

**ENQUIRY NO.**

**OFFSHORE SUBSTATIONS - EPC**

**APPENDIX A**

**SCOPE OF WORK**

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# 1 INTRODUCTION

## 1.1 General

Appendix A is solely intended to enable the principal elements of the Work to be identified and must be read in conjunction with all the Appendices, documents and enclosures within this Contract.

Appendix A does not present exhaustive details of each activity required to complete the Work

Company shall have access to updated information from Contractor's systems, plans and reports upon Company request.

## 1.2 Project description

The contract relates to two projects of offshore wind farms i.e. . They are developed - respectively - by project) and project). Both companies are JVs, owned by (50% of shares) and (50% of shares).

[REDACTED]

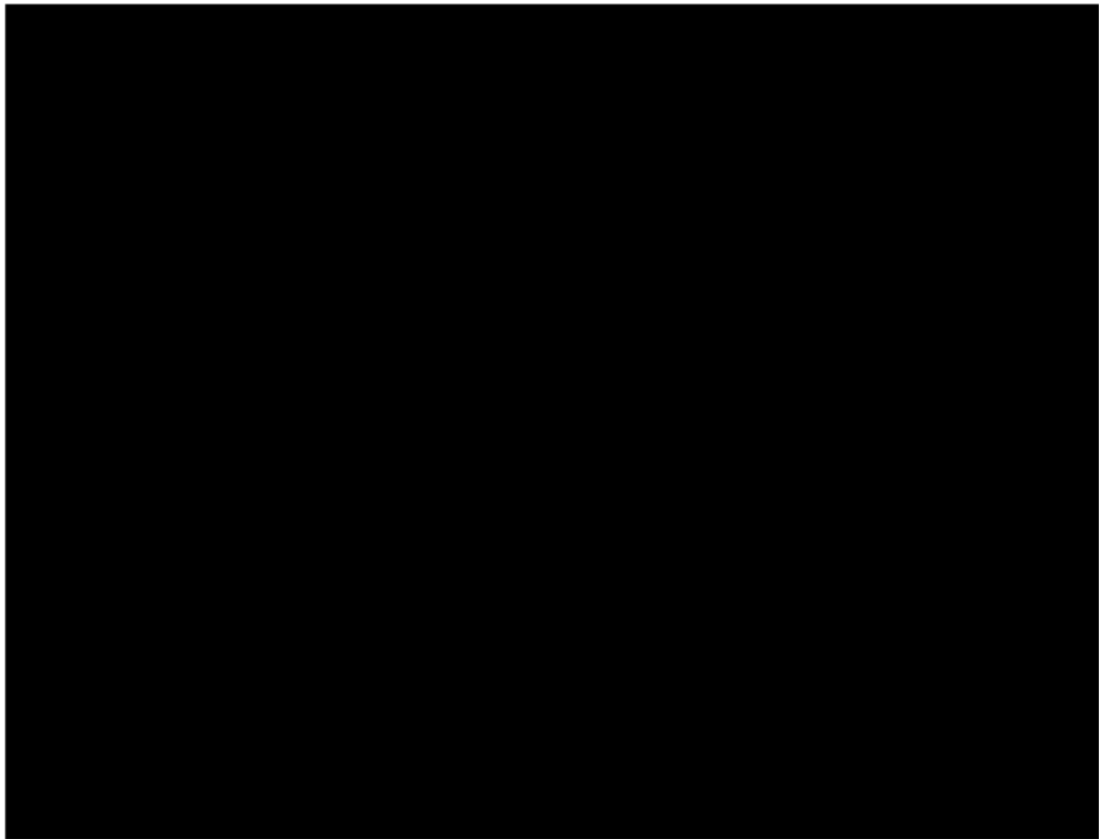
MW). The offshore wind farms will be located in Polish exclusive economic zone of Baltic Sea and are subject to Polish regulatory regime.

The electricity generated in the wind farms will be exported to the Polish transmission grid, operated by Polskie Sieci Elektroenergetyczne S.A. (Polish TSO). Each wind farm has obtained separate grid connection conditions and is covered by one Grid Connection Agreement with TSO, concluded by - respectively -

Each has obtained or will obtain separate set of Permits required by Applicable Law for development, construction and operation of the offshore wind farm in Polish exclusive economic zone of Baltic Sea.

Both have obtained the decisions of the Polish Energy Regulatory Authority on granting support (state aid) for each project, in accordance with the Act of 17 December 2020 on the promotion of electricity generation in offshore wind farms.

## 1.3



Design life is 25 years.

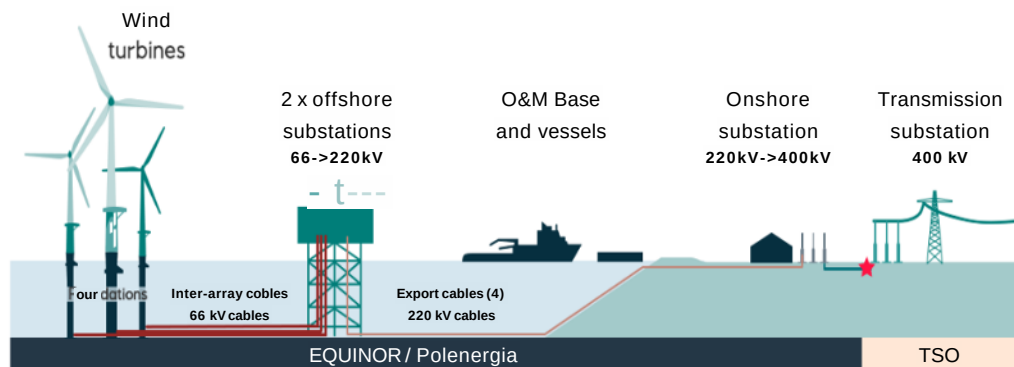


Figure 1.2 ESI Schematic overview

The two High Voltage AC Offshore Substations are in approx. 30 meters of water depth. During the FEED studies the two topsides were treated as they were identical, whereas the design for the substructures/jackets have been treated separately.

For the detailed design however, it can be expected minor differences in topside design that must be considered. These are mainly related, but not limited to cables, hang offs and routing of cables.

Both substructures are a four-legged jacket type with two piles in each corner. Ten (10)-Jubes for IAC and two (2) J-tubes for EC are installed on each substructure and one cable deck. The J-tubes shall be protected against sea ice.

The OSS shall carry equipment for high-voltage transmission and distribution, such as transformers and switchgears (GIS), as well as other facilities such as diesel generator, oil/water separator, batteries and panels for station and wind farm control. Topside FEED summary Report C274-RA-A-RA-01014 will give more information.

The OSS is categorised as normally unmanned; however, it is equipped with an emergency shelter including minimalistic welfare facilities and overnight stay for 12 persons in the permanent operative phase. During HUC, it shall be possible to be used for 36 persons. The OSS will not be equipped with a fresh water supply system. Instead, all fresh water supplies for the kitchen etc. will be brought on board for each manning operation. The OSS will be equipped with a helicopter winch area for emergency transfer of personnel. The primary means of access will, however, be by Service Operation Vessel (SOV) and/or Crew Transfer Vessel (CTV).

The OSS will be designed with walk-to-work access facilities (2 locations), which will allow an SOV equipped with a motion-compensated gangway to safely transfer technicians and minor spare parts directly from the SOV to the OSS.

The High Voltage electrical transmission system on the OSS consist of 10 IACs connected to 66 kV pluggable joints on cable deck, followed by topside 66 kV flexible cables connected to 66 kV GIS switchgears.

The 66 kV GIS switchgears are connected to the 220 kV GIS switchgears via two 220/66 kV step-up transformers. The connection between the 66 kV GIS switchgear and the 220/66 kV transformers shall be Duresca busbar system. The connection between the 220/66 kV transformers and the 220 kV GIS switchgear shall be delivered by export cable contractor. From the 220 kV GIS switchgears two EC export power to the ONS.

The 66 kV and 220 kV GIS switchgears for A&B system shall be segregated into separated GIS rooms by a fire wall. While the 220 kV GIS switchgear are fully separate, the 66 kV GIS switchgear are connected by a normally open bus-tie circuit breaker.

The 220 kV system is directly earthed through the main transformers high voltage winding, while 66 kV system is earthed though the combined 66 kV earthing and auxiliary transformers.

The topside is divided into five deck levels. Each deck level supports relevant substation equipment, control rooms, storage rooms, etc. The deck levels are Cable deck – Located on jacket structure, Cellar deck, Main deck, Cooler deck, Utility deck and Roof deck.

