting devices (shackles, slings, spreaders, etc.) but including packaged items, temporary equipment, internal seafastening etc.

5.1.2 Load Out Weight

Load Out weight is that condition in which single weight item or a collection of items is ready for load out, including all lifting devices (shackles, slings, spreaders, installation aids, etc.) including packaged items, temporary equipment and attached grillage

5.1.3 Sea Transport Weight

Sea Transport weight is that condition in which single weight item or a collection of items is ready for sail away , including all lifting devices (shackles, slings, spreaders, installation aids, etc.) including packaged items and temporary equipment including ,upper and lower grillage and seafastenings.

5.1.4 Dry Weight

Dry weight is that condition in which single weight item or a collection of items is characterized by its dead weight alone which is the installed condition including permanent utilities such as gearbox oil, hydraulic oil, filter sand, etc. Any operating fluid content flowing through a component, weight item or an assembly, is excluded.

The dry weights are considered to be input to the offshore lift weights. Installation aids such as slings, sling laydown platforms, bumpers and guides require to be added to the dry weights to develop the lift weights and installation vessel hook loads.

5.1.5 Operating Weight

Sum of the Dry weight and the fluid content weight in operation including consumables and live loads when the platform will be operated standalone.

6 WEIGHT ESTIMANTING METHODOLOGY

For each of the above listed weight conditions, that will be reported in Weight Control Report, the following key weights will be produced, depending on the various contingency allowance.

- Net Weight; This weight includes all known weights and allowances for known unknowns and excludes estimating allowances. The estimate does not include any unforeseen quantity growth, estimating errors or unnamed events.

- Gross Weight; The best estimate prediction of the final out-turn weight, which is used for structural checks. It includes net weight + contingencies and allowance for fabrication.

- Upper Bound Weight (also named possible weight); Sum of the weights, allowances and reserves. To be directly compared with NTE.

For the preparation of the WCR the following assumptions will be considered:

- Weight of equipments will be considered as per Vendor supplied item or from vendor estmates

- Primary steel weights based on Tekla model supported by structural calculations

- Secondary steel weight based on calculations of deck plate, equipment support structures, piperack, etc. based on platform layout

- Tertiary steel like stairs towers, access platforms, based on Tekla 3D model

All the weight will be updated and replaced during the development of construction, vendor supplied items.

The CoGs position will be considered from Tekla 3D model and for vendor supplied items its position will be assumed as per technical datasheet.

6.1 WEIGHT CONTINGENCY

Weight contingencies will be assumed according to ISO19901-5:2021, appendix J, Ref. 1, as variable depending on design and construction phase.

The table below shows the applicable values:

Phase	Detailed Engineering		Construction	
	IFR	AFC	As-built	Weighed Weight
Primary structures	10	7	5	2

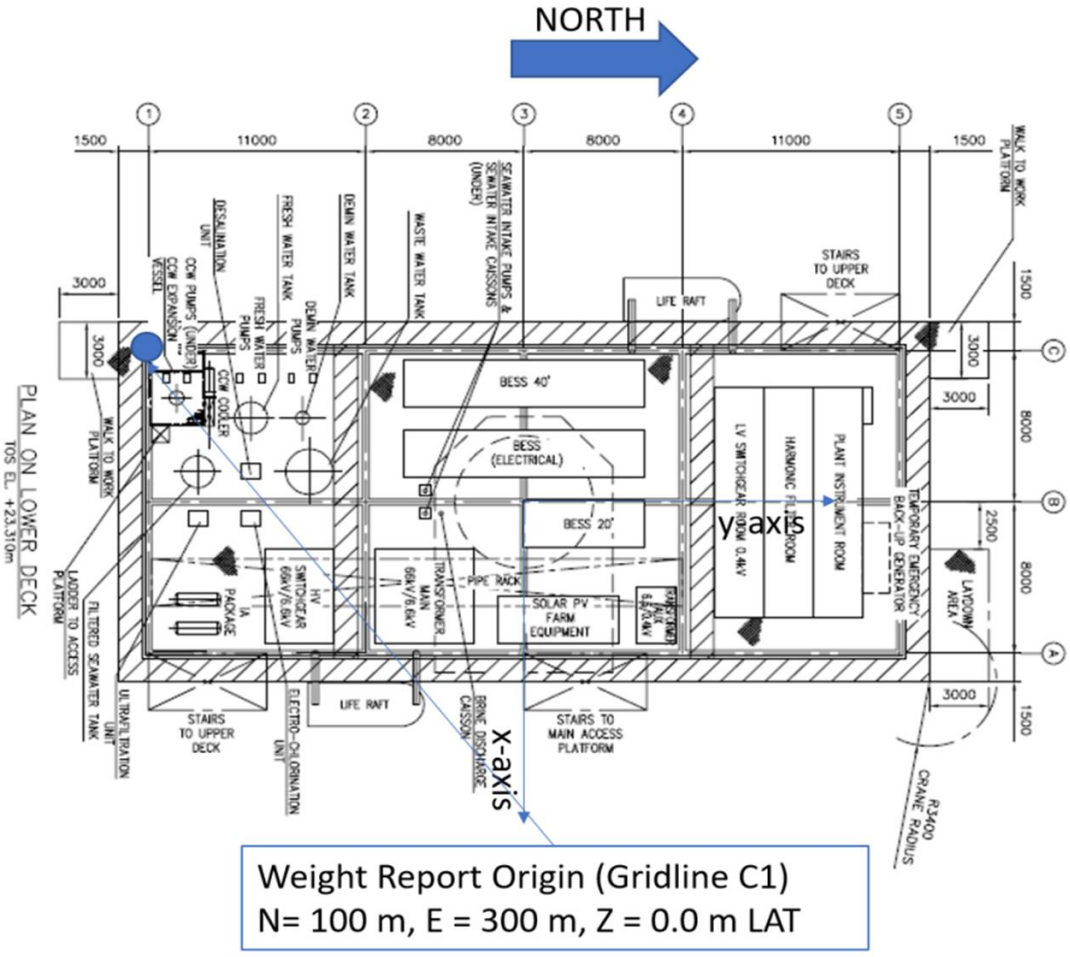
Secondary and tertiary structures	12	7	5	2
Mechanical	12	7	5	2
Piping	12	7	5	2
Electrical	15	10	5	2
Instrumentation	15	10	5	2
Architectural	15	10	5	2
Safety	15	10	5	2

6.2 NOT-TO-EXCEED WEIGHT & COG POSITION

According to the Basis of Design report, Ref. 9 and 10, the following limits wil be considered:

- Not to exceed weight (Operating condition) : **2400 mT including TP**, Ref. 2 and 4.
    - CoG Envelope within radius 1.5m from monopile center.
    - Maximum vertical CoG position El. +28.0 LAT

NOTE: NTE weight includes the topside operating weight and include the snow and ice accumulations and load on laydown area, documented in the Structural Design Report [2]. Individual component NTE weights may also be set for the installation operations when considering available installation vessels.



6.3 WEIGHT CONTROL CODES

For practical reasons, codes are assigned in the weight database to areas and disciplines. They are listed below.

6.3.1 Area Codes

Deck elevations are indicated in the table below.

CODE	DESCRIPTION	ELEVATION
CS	Caissons	+0 up to +21700

TP	Transition piece	+21710
TS-LD	TOPSIDE LOWER DECK	+23310
TS-UD	TOPSIDE UPPER DECK	+30310

6.3.2 Disciplines

Weight control concerns the following disciplines, if applicable.