Due to Building Permit process the OSS topsides main dimensions like topsides length, height, width, elevations, main layout, total height are frozen at FEED stage.

## **1.4 Abbreviations**

The following abbreviations shall have the meanings hereby assigned to them:

|          |   |                                       |
|----------|---|---------------------------------------|
| 3D Model | = | Company's AVEVA Plant Global 3D model |
| ALARP    | = | As Low As Reasonably Practical        |
| AC       | = | Alternating Current                   |
| ATS      | = | Agreement for Technical Services      |
| BAT      | = | Best Available Techniques             |
| BPA      | = | Building Permit Advisor               |
| CAD      | = | Computer Aided Design                 |
| CA       | = | Contract Award                        |

|        |   |                                                                                                     |
|--------|---|-----------------------------------------------------------------------------------------------------|
| CB     | = | Certification Body                                                                                  |
| CFD    | = | Computerised Fluid Dynamics                                                                         |
| CMS    | = | Condition Monitoring System                                                                         |
| CMR    | = | substances classified as <u>C</u> arcinogenic, <u>M</u> utagenic, or toxic for <u>R</u> eproduction |
| EAT    | = | Earthing and Auxiliary Transformer                                                                  |
| ESON   | = | Electrical System design and Onshore EPC Contractor (Hitachi Energy)                                |
| ESI    | = | Electrical System Infrastructure                                                                    |
| EWP    | = | Engineering Work Package                                                                            |
| E3D    | = | AVEVA E3D Design                                                                                    |
| FAT    | = | Factory Acceptance Test                                                                             |
| FCP    | = | Field Check Package                                                                                 |
| FEED   | = | Front End Engineering Design                                                                        |
| HAZOP  | = | Hazard and Operability Analysis                                                                     |
| HE     | = | Hitachi Energy                                                                                      |
| HMI    | = | Human Machine Interface                                                                             |
| HSE    | = | Health, Safety, Security and Environment                                                            |
| HUC    | = | Hook Up and Commissioning                                                                           |
| HVAC   | = | Heating, Ventilation, Air Conditioning                                                              |
| ISO    | = | International Standardisation Organisation                                                          |
| ISS    | = | Insulation, Scaffolding and Surface                                                                 |
| kV     | = | kilovolt                                                                                            |
| LCC    | = | Life Cycle Cost                                                                                     |
| LCI    | = | Life Cycle Information                                                                              |
| MC     | = | Mechanical Completion                                                                               |
| MEL    | = | Master Equipment List                                                                               |
| MPS    | = | Master Package Specification                                                                        |
| MPST   | = | Master Package Specification Template                                                               |
| MTO    | = | Material Take-Off                                                                                   |
| MVA    | = | Megavolt Ampere                                                                                     |
| NORSOK | = | The Competitive Standards of the Norwegian Offshore Sector                                          |
| OSS    | = | Offshore Substation                                                                                 |
| PFD    | = | Process Flow Diagram                                                                                |
| P&ID   | = | Piping and Instrument Diagram                                                                       |

|          |   |                                                       |
|----------|---|-------------------------------------------------------|
| PMS      | = | Power Management System                               |
| PMT      |   | Procurement Milestone Plan                            |
| PO       | = | Purchase Order                                        |
| ProCoSys | = | Project Completion System Tool                        |
| PS       | = | Package Specification                                 |
| RFCC     | = | Ready for Commissioning Certificate                   |
| RFOC     | = | Ready for Operation Certificate                       |
| SAP      | = | Data System for Working Order & Document Handling     |
| SAS      | = | Safety and Automation System node                     |
| SRS      | = | Safety Requirements Specification                     |
| SCD      | = | System Control Diagram                                |
| SEMI     | = | Standard Equipment and Material Information           |
| SESAM    | = | Computer system for finite element analysis           |
| SPIR     | = | Spare Parts Interchangeability Record                 |
| STID     | = | Technical Information and Documentation system Safety |
| SUS      | = | and Utility Automation Systems                        |
| SOV      | = | Service Operation Vessel                              |
| CTV      | = | Crew Transfer Vessel                                  |
| TAC      | = | Technical Acceptance Certificate                      |
| TIE      | = | Technical Information Exchange                        |
| TRA      | = | Total Risk Analysis                                   |
| WE       | = | Working Environment                                   |
| WO       | = | Work Order                                            |

### **1.1.1 Definitions**

In this Appendix A the words and expressions established as definitions in Conditions of Contract shall have the same meaning as assigned to them in such Articles. In addition, the following words, expressions, and abbreviations shall have the meaning hereby assigned to them:

**Agreement for Technical Services (ATS)** means the terms, conditions, pricing schedules, and administrative requirements agreed in POs which govern services from a Subcontractor after delivery of the goods to Contractor, and after the Contract Object have been delivered to Company.

**Concession** means a written permission to use or release a product or service that does not conform to specified requirements.

**Construction** means all Work associated with pre-fabrication, fabrication, assembly, outfitting, handling, and any other physical work associated with the Contract Object.

**Contract Object** the object which Contractor, according to the contract, shall deliver, together with parts thereof, except for Company Materials before their incorporation into the Contract Object.

**Deviation Permit** means permission to depart from the originally specified requirements of a product or service prior to realization.

**ENS** means Engineering Numbering System - the engineering numbering system used for tagging and Engineering Document numbering purposes.

**Equipment** is a collective term for Material components to be incorporated in the Contract Object, in all disciplines.

**Equipment Package** is a collection of Equipment as defined in the purchase package.

**Facility** means the Site and all property, offices, computer hardware, accommodation, working equipment, fabrication shops, plant and Temporary Work provided by Contractor for the performance of the Work but excluding materials and items forming part of the Contract Object

**Factory Acceptance Test (FAT)** means the test, performed prior to delivery, at the manufacturer's premises and which demonstrates that the equipment function is in accordance with the Project requirements.

**HV Equipment** means high voltage (HV) equipment delivered from ESON contractor.

**Lead Interface Party** means responsible for administration of the interfaces towards other contractors or Company.

**Life Cycle Cost (LCC)** means the present value of all cost elements which are connected to an investment item (the Project) as defined by ISO 15663.

**Life Cycle Information (LCI)** is technical information required for all phases of a plant's life cycle.

**Load-Out** means the transfer and securing of the Contract Object (or any Unit) to a Company provided barge and/or transport vessel.

**Nonconformity** means non-fulfilment of a requirement. A requirement is a need or expectation that is stated, generally implied or obligatory.

**Offshore Substation (OSS)** means the topside and substructure including piles and scour protection.

**Offshore Site** means the MFW and Wind farm and where the Contract Object will be permanently installed.

**Preservation** means all required preservation and preservation maintenance activities required to ensure warranties and functionalities of equipment and materials are retained.

**Professional Engineer** means a person having a certificate issued in the form of a decision of the appropriate qualification committee, authorizing the activity in the field of performing independent technical functions in the construction industry, consisting in designing and managing construction works.

**Quality Deviation** means type of Nonconformity related to undesirable events or defects that require rework, repair, scrap, and similar corrections with direct or indirect impact on cost and/or schedule.

**Spare Parts** means the following categories of spares:

- Project Spares means spare parts which shall be available during installation including Mechanical Completion.

- Commissioning Spares means parts, which may be required during the construction and commissioning period.
- Operational Spares means parts or units required to maintain the operational and safety capabilities of the equipment during its normal lifetime.
- Capital Spares means items of equipment which have long lead times and may be procured and tested together with the main item of equipment. Examples of Capital Spares are compressor rotors and gears.

**Standard equipment** is defined as equipment/component/products from the Supplier catalogue / off-the-shelf equipment.

**Supply Base** means .....

**Temporary Works** means all temporary structures or items that may be necessary to enable Contractor to construct and transport the Contract Object or part of the Contract Object but do not form permanent part of the Contract Object.

**Third Party** means any party other than Company and Contractor

**Work means** all work which shall be performed or cause to be performed in accordance the Contract.

## 2 THE WORK

### 2.1 Scope summary

The Scope of Work includes the following main activities:

- Management including Health, Safety and Environment (HSE) management
- Interface coordination towards other contractors, including building permit designer and certification body
- All detailed engineering and design (based on FEED design)
- All procurement necessary to complete the two OSS
- All construction activities necessary to complete the two OSS
- Installation of Company's Materials (e.g., HV Equipment, etc)
- Mechanical Completion (MC), onshore OSS commissioning, functional testing and certification
- Contract Object prepared for load out, transportation and preservation.
- Intermediate storage, if relevant prior to load-out for transportation/installation
- Offshore hook up and commissioning assistance
- Follow on engineering
- Contract close out activities required for issue of the Completion Certificate
- **Options:**
  - O&M service agreement
  - Implementation of active bird deterrent system
  - HV cables between HV Equipment
  - Preinstall topside Export cable

- Temporary equipment for dry clean building during load-out and HUC
- Lifetime extension
- HVAC fan coil unit and wall mounted heater
- Transport of Contract Object to Offshore Site

## 2.2 Battery limits Contract Object

The Battery limits for the Contract Object are illustrated in Figure 2.1 below.

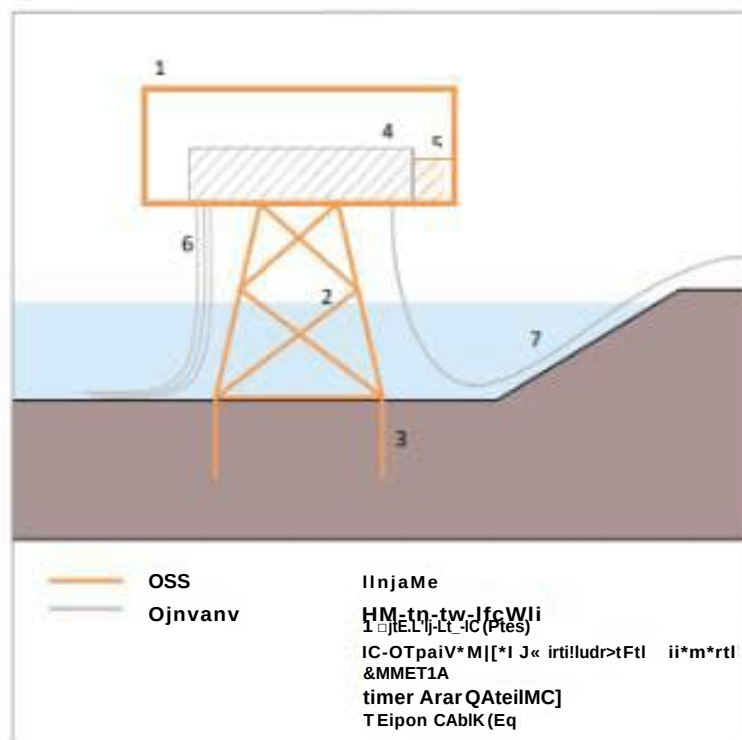


Figure 2.1: Battery limits for Contract Object

## 2.3 General

Contractor shall perform all Work in accordance with regulations, functional and technical requirements, and codes and standards referred to in this Contract.

All work shall be executed in accordance with Company's "Zero harm" vision and strategy for "Always safe, High value and Low carbon". See site [Health, safety and security -](#)

The Work shall be executed as an Engineering, Procurement, Construction, Commissioning, Commissioning support and hook up support EPC Contract. Contractor's responsibility for performance of the Work includes all activities.

Contractor is responsible for ensuring that the final design and installation of the Work is complete and suitable for the intended purpose and ensure compliance with Building Permit Design.

### **2.3.1 Certification Body**

The OSS shall be certified by a certification body contracted directly with Company. Contractor shall support the certification process and interface, share needed information and implement improvements and/or changes if required to obtain final certification of the OSS. Contractor shall also participate in meetings when required and requested.

### **2.3.2 Local requirements & conditions – construction license**

- Project Documentation - In reference to the Scope of Work regarding the project documentation, the Contractor shall ensure that project documentation (in particular Detailed / Executive Designs and Workshop Drawings) are signed by certified Professional Engineer having construction license according to the applicable acts, regulations and practise in Poland. Project documentation developed by the Contractor must comply with the Building Permit Design.
- Construction Works - In reference to the construction phase of the project the Contractor shall ensure as well personnel as licensed professionals having proper construction licenses to manage the works on the construction site, file construction plans, logs, time schedules, construction method statements, applications prior to start of construction works etc. according to the applicable acts and regulations in Poland.

### **2.3.3 Building Permit Process**

Regarding the Building Permit Process, the EPC OSS Contractor is obliged to:

- Ensure compliance with Building Permit Design
- Continuous cooperation with the Company's contractor/BPA to provide the best quality solution in the line of Building Permit requirements
- Interface with BPA. Any time when BPA ask for issues related to Building Permit Design, EPC Contractor shall respond accordingly. The response should not be unreasonably withheld and will be given within 5 working days.
- Implement changes resulting from Building permit process. In the event of changes in the design of the FEED OSS documentation resulting from the ongoing building permit process (e.g., because of arrangements, requirements of administrative/ministry offices, decisions), the Contractor shall introduce these changes to the design as soon as possible and send the solutions/data to BPA.
- Participation in meetings with BPA (if needed and approx. 1 time per month)
- Inform BPA about any design changes and provide data about any changes in execution design comparing with technical design, building design and FEED documentation: In the event of a change to data that has already been sent to BP Advisor, the Contractor must agree the changes with Company and BPA and immediately send detailed information about the change.
- Submit of drawings for BPA in editable file formats (dwg, dxf, docx) in 2D.

### **2.3.4 Contract Object**

The Contract Object shall comprise the following Units:

- A complete Offshore Substation Topside
- A complete Offshore Substation Substructure (incl. piles and scour protection)

#### 2.3.4.1 Topside

The Topside shall be a complete OSS topside module including Materials, Company's Materials, internal and external sea-fastening, grillage and export cables (EC) and inter array cables (IAC) pull-in system and winch(es).

The Topside shall include temporary signage, markings, lights, navigational aids, HVAC, diesel generator and such other ancillaries to be used until permanent systems are operational at Offshore Site, and temporary equipment and structures required during transport and at the Offshore Site.

#### 2.3.4.2 Substructure

The Substructure shall be a complete jacket with piles including design, fabrication, Materials, Company's Materials, grouting systems, install grillage, internal and external sea-fastening and EC/IAC pull-in system and winch(es) and scour protection.

The Substructure shall include temporary signage, markings, lights, navigational aids, HVAC, diesel generator and such other ancillaries to be used until permanent systems are operational at Offshore Site, and all temporary equipment and structures required during transport and at the Offshore Site.

#### 2.3.4.3 Yard(s)

The Topside shall be constructed at Contractor's XXX Yard in XXX (TBA by Contractor). The Substructure shall be constructed at Contractor's XXX Yard in XXX (TBA by Contractor).

Any changes to the selection of the Yard(s) and Yard location specific Work activities shall be approved by Company. If Contractor relocates Work to new yard(s) or Subcontractors without Company approval it will be considered a breach of the Contract.

### 2.4 Mechanical Completion, Commissioning and Delivery

#### Mechanical Completion

Each Contract Object Unit shall achieve Mechanical Completion when all test, verification and Mechanical Completion check records within the Unit are completed. Company system for completion documentation ProCoSys to be used.

#### Commissioning

Contractor shall plan, prepare and execute onshore commissioning of the Contract Object.

#### Delivery

The Topside and Substructure shall each achieve Delivery when:

- Mechanical Completion Certificate issued for the Unit
- All Minor Outstanding Items listed in the Unit's Mechanical Completion Certificate is completed
- All Commissioning completed and approved by Company.
- All Company's other contractors work at Yard for the relevant Unit is completed
- Engineering Work Packages (EWP), including plans for resources and materials, for Minor Outstanding Items or offshore Work listed in the Delivery Certificate issued and approved by Company

- All Work necessary for the offshore substation installation contractor to perform the transport and installation is complete and Marine Warranty Surveyor (MWS) has issued all required certificates of approval

Contractor can only apply to Company for a Delivery Certificate after the respective Company provided barge and/or transport vessel is in Contractor's custody and Contractor has performed weighing of the Contract Object, Load-Out to transport barge/vessel, sea-fastening, Preservation, and all Construction and preparations for transport and installation at Site prior to sail away.

When Delivery Certificate is issued the care and custody of the Contract Object is handed over to Company and simultaneously to the nominated installation contractor.

## 2.5 Project Agreements and Objectives

- The Work and the Contract Object shall adhere to Project Agreements, Project Agreements Obligations, Permits and requirements listed in Appendix E and elsewhere in the Contract.
- Deliver Contract Object according to rules and regulations and ensure full compliance and alignment with the Building Permit Design input required for the Building Permit.
- Ensure certification of the Contract Object
- Secure inherent safety, security, occupational health and sustainability in design and performance of the Work.
- Use of cost effective and standard solutions to reduce the total cost of ownership (TCO).
- Develop a technical concept based on low carbon solutions.
- Minimise offshore man-hours by selecting solutions with highest possible degree of completion onshore
- Ensure operational/maintenance-friendly design/product
- Identify simplifications contributing to robust and cost-effective project execution

## 2.6 Improvement agenda

The Project's improvement agenda shall have high attention throughout the contract period to support "bottom line" success for Contractor and Company. However, it is important to understand the limitations given by Building Permit designer. "One team" approach with high degree of collaboration between Contractor and Company and interface parties shall support high project performance. Contractor shall ensure that its organisation and execution support the improvement agenda.