DISCIPLINE CODES	DISCIPLINE	DESCRIPTION
A	Architectural	• Internal partitioning • Floors , Raised floors , floating floors, floor finishes and suspended ceilings • Shelter external walls (insulation included) • Doors , External Doors and windows. • Miscellaneous furniture
C	Surface protection (Coating & Galvanizing)	• Painting • Coating • Galvanizing
E	Electrical	• Equipment: - Enclosed Areas: cabinets, distribution panels, battery chargers, inverters, batteries, variable speed controllers, etc. - Open Areas: Diesel Emergency electricity generator, transformers, turbo-generators • Bulks: cables, trays, runs and supports, junction boxes, lighting, etc.
FG	Fire & Gas	• Fire fighting equipment (such as fire hydrants and extinguishers) • Deluge valves skid
I	Instrumentation	• Equipment: - Enclosed Areas: cabinets, logic controllers, computers, consoles, PCs, printers, microwave link stations, etc. - Open Areas: machine control panels

		• Bulks: links (cables, junction boxes), trays, in-line instrumentation (flowmeters, sensors) and supports
LL	Live Loads	• Live Loads includes :Maintenance loads , Temporary load allowances , laydown areas loads , others live load area allowances according to Loads Plans
M	Mechanical	• Hydrogen Storage vessels • Electrolysers • Fuel cell containers • Battery storage containers • Crane • Pumps including drivers • Heaters • Pressure vessels (such as separators or drums) • Tanks • Other containarized packages • Other packages
P	Piping	• Piping (manifolds, including the fire fighting system) • Valves (all valve, including instrumentation valves) • Fittings, couplings (flanges, bends, joints, tees, etc.) • Piping supports. • Insulation and personal protection • Piping Coatings
S	Safety / loss prevention	• Lift rafts
SP	Primary Steel	• main beams and main trusses including crane pedestal and primary lifting padeyes
SS	Secondary Steel	• joists, panels
ST	Tertiary Steel	• ladders, handrails • Staircases
SA	Architectural Steel	• Thermal Insulation • Passive Fire protection • Heat shields • Cladding
T	Telecom	• Equipment • Bulks: links (cables, junction boxes), trays and supports

W	Weight Control \ Correction	• Post weighing and weight control corrections

6.3.3 Item number

The Item Number is a progressive code identifying the item within the same Discipline.

6.3.4 Tag

The Item tag code univocally identifies the equipment , according to the datum information / source, within the whole project Tag numbers are derived from relevant Lists (Mechanichal ,Electrical , Instrumental , Telecom, etc).

7 WEIGHT CONFIDENCE CLASSES

Weight Status codes indicates the weight confidence class and is related to the Weight Growth Factor .

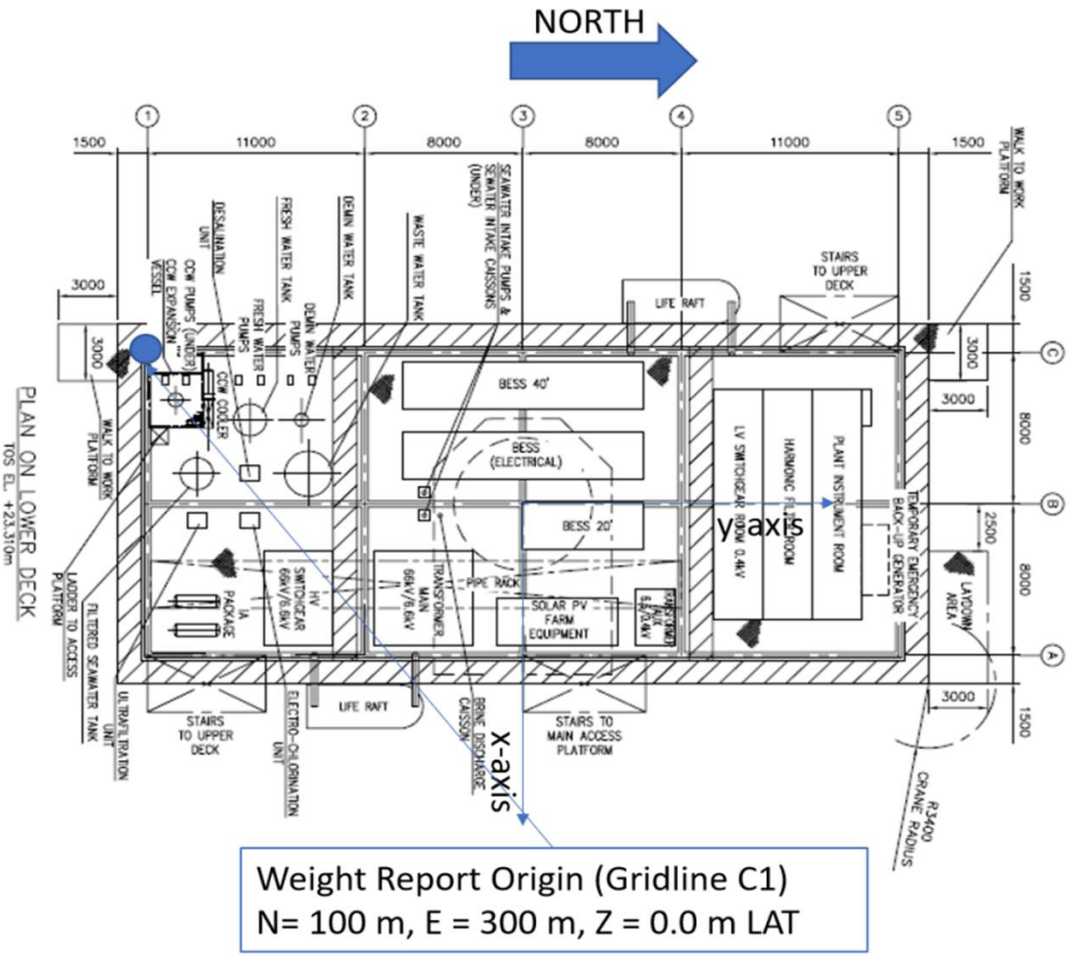
The Weight confidence classes used in the Weight Control and the relevant weight Growth Factors will be coded as follows :