### 2.6.1 Objectives

The following improvement agenda objectives is defined to support high performance project execution:

1. Always safe
  - Make safety personal
  - Safety in execution
  - Safety and security in design
  - Conducting business with integrity and transparency

## 2. High value

- Optimize regularity
- Reduce CAPEX
- Accelerate schedule
- Secure certification and avoid delays in Building Permit process

## 3. Low carbon

- Energy efficient solutions
- Energy efficient execution

### 2.6.2 Key Performance Indicators (KPIs)

A set of KPIs shall be established to measure achievement of the objectives. Company may define some of the KPIs and the total KPI set shall be agreed with Company. The KPIs shall be continuously monitored during different stages of execution.

### 2.6.3 Target

Company and Contractor shall establish common targets for all KPIs. The targets shall support achievement of the Objectives

## 2.7 Digitalisation

Contractor shall in cooperation with Company identify, specify, and incorporate digital solutions related to project execution and facility operations/maintenance.

Contractor shall drive and/or contribute to digitalisation initiatives when agreed with Company.

Contractor shall:

- Use all digital tools stated in Contract in cooperation with Contractor's digital tools to ensure effective execution and collaboration.
- Ensure that the technical design supports remote operation and maintenance in accordance with Company operation philosophy.

## 3 MANAGEMENT AND ADMINISTRATION

### 3.1 General

To achieve Company's objectives, Contractor shall manage the work and deliver according to requirements further described in Appendix D.

Contractor shall cooperate with Company to secure efficient work processes further described in this section.

### 3.2 Execution schedule

Contractor shall the develop the execution schedule in accordance with requirements and frame conditions in Appendix D.

Contractor shall ensure robustness in schedule and resource capacity, contributing to maintain ability to handle risk and resolve unforeseen premises. Contractor shall ensure early identification and specification of engineering deliverables, long lead items, equipment and materials to sustain the project execution robustness.

The engineering deliverables as listed in MDR such as drawings, documents, specifications and technical requisitions shall be scheduled and networked considering lead times to meet procurement, construction, and commissioning needs.

The execution schedule shall reflect the main engineering activities and milestones per engineering discipline with link to relevant procurement, construction and commissioning activities.

Contractor shall ensure that the E3D model maturity reflects the needs of the construction yard schedule and commissioning schedule with regards to method and sequence of work. If engineering and procurement deliverables in any area is deemed to be out of sequence with construction, or commissioning schedules, Contractor shall ensure required coordination, adjustments and improvement of schedules to achieve an integrated execution schedule.

A detailed construction schedule (planned discipline punch out date) and commissioning schedule (planned RFCC date) shall be developed as part of the schedule to suit the agreed commissioning schedule and project milestones.

### **3.3 Health, safety, security and environment management**

#### **General**

All work shall be executed in accordance with Company's "Zero harm" vision and strategy for "Always safe, High value and Low carbon".

Contractor shall demonstrate proactiveness and hands-on HSE leadership, as well as be collaborative in planning and executing of the Work to ensure good HSE performance. Contractor shall ensure implementation of the highest HSE standards by active involvement in all part of its organization and its Subcontractors. HSE related risks shall be defined and followed up in the Contractor's risk management system. HSE considerations shall be an integrated part of the Work and shall be performed in a proper, systematic manner to meet the "zero harm" goals. All HSE activities shall be reflected in plans and procedures and documented in accordance with applicable authority regulations, industry standards and Company's safety, security and sustainability requirements described in Appendix A, D and E.

In order for Company to be compliant to the International Finance Corporation (IFC) Performance Standards (PS) and the Equator Principles (EP4), Contractor shall provide upon request all relevant information and work in the direction of fulfilling these requirements as long as they do not unreasonably exceed renewable industry standards and practices such as defined by G+, IMCA or DNV. The World Bank Group Environmental, Health and Safety Guidelines ("EHS Guidelines") are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP) and may be used as reference.

Contractor shall for each engineering discipline ensure HSE in design has been conducted and the principle of ALARP addressed when developing control measures.

Contractor shall be responsible for all HSE and security aspects including personnel engaged in the Work and all personnel visiting the Sites. Contractor shall demonstrate proactiveness and visible leadership and ensure implementation of the highest HSE standards by active involvement and engagement in all parts of its organisation and with its Subcontractors.

Qualified safety inspectors shall be available at construction site(s). Security measures shall be identified and implemented to prevent unauthorized access to Sites; and to safeguard against eavesdropping, sabotage, damage and theft, and they shall meet relevant Polish requirements.

The main deliverables for HSE management in this contract are as follows:

Contract specific HSE plan and activity list

Contractor shall develop and maintain a specific HSE plan and activity list covering all relevant phases according to Appendix D. This shall be based on minimum requirements in IOGP 577, IOGP Life Saving rules and experience/learnings. HSE improvement plans for all sites shall be developed and included in the action and mitigating plan. An HSE inspection program shall be a part of the HSE plan and activity list. The HSE plan and activity list shall also include planned timely HSE campaigns relevant for upcoming activities and associated risks. This requirement also applies for the subcontractors.

Emergency response

Emergency response procedures and plans shall be developed and implemented for all identified emergency situations. Emergency response means all technical, operational and organisational measures which prevent a hazard from escalating into an accident, or which prevent or reduce the damaging effects of an accident. The responsibilities of individual functions of Contractor's organisation and Company's role in such emergencies shall be clearly documented. Contractor shall make all its personnel familiar with such procedures and plans and execute emergency preparedness drills. Lines of communication and associated roles/responsibilities shall be clearly documented and tested with third party emergency services. Further details are described in Appendix D.

Site safety readiness review

Contractor shall carry out a site safety readiness review of own and subcontractors' sites in accordance with IOGP577 in a timely manner before start of site activities with involvement from Company.

HSE training plan

Contractor shall establish a HSE training plan. This shall include HSE awareness training, specialised HSE training related to tasks and equipment based on IOGP life-saving rules and IOGP577 and leader and supervisor training with emphasise on proactive and visible safety leadership. Training of personnel shall be performed and documented before execution of the Work. This requirement also applies for the subcontractors.

Dropped object management plan

Contractor shall have a systematic approach to avoid incidents involving dropped objects. A plan for prevention of dropped object shall be develop, maintain and in accordance with minimum requirement in IOGP 577. The plan shall also address the aspects contained within the IOGP Lifesaving rules; safe mechanical lifting, working at height and line of fire.

Constructability study

A constructability study shall be carried out during engineering accordance with IOGP 423-2 (HSE Plan Checklist). This study shall ensure that relevant hazards and risks are identified, appropriate risk controls are put in place and that the design promotes a satisfactory HSE standard for the construction phase.

Lagging and leading indicators

Contractor shall develop lagging and leading indicators

Occupational health hazards related to work

Contractor shall ensure that occupational health hazards related to the Work have been identified, and preventive measures have been taken and are fully implemented. Contractor shall ensure that every substance, product and material considered as hazardous by

applicable law or international standards of reference is clearly identified, quantified and known by all personnel.

#### ALARP

A systematic approach to risk shall be utilized in all activities. Priority is to establish inherently safe solutions in layout and design followed by implementation of risk reduction measures according to ALARP principle. An ALARP register shall be kept updated throughout the whole project period to ensure a traceable ALARP process. ALARP shall be considered only where compliance is already reached and verified.

### **3.4 Risk management**

Contractor shall maintain and follow up a risk management system for the Work in accordance with the requirements given in Appendix D. Such risk management system shall also be made for subcontractors' scope of work.

The risk management framework and process shall ensure that risks are properly identified, analysed, evaluated, managed and documented and that all levels in the organisation are involved.

### **3.5 Quality management**

Contractor shall establish, maintain, and follow up a quality management system in accordance with the requirements given in Appendix D.

#### **3.5.1 Nonconformities**

Contractor shall without undue delay notify Company of any identified Nonconformities related to the Work and the corresponding mitigating actions according to requirements in Appendix D.