W. Confidence	Net weight	Gross weight	Possible weight
A	1.00	1.00	1.00
B	1.00	1.04	1.06
C	1.00	1.10	1.20
D	1.00	1.20	1.40

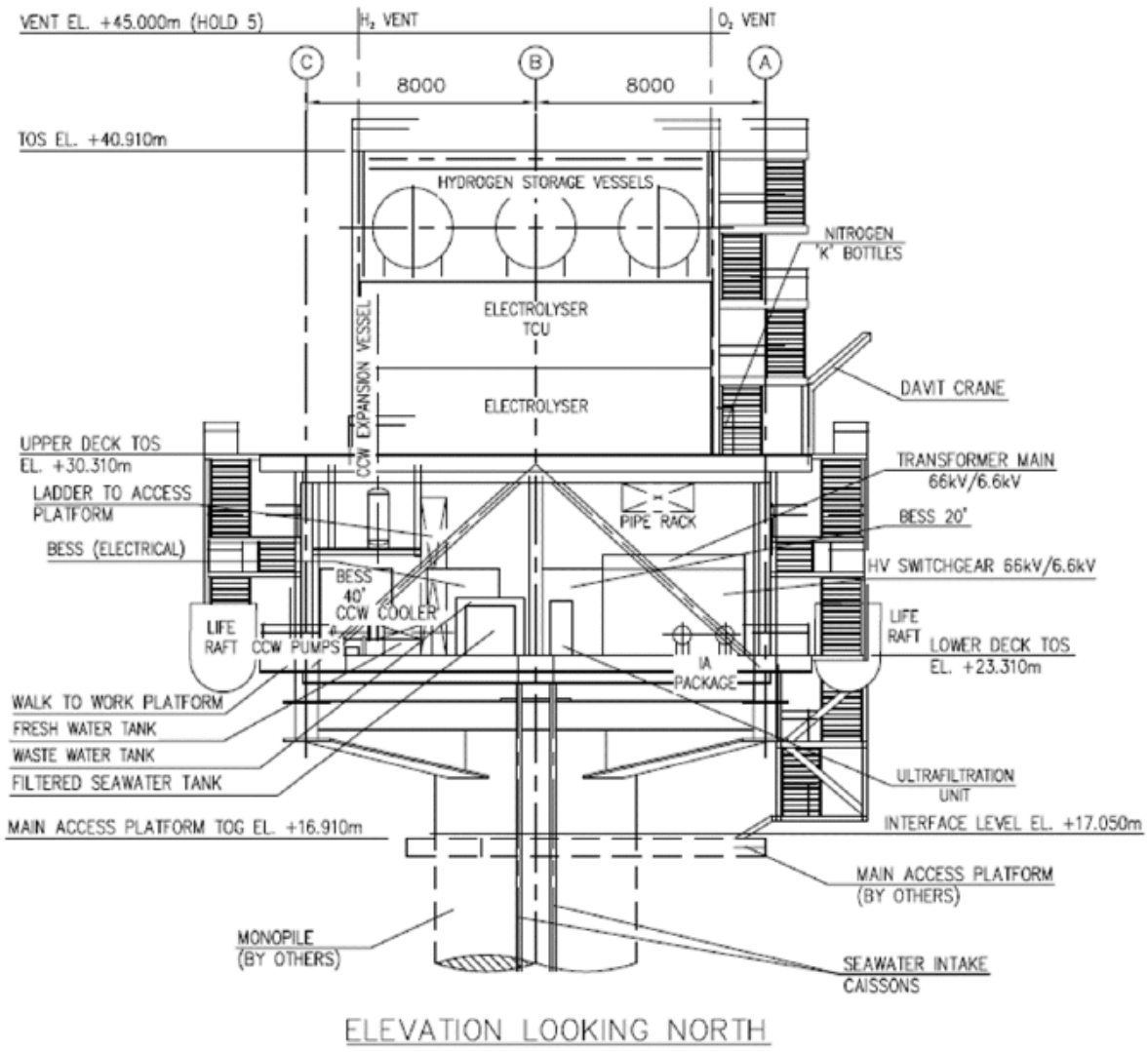
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8 COORDINATE SYSTEMS