##### **3.5.1.1 Quality Deviations**

Contractor shall establish, implement and maintain a system to systematically track, control and trend Quality Deviations, in Contractor and Subcontractor products and processes throughout the Work according to requirements in Appendix D.

The Quality Deviation summary report shall contain description, suggested actions and necessary documentation of each deviation, including any associated financial loss and schedule impact.

The report shall be made available to Company monthly through the Contractor's Nonconformity system.

For Quality Deviations with high potential for financial loss or schedule impact, Contractor shall make Quality Alerts to share with Company for learning purposes and to prevent recurrence.

##### **3.5.1.2 Deviation Permit or Concession**

If a potential or actual Nonconformity is detected, Contractor shall seek a Deviation Permit or Concession if correction is not possible or not the best solution. Such requests shall be issued to Company and followed up in Company's tool for handling Deviation Permits and Concession requests.

Contractor shall submit all Deviation Permits and Concession requests together with proposals for corrective actions to Company within 5 (five) working days after detection.

All Deviation Permits or Concession requests rejected by Company shall be corrected by Contractor as soon as possible. If the Deviation Permits or Concession request is approved with condition, the Contractor shall document that conditions are closed out when the corrective work is performed. Corrective actions shall be completed as soon as possible after agreement of corrective action.

Approved Deviation Permits and Concessions shall be traceable to system, sub-system, functional location, and Commissioning Packages.

### **3.6 Change control management**

Contractor shall implement a change management process, providing a full overview of all impacts related to changes.

Contractor shall submit a design change register. The design change register template shall be agreed with Company.

### **3.7 Interface management**

#### **3.7.1 General**

Contractor shall have responsibility for coordination of interfaces that affects overall system integrity on the OSS. Contractor shall also have the overall responsibility for coordination of interface work with other contractors and ongoing activities that have interfaces with the Work.

Contractor shall be responsible for identifying, collecting, and exchanging all necessary interface information, ensuring that the need dates for interface information are identified and agreed. Emphasis shall be on utilisation of cost-effective solutions across the interfaces. Aspects which are identified through the interface work, and which affects the functionality and construction of the Contract Object shall be considered in the design development.

Contractor shall nominate an interface coordinator within own organisation, reporting on a regular basis to Company with special focus on critical interfaces.

Contractor is responsible for managing Interface Requests (IR) towards external parties in Company interface tool (PIMS). The main external interface parties and Lead Interface Party are listed in PM735-PMS-012-001 rev.03, appendix E. In addition, Contractor shall interface with Certifying Body and Building Permit Designer.

For interfaces where Contractor has been assigned the role as Lead Interface Party, Contractor has a special responsibility for ensuring that all IR are completed in a timely manner, that regular interface meetings are being held and minutes of meeting are taken and distributed to the relevant parties. Company personnel shall be invited to all interface meetings.

Contractor shall seek resolution with Company for disagreement between contractors or decisions with contractual consequences. Company shall be given access to all interface documents and correspondence. For exchange/subscription on interface documents from other contractors, the interface document functionality in Company's document management system shall be used.

Each contractor has responsibility to manage own (internal) interfaces with its subcontractors. This is not a part of the Project's interface matrix, but Company shall however have access to this information.

A preliminary Interface Matrix between the EPC Contractor and T&I contractor is presented in Annex A1”

### **3.7.2 Deliverables**

- Interface management procedure (Contractor's).
- Detailed System Interface Matrix / Battery limit documents between Contractor and interfacing Parties, including need dates for interface information.
- Minutes of meeting from interface meetings.

## **3.8 Information and data management**

Contractor shall establish an information management function, including document control systems and procedures for administrative and technical documents. This also includes the use of Company's information systems, in accordance with Appendix D.

## **3.9 Information technology**

Contractor shall provide all required data equipment and systems to complete the Work according to requirements described in Appendix D and Appendix F.

## **3.10 Project control**

Contractor shall establish, implement and operate a project control system according to Appendix D covering the entire Work.

Planning principles, assumptions and expectations shall be documented.

## **3.11 Services to Company**

Contractor shall provide offices for Company, integrated with Contractor's project personnel, capability for network connection to the Company network, accommodation and related services for Company in accordance with Appendix D.

The Information Technology (IT) system provided shall support use of remote virtual inspections (RVI) and use of video meetings.

## **3.12 Provision of facility**

Contractor shall plan, provide, organise, maintain and operate the facility, as required for the efficient execution of the Work.

Facility means the Site and all property, offices, computer hardware, accommodation, Working Equipment, fabrication shops, plant, Temporary Works, and things of whatsoever nature provided by Contractor for the performance of the Work but excluding Materials and items forming part of the Contract Object.

Contractor shall pay due regard to the activity level and number of personnel in the various phases of the Work when planning and organising the facility.

## **3.13 Training of Company personnel**

Contractor shall identify necessary training for Company personnel which are required to operate and maintain the plant.

Contractor shall develop and provide training programmes and conduct the training in due time before handover to Company, in line with section 5.13. A training plan shall be established and delivered by the deadline agreed with Company. Contractor has the responsibility for involvement of relevant Subcontractor personnel as part of the training programmes.

The training activities shall include simulator training and participation in commissioning activities.

## **4 ENGINEERING**

### **4.1 General**

Contractor shall perform all engineering activities and processes required to enable completion of the Contract Object. This includes all engineering work to support procurement, construction, mechanical completion, commissioning, start-up and operation including temporary phases. Detail engineering shall have emphasis on preventing major accidents, personal injuries and work-related illness, and promote, high reliability, constructability, energy efficiency, robustness, operability and maintainability.

Contractor shall ensure effective management of HSE in detail engineering through multidiscipline collaboration, continual improvement regarding learning from relevant incidents and quality in safety reviews.

Contractor shall in addition to the deliverables listed in Appendix A, deliver all engineering Life Cycle Information relevant to the Work in accordance with TR2381. Contractor shall study and review TR2381 to understand the requirements.

The scope of the engineering deliverables shall be shown in a Master Document Register (MDR). The MDR shall be kept updated throughout the project and in accordance with the template and routines described in the Contract.

Contractor shall prepare and deliver all documents, drawings, registers and data in accordance with the requirements given in the Contract. Where standards are not specified, Contractor shall select an appropriate specification or standard, and this shall be approved by Company.

Contractor shall integrate Company Provided Items (CPI) into Contractor design and documentation.

3D model shall be basis for layout related design reviews for all disciplines.

Contractor shall secure integration of resources from critical /complex equipment Subcontractors in the early detail engineering phases to utilize Subcontractor's knowledge and to achieve the right mutual and aligned understanding of the design parameters and specifications.

Contractor shall establish and maintain engineering site organisations for handling of all engineering activities and participation in quality assurance throughout the Contract period. Size and location(s) of site engineering team shall be agreed with Company.

Contractor shall ensure internal multidiscipline cooperation and involvement in all deliveries. Construction and commissioning personnel shall be involved in detail engineering to promote solutions for efficient construction and commissioning phases.

#### **4.1.1 Technical queries**

Queries shall clarify technical issues:

- Queries shall not have any contractual impact.
- Queries shall not be a matter of deviation to requirements.
- Queries shall include proposed solution for the query.
- Queries cover clarification between Contractor and Company. The issue shall be discussed in advance with Company, and reference to Company's contact person shall be included in the query.
- Queries shall be issued through Company's tool for handling of queries.

#### **4.1.2 Engineering follow-up system**

A follow-up system shall be established, implemented and maintained by Contractor to enable proper documentation, handling, follow-up and close out of actions and recommendations from the various engineering activities such as discipline meetings, workshops and reviews.

The follow-up system shall give information about status, responsible person, corrective measures and due dates for implementation, and be used actively by all engineering disciplines. Contractor shall ensure that proposed closing of actions is aligned with Company.

#### **4.1.3 Engineering tools**

Contractor shall perform and document all required calculations and analyses to complete the Work. All such calculations and analyses shall be performed utilizing verified methods, algorithms, computer programs and models. Methods, algorithms, computer programs, databases with models and all other data which are required to rerun analyses shall be made available to Company in native, executable and unprotected format.

The application versions shall always follow the current version used by Company. Version or fix might change during a project.

Contractor engineering tools shall comply with the following, deviations to be agreed with Company:

- 3D CAD model – Aveva E3D
- 3D Management – Aveva Administration
- 3D model viewer – Navisworks
- Cable routing – STIDcablerouting
- CFD analysis – FLACS or Kameleon FireEx (KFX), PHAST (for coarse safety analysis modelling)
- Collaboration, queries and meetings – Fusion
- Correspondence and document review – PIMS DC, interface and correspondence
- Deviation/Concession handling – Fusion
- Electrical distribution information – STIDele
- Interface handling – PIMS Interface
- Loop diagrams (instrument, fire & gas and telecom) – STIDloop
- Master system for tags and documents – STID
- MC and commissioning – ProCoSys

- Noise and vibrations – Cadna (A and/or R) or SoundPLAN
- Pipe stress analyses – Caesar II FEM
- Reliability data – Oreda
- Standard documentation for equipment and materials – EqHub
- Structural analysis – SESAM Package, i.e., GeniE, Sestra, Framework etc. USFOS is recommended for non-linear analyses. Note: Latest available official program versions shall be used unless otherwise agreed with Company
- Thermal calculation of heat exchangers – HTRI
- Transfer of LCI data –TIE (Technical Information Exchange)
- Wind chill calculations including cold stress analysis – Contractor to propose

#### **4.1.4 Technology qualification**

All structures and systems design shall apply technology, materials and components that are qualified for the service in question both as stand-alone items and as an integrated system.

Any need for new or unproven technology, or proven technology used in new applications, shall be assessed and qualified through Company's formal technology qualification work process. Technology qualification and familiarisation plans to be agreed with Company before implemented in design. Company shall have unlimited access to tests and results if qualification tests are initiated and/or carried out.

#### **4.1.5 Certification Body approval**

All Work shall as a minimum comply with the Certification requirements.

Information of Certification Body (CB) will be announced later.

Contractor shall issue a plan for approval of documents and an inspection and test plan that fully reflects CB involvement.

Company shall be given access to all correspondence and be invited to technical meetings between CB and Contractor.

Contractor shall obtain all Permits, licenses and authorizations related to CB, including being fully responsible for the timely issuance of such approvals.

#### **4.1.6 Digital initiatives**

Digital initiatives will be applicable for the OSS and interface with ESI system provider are expected.

#### **4.1.7 Lifting appliances and lifting operations**

##### **4.1.7.1 General**

Contractor shall perform design, verification, fabrication, testing, commissioning and complete the certification of all lifting appliances prior to use. A Third Party shall be involved during all phases of the certification and CE marking process.

Contractor shall engage Third Party for design verifications, fabrication follow up, testing, commissioning, certification, and CE marking on all relevant loose or fixed equipment and

lifting appliances according to Laws, Regulation and Contract. The Third party shall be an enterprise of competence authorized in accordance with the national regulations where the lifting appliance shall be used.

The Work in sections above includes both temporary and permanently installed equipment and all kinds of lifting appliances during all phases of the Work both onshore and offshore.

#### **4.1.7.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381:

- Documentation and verification reports as required by Laws, regulations, and Contract shall be included in the delivery.
- WE and HF design reviews shall be performed for the offshore cranes. The WE/HF checklist for crane cabin/cabin chair shall be used.

## **4.2 Field Engineering / Global Engineering**

NA

## **4.3 Cyber security and network engineering**

### **4.3.1 General**

Cyber security shall be designed into the solution according to referenced standards and requirements documents defined in Appendix E, which gives a framework and guidance for how to apply the IEC62443 standard. As described in Appendix E, Contractor shall ensure that the self-assessment is performed and documented to cover all systems in Work. New requirements published but not necessarily enforced in IEC62443 and applicable cyber security laws and regulations shall be applied. All systems connected to Ethernet shall be assessed, designed and implemented according to the requirements and guidance in this framework.

Contractor shall work closely with Company and other package vendors to exchange relevant information for the IT/OT infrastructure. The Contractor shall facilitate and agree on external interface and services with others, such as information management system (IMS), interfaces with other SCADA systems, remote access, patching, antivirus, backup, NTP, FTP etc. All interfaces shall be subject for Cyber security risk assessments.

Contractor shall arrange the necessary workshops with Subcontractors to ensure the quality of the self-assessments from Subcontractors. Company shall be invited to participate in all such workshops.

Contractor shall identify and develop the necessary documentation within the IT/OT infrastructure and cyber security discipline to complete the Work. The following assessments and documents should be submitted, but not limited to:

- Risk and Vulnerability Assessment (RVA) report.
- Network, Security Zones and Conduit drawings shall be made by Contractor. The template for the drawing shall be provided by Employer. The contractor shall do a detailed criticality assessment and zones & conduits partitioning for each procurement package.
- The Zones and Conduit drawing shall contain Security Level-Targets substantively following the processes as set out by IEC62443-3-3:2019. The SL-Ts will be based on the Reference Architecture Model in IEC62443-3-3:2019 and the SL-Ts shown

therein and documented as a part of the topology drawing agreed between Company and Contractors/Suppliers. SL-T shall be evaluated and agreed upon between Contractor and Company.

- Cyber Security tests shall be a part of the Contractors and Suppliers' FAT procedure and report
- The Contractor shall conduct a detailed Cyber Security Risk and Vulnerability Assessment. A Detailed Risk and Vulnerability Assessment report shall be provided to Company. The assessment should follow the processes defined in IEC 62443-3-2. The actual achieved security level (SL-A) for a zone or conduit shall be documented.
- The Contractor shall create backups and test the backup and recovery procedures. Contractor shall throughout the Contract maintain regular software backups of all application software, settings and configurations, at least on a weekly basis. Company shall have the right to review the backup system and logs.
- Antivirus and patch management procedures shall be described. All systems, servers and clients, shall be tested to ensure that required antivirus and security OS patches are installed. All security patches, anti-virus and malware updates shall be maintained on a continuous basis.
- The Contractor shall make procedures and strategies for hardware, OS and software upgrades for all systems.
- Inventory details for components in scope.
- IP address plan.
- Firewall rulesets.
- Network switch configuration.

All proforma and confidential information/documents shall be shared/provided to an agreed Cyber site area, not via PIMS.

## **4.4 Technical safety**

### **4.4.1 General**

Contractor shall have the total responsibility for the safety design of the Contract Object. The needs for external studies shall be evaluated at an early stage of the Work and agreed with Company.

Contractor shall review the Contract Object to ensure that design accidental loads are kept on established levels. The timing for the review shall be agreed with Company.

Contractor shall perform or update the necessary studies, analysis and reviews, e.g., HAZID, which are required to complete and document the work.

Functional safety management work shall be limited as follows: When instrumented safety barriers are required to protect against severe safety, environment and /or business loss/asset consequence, components used in the instrumented barriers shall comply to predefined minimum performance level (SIL). The requirements are limited to the components, and not to the entire functions.

The functional safety documentation for the components can be limited to documented use of certified equipment and/or by safety manual from equipment vendor. SIL verifications may only include acceptance of safety manuals, and certificates, when relevant.

The number off, timing, and scope of reviews and HAZID shall be agreed with Company. Company shall be invited to participate in the system design reviews and HAZID.

For safety equipment installation interface with other relevant disciplines are required to ensure that supports are available and designed for the actual equipment.

#### **4.4.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381.

- HAZID
- Safety strategy
- Performance standard
- Fire segregation requirements: A heat load analysis of transformer fires to be delivered. The aim is to evaluate and document the possibility to use A-rated firewalls for the transformer areas and thereby optimize structure, passive fire protection and HVAC-design.
- Area classification source of release schedule
- Escape, evacuation, and rescue analysis/assessment
- Safety information posters; "Orientation plan" and "Fire and Safety plan".

### **4.5 Working Environment**

#### **4.5.1 General**

Contractor shall perform all engineering activities and processes required to ensure sound working environment and efficiency in the operation phase of the Contract Object.

The methods and level of documentation shall be agreed with Company.

Guidelines listed in App E are company preferred methods. Contractor shall be responsible for scope and delivery of any Subcontractor work found necessary for input to WE analysis. Selection of any Subcontractor and scope shall be agreed with Company prior to tender. The level of Company involvement in the follow-up shall be agreed with Company.

Verification of WE, including access in areas/ modules and to equipment during construction onshore and offshore, shall be part of the Contractor's audit and verification program according to Appendix D.

Documentation of all WE information/actions, risks and status shall be connected to tags and/or area codes.

#### **4.5.2 Technical working environment deliverables**

These deliverables are in addition to deliveries listed in TR2381:

Update technical working environment strategy and activity plan.

The activities shall be coordinated with the overall project's milestones and agreed with Company. The strategy and plan shall include the follow-up of procurement packages.

Project specific Working environment design checklist

The Project specific working environment design checklist for Equipment Packages (issued in FEED) shall be part of equipment purchase and shall be used in follow-up of equipment design and construction.