The Global Coordinate system to be used in the weight control report is based on the PDMS Model



Picture 8-1 - Global Coordinate System (Easting – Northing)



Picture 8-2 - Global Coordinate System (Elevation - Z)

9 WCR CONTENT

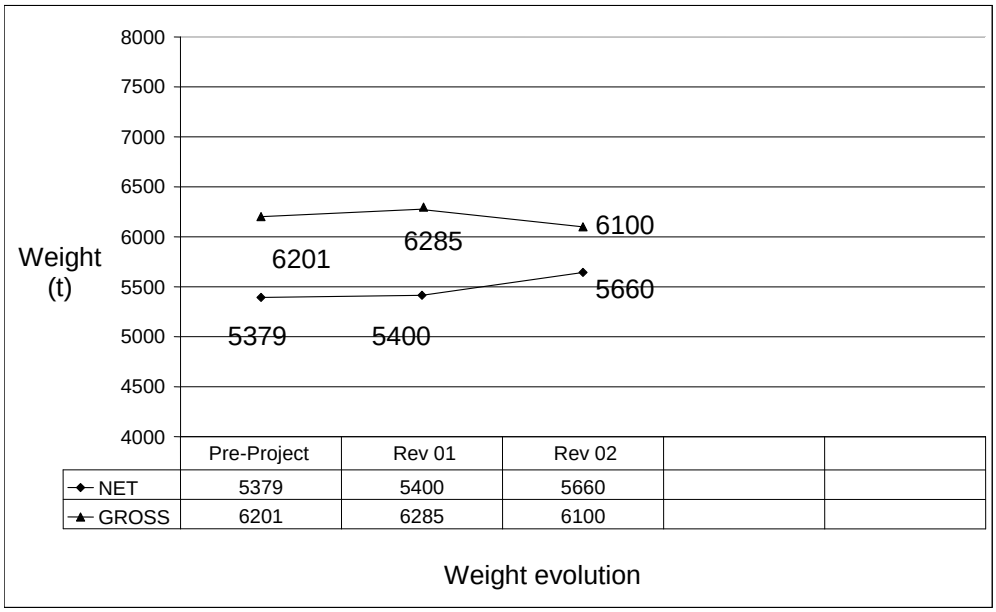
This section presents the content of a typical Weight Control Report. As per COMPANY standard , WCRs will be updated every month from the first emission.