Working Environment Area Limits (WEAL) and Working Environment Area Charts (WEAC)  
Contractor shall update the WEACs /WEACs with any new areas and predictions and as-built status for WE factors continuously until handover to Company. WEALs shall be implemented in specifications for vendor packages.

Working Environment Health Risk Assessment (WEHRA)  
The FEED WEHRA shall be updated and be the basis for the detailed engineering. New input due to development and detailing of design shall be included. The need for detailed risk analysis shall be identified in the WEHRA.

Technical working environment design reviews  
Contractor shall perform WE 3D design reviews for all areas and equipment based on the WEACs and by using guidewords and the Project specific Access guideline completed in the FEED phase. The reviews shall be performed as iterative processes during the project phase until all secondary outfitting is completed in the 3D model. The frequency and participation for the reviews shall be agreed with Company. Company shall be invited.

Detailed risk analysis of relevant topics:  
Can include (but not limited to): Health hazardous substances, radiation, outdoor operations, indoor air quality, detailed ergonomic assessments, job hazards

Procedures for as-built measurements  
As built measurement procedures for noise, vibration, air changes, temperatures, illumination, non-ionising radiation including low frequency magnetic fields and concentration of CMR-substances shall be issued and agreed with Company.

As-built measurement reports  
As-built measurements for air changes, temperatures, illumination, non-ionising radiation including low frequency magnetic fields and concentration of CMR-substances in relevant work task areas, with respect to normal operation shall be performed. Company shall witness the as-built measurements.

Verification during construction  
Contractors shall perform regular WE verifications in verify areas/ modules and vendor packages to verify that the fabricated Contracted Object complies with all design requirement in the contract including implemented actions from the WE analysis. The WE verifications shall take place while rectification work is still possible. Special checklists shall be prepared for inspections purposes and shall be used to document the results and findings. Contractor shall notify Company when the verifications shall be performed and invite Company to attend the verifications

The content and the level of documentations shall be agreed with the Company.

#### **4.5.3 Noise and vibration control deliverables**

*These deliverables are in addition to deliveries listed in TR2381.*

Noise and vibration strategy  
The noise and vibration strategy shall be updated. The noise and vibration strategy shall describe the Project's approach on how to control noise and vibration to comply with requirements.

Noise prediction model  
The noise prediction model shall be updated.

The noise prediction model shall include all noise sources, piping, acoustic properties of the area, and reflection from adjacent equipment and structure as well as noise reducing measures.

The noise prediction model shall be used to determine equipment noise level limit for each individual equipment to comply with the area noise and noise exposure limits.

Pipe and valve noise shall be calculated and included as a noise source in the noise prediction model and adequate acoustic insulation class shall be specified and implemented in design.

#### Noise and vibration control report

A noise and vibration control report shall be updated.

The report shall give sufficient data and calculations to demonstrate that the acoustic design of the plant will comply with requirements.

The report shall document the noise control activities throughout the project including preconditions for calculations and selected solutions.

A vibration source review shall be performed in order to identify equipment requiring anti-vibration pads/supports. All noise and vibration issues potentially not in compliance with noise requirements shall be identified.

#### Verification

Contractor shall provide input to procedures, scope and verification plan for commissioning and final as-built noise and vibration measurements.

Contractor shall ensure that measurements are performed to verify compliance with requirements on noise and acoustics.

Verification measurements shall commence during mechanical completion and commissioning to reveal non-compliance issues, clarify site findings and make necessary corrections prior to sail-away.

Measurements during commissioning shall include:

- Airborne sound insulation and sound absorption in rest areas
- Sound level measurements of HVAC, restricted areas and intermittent equipment

For areas, systems and equipment where a representative noise level is not obtainable during commissioning, verification shall be carried out as soon as the installation is in normal operation.

### **4.5.4 Human factors deliverables**

Development of control suites, control cabins and safety critical workplaces shall follow design process and principles described in requirements. Control suites in this context means group of functionally related rooms, co-located with the control room and including it, which houses the supporting functions to the control room, such as related offices, equipment rooms, rest areas and training rooms.

These deliverables are in addition to deliveries listed in TR2381:

#### Human Factors (HF) strategy and integration plan

The document shall describe the design process, analysis, and activities to be conducted. A dedicated design group shall be formed, and include relevant technical disciplines, and representatives from Company.

#### Human Factors analysis report

Contractor is responsible for selecting appropriate Human Factors (HF) analysis and aligning this with Company. The analysis shall be facilitated and documented by Contractor's human factors specialist. Factors that shall be assessed include job organisation and functional allocation, HMI design, alarm management and working environment. Task analysis shall be used to define requirements to functionality, layout and

arrangement, and Human Machine Interface (HMI) and alarm system requirements. Assessment of safety critical tasks and operational barrier elements shall be conducted as input to safety strategy. Other methods or further need for quantification of safety critical tasks shall be selected in cooperation with Company.

#### Control suite design specification

The human factor design specification shall be updated, defining requirements for layout and arrangement, and configuration of human machine interfaces, including operators' stations, large screen, critical action panel. Engineering disciplines and operations shall be aware of human factor issues and requirements identified in analysis and implement these in design.

#### Verification and validation:

Verification and validation of control suites and human machine interfaces shall be conducted, based on accepted methods and standards.

## **4.6 External environment**

### **4.6.1 General**

Contractor shall identify and carry out required activities to ensure that all systems and equipment are designed to operate with a minimum of environmental impact and with optimised energy consumption and efficiency. Assessment and implementation of Best Available Technology (BAT) shall be the overriding principle according to requirements in Appendix E. The environmental budget shall be used in all technical evaluations to ensure that environmental aspects are included.

External environment shall be part of the engineering HSE activity plan covering the scope of work and related deliverables. The scope of activities shall be proportionate to the nature and scale of the environmental aspects of the Contract Object.

### **4.6.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381:

#### Environmental aspects identification, assessment and reporting

Contractor shall review and update the assessment of significant environmental aspects from the FEED phase, related to the remaining design options/solutions and equipment selections of the Contract Object.

The impact assessment commitments register, shall be included in the review to verify that all design related commitments are implemented.

#### Environmental budget

The FEED Environmental Budget report shall be reviewed and updated, reflecting design developments and changes that could have an impact on the environmental performance of the system/technique/equipment.

#### Best Available Technology BAT)

The FEED BAT report shall be reviewed and updated, reflecting design developments and changes that could have an impact on the environmental performance, including energy optimisation, of the system/technique/equipment.

#### Waste management plan

A waste management plan shall be developed for the Contract Object

## **4.7 Process and utility system design**

### **4.7.1 General**

Contractor shall perform process design for all systems and shall have the total responsibility for process design of the Contract Object, including drain, cleaning water, diesel system, chilled water and condensed water system.

Contractor shall have an overall system responsibility of the interfacing systems. By overall system responsibility means that Contractor shall verify and secure the overall system consistency, integrity, and operability. Engineering activities planned for verification of such systems will include, but is not limited to; dynamic system analysis, process simulations (static and dynamic), pressure drop calculations, frost protection analyses.

Contractor shall perform system design reviews for all relevant systems at an early stage of detail engineering and shall be documented and closed out. The basis for the reviews shall be PFDs, Utility Flow Diagrams (UFD's), process safety schematics and P&IDs. The reviews shall be executed prior to process HAZOP. All findings, comments and actions from the system design reviews shall be documented and closed out prior to process HAZOP.

Contractor shall perform process HAZOP for all relevant systems. Relevant documents as agreed with Company shall be available for Company minimum 14 days before start of HAZOP. The HAZOP shall be carried out in due time to allow follow-up and close-out of actions before P&IDs are issued for construction. HAZOP findings, comments and actions shall be closed out progressively in the period after HAZOP and Contractor shall provide a status on the progress of closure at regular intervals. All close-out actions shall be agreed with Company. The HAZOP shall be led by a 3rd party.

The number, timing and scope of system design reviews and HAZOP shall be agreed with Company. Company shall be invited to participate in the system design reviews and HAZOP.

API RP 520 shall be used for PSV dimensioning. Relevant relief scenarios shall be evaluated and the dimensioning scenario shall be described.

A design, system performance verification, operation and maintenance strategy document, shall be established and implemented to ensure proper operation of safety critical heat conservation and heat tracing.

Contractor shall perform line sizing according to NORSOK P-002 and document this in a line sizing del

Process discipline shall communicate closely with HVAC discipline regarding interfaces with chilled water, condensed water and cleaning water system.

For the process discipline work, the contractor shall have interface work with (but not limited to) the high voltage equipment contractor and SOV/CTV contractor (if relevant).

### **4.7.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381. All deliveries shall be delivered in both native format and PDF.