The Weight Control Report (WCR) includes the following information:

- A paragraph summarising with tables the overall weight [Topside weight] and CoG in Lifting, Load out , sea transport , and Operating phases and for Current , Expected and Possible conditions . .
- A paragraph summarising changes Since last revision
- A trend graph and the main changes of weight and CoG, indicating their origin, for Lifting, Dry, and Operating
- A paragraph detailing with tables the weights and CoG of equipments by disciplines
- Full weight detail list will be gathered in Appendix. (R1-R2-R3)[Item list Area by Discipline Main section]
- Reaction Tables
- Load Plans
- Equipment plans, relevant layout plans and Project Equipment List

A weight trend graph typically looks like below:

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	Pre-Project	Rev 01	Rev 02		
NET	5379	5400	5660		
GROSS	6201	6285	6100		

Note: layout, headers, numbers and revisions are merely illustrative

Example of Load-out WCR

TOPSIDE LOAD OUT CONDITION PER DISCIPLINE

			CoG									CoG		
	CURRENT	CONTENT WEIGHT	X	Y	Z	ALLOW.	EXPECTED DRY	EXPECTED	ALLOW.	POSSIBLE DRY	POSSIBLE	X	Y	Z
DISCIPLINE	[t]	[t]	[m]	[m]	[m]	[%]	[t]		[%]	[t]		[m]	[m]	[m]
A	642.46	0.00	111.628	111.655	47.835	4%	668.6	668.6	6%	681.96	681.96	111.628	111.655	47.835
E	322.98	0.00	113.358	115.160	40.577	4%	335.9	335.9	6%	342.36	342.36	113.358	115.160	40.577
FG	237.84	0.00	109.457	118.336	30.839	0%	239.0	239.0	1%	239.51	239.51	109.457	118.336	30.839
H	170.42	12.00	110.610	110.840	45.663	4%	177.2	189.2	6%	180.65	192.65	110.610	110.840	45.663
I	127.72	0.00	112.903	112.878	44.247	4%	132.8	132.8	6%	135.38	135.38	112.903	112.878	44.247
LL	0.00	0.00	0.000	0.000	0.000	0%	0.0	0.0	0%	0.00	0.00	0.000	0.000	0.000
M	374.82	18.44	118.085	104.879	44.403	1%	379.4	397.9	2%	381.81	400.25	118.085	104.879	44.403
P	200.60	0.00	112.695	117.181	37.063	4%	208.6	208.6	6%	212.63	212.63	112.695	117.181	37.063
C	55.40	0.00	111.447	111.335	39.953	4%	57.6	57.6	6%	58.72	58.72	111.447	111.335	39.953
S	230.41	0.00	91.975	115.320	36.479	1%	233.2	233.2	2%	234.63	234.63	91.975	115.320	36.479
SP	2413.82	0.00	112.297	111.674	37.002	4%	2519.7	2519.7	7%	2580.49	2580.49	112.297	111.674	37.002
SS	807.31	0.00	109.892	112.449	43.677	4%	839.6	839.6	6%	855.75	855.75	109.892	112.449	43.677
ST	482.46	0.00	113.015	113.578	41.201	4%	501.8	501.8	6%	511.41	511.41	113.015	113.578	41.201
SA	0.00	0.00	0.000	0.000	0.000	0%	0.0	0.0	0%	0.00	0.00	0.000	0.000	0.000
T	30.57	0.00	109.516	114.110	44.548	4%	31.8	31.8	6%	32.41	32.41	109.516	114.110	44.548
W	45.20	0.00	82.019	99.117	40.721	9%	49.3	49.3	18%	53.49	53.49	82.019	99.117	40.721
TOTAL	6142.01	30.44	111.239	112.185	40.208	3.79%	6374.58	6405.0	5.85%	6501.20	6531.64	111.233	112.173	40.213