- System design review report
- System design review close-out report
- HAZOP Terms of Reference (to be delivered prior to HAZOP)
- HAZOP report

- HAZOP close-out report
- Line list
- Hydraulic systems calculations, according to NORSOK P-002
- Safety critical heat conservation and -heat tracing document
- Process Flow Diagrams (PFD)s
- Data sheets – Process
- Process system engineering manuals

## **4.8 HVAC and sanitary systems**

### **4.8.1 General**

Contractor shall perform overall HVAC system design, procurement and installation for the Contract Object. Contractor shall perform HVAC system design and shall take responsibility for the required system capacities. Contractor shall perform necessary reviews and establishment of specifications and equipment type selections. Contractor shall review and follow-up equipment selection impact on layout and material handling.

In Electrical, Instrument and Telecom (EIT) rooms, equipment heat losses shall be estimated based on Subcontractor datasheet.

If the layout of EIT rooms considers the future installation of additional equipment, spare capacity in the main HVAC system or available area for new cooling equipment, shall be evaluated and clarified with Company.

For cooling plant systems, low GWP (Global Warming Potential) refrigerants shall be considered, and final solution shall be approved by Company.

HVAC discipline shall give input to Process discipline regarding cooling system design. There shall be close communication/interface between HVAC and Process disciplines during engineering and construction to ensure that correct cooling capacities and system design is obtained.

HVAC discipline shall communicate closely with Process discipline regarding interfaces with cleaning water solution.

HVAC discipline shall give input to and cooperate with Safety discipline regarding analysis of optimized fire rating of transformer room walls and penetrations.

HVAC discipline shall communicate and coordinate with Electrical and Structural disciplines with regards to design and installation of all necessary duct supports, indoors and outdoors. Contractor is responsible for calculation and dimensioning of supports that can withstand all external forces, loads, and accelerations during construction, installation, transportation, and operation.

Contractor shall have scope responsibility to interface with all relevant contractors (including but not limited to ESON, building permit, certification body, equipment suppliers, SCADA) to exchange relevant information and data to complete detail design.

### **4.8.2 Plant specific design**

- Louver with vertical lamellas for all air inlets both for mechanical and natural ventilation inlets.

- Solution for fire dampers to allow for remote testing without risk of shutdown in case of failure.
- System for collecting condensed water in main air handling units connected to pipes leading to cleaning water tank

### **4.8.3 Deliverables**

These deliverables are in addition to deliveries listed in TR2381.

- Equipment Heat Emission must be issued monthly during detail phase to catch up changes in heat emission as vendor gets confirmed data. Calculation report documenting expected room temperature rise in all operational scenarios shall be included.
- Updated Computerised Fluid Dynamics (CFD) analyses report to document optimal location of air intake/exhaust, to prevent contamination and minimize influence of variable weather conditions.
- Updated CFD analyses report for mechanical ventilated areas where contamination, draught and/or temperature will be a challenge.
- Updated CFD analyses report for naturally ventilated areas that document sufficient ventilation and temperatures in naturally ventilated rooms.
- HVAC workmanship document that describes in detail the fabrication and installation of ductwork (including inspection doors and other relevant accessories) and in-line equipment.
- Procedure detailing how ductwork is kept clean and free of dust/dirt during construction. Acceptance criteria according to ISO15138 table B.3. Cleaning class “high” shall be achieved, documented with test method gel tape type or similar.
- Ductwork leakage test procedure.
- Ductwork cleanliness test procedure.
- Access design of Air handling Unit:
  - This document shall be issued before construction of AHUs are started and shall be basis for a review prior to start construction.
  - Description of general access and access to components requiring inspection, maintenance, replacement.
  - Location and sizes of hatches/doors for inspection and maintenance of components.
  - Description of necessary components, wall panels, cable trays etc needed to be dismantled to facilitate changeout or maintenance of components.
- FAT procedures. Note: Procedure shall include leakage test and be reviewed and approved prior to FAT

## **4.9 Electrical**

### **4.9.1 General**

Contractor shall perform all activities necessary to design and engineer the complete auxiliary power system with battery limit at the low voltage side of the Earthing Auxiliary Transformers (EAT) delivered by ESON contractor.

Contractor shall perform design for all cables pulling and routing between HV & MV and LV electrical equipment including all associated cable support systems and labelling/markings of all cables and shall maintain the complete and updated cable documentation for all cables. This is included but not limited to:

- Duresca busbar system between 66 kV GIS and 380 MVA transformers and ensuring busbar system type tested at 4000 A.
- Two 66 kV cables between EAT and 66 kV GIS
- Ten Topside flexible cables and associated pluggable joint.

Contractor shall have scope responsibility to interface with all relevant contractors (including but not limited to ESON; Export cable; Inter array cable; WTGs, building permit, Certification Body) to exchange relevant information and data to complete the detail design.

Contractor shall develop further layout design for the protection and control cabinets for the HV and MV GIS rooms.

Contractor shall optimize battery room design if it is required (including but not limited to weight and space utilization, low maintenance requirements and long lifetime) based on the evaluated and chosen battery type (SMC) in FEED phase.

Contractor shall be responsible to update design information related to the SMC battery type, submit and align alternative design to the building permit design contractor. Contractor shall be responsible for establishing and applying application to relevant Ministry of Climate and Environment. The application shall contain alternative design solution (including but not limited to battery location, battery room ventilation design and fire/explosion protection measures) to be used that is deviating from Polish act.

Contractor shall perform all relevant studies and calculations to confirm the system design and selection of Materials.

Contractor shall incorporate Company's Materials into the electrical system analysis and studies to secure a complete functional and documented electrical power system for the Offshore Substations.

Contractor shall perform an ELHAZ (Electrical Hazard Review), follow-up, close-out and implementation of all action items, including actions from FEED phase ELHAZ which is performed by OSS and ESON FEED contractor. Company and other relevant parties shall be invited to participate in the ELHAZ. Relevant documents as agreed with Company shall be available for Company minimum 14 days before start of ELHAZ. A close-out report shall be prepared. All close-out actions shall be agreed with Company

#### **4.9.2 Deliverables**

Contractor shall identify and develop the necessary documentation within the electrical discipline to complete the Study, these deliverables are in addition to deliveries listed in TR2381 including but not limited to:

- Electrical load study including HV, MV and LV loads
- Earthing and Lightning protection studies
- Arc flash hazard study and calculations
- Data sheets – noise
- EMC and EMF study
- Overall single line diagram (LV) with Arc flash data
- MTO for electrical bulk

- Heat Trace Philosophy (if it is needed)
- Lighting study
- Lighting and small power design philosophy
- Single line diagram of LV system including EATs
- Electrical LV design basis
- LV electrical system operation and control philosophy, including interlock procedure
- ELHAZ assessment report

## **4.10 Automation and instrumentation**

### **4.10.1 General**

Contractor shall perform Safety and Utility automation Systems (SUS) detailed engineering for procurement, construction/installation, testing, MC and preservation and interfaces according to requirements given in Appendix E.

Contractor shall deliver and install a fully functional SUS including all required interfaces.

Contractor to identify and secure all interfaces.

Contractor shall install all Contract Objects and ESON contractor equipment including network, WTG equipment, Company provided items (i.e., DTS), metering and power quality equipment and TSO equipment. Contractor shall also purchase, deliver and install cables for these systems. Contractor shall hook up, MC, preserve and test these systems.

Contractor shall organize and participate in interface meetings, design meetings, HAZID, HAZOP, Human Factor studies (HMI) and other relevant studies.

The SUS shall include the following functions/subsystem, but not limited to:

- SAS Node
- Emergency shutdown (functions)
- Fire detection (FiDe) system and equipment
- Firefighting (FiFi) systems and equipment (automatic and portable)
- Heat, ventilation, and cooling (HVAC) system
- Crane
- Process system including
  - Diesel system
  - Cleaning water system
  - Drain system
- PDCS systems
  - Low voltage power control/Power management system (PMS)
  - UPS system
  - Diesel generator
  - Monitoring equipment on substructure

Contractor shall engineer necessary interfaces between SUS, ESI SCADA, other relevant sub-suppliers/contractors and disciplines to ensure overall consistency, integration, and compatibility of automation equipment.

Contractor shall liaise with and shall secure required design and interface information from the contractors/suppliers for required design and provide required interface information and documentation to the ESI SCADA system contractor.

Contractor is responsible for the overall design of the safety functions including delivery of Safety Requirements Specifications (SRS) for Fire/protection and emergency shutdown functions and that the design is compliant with Contract Requirements and Appendix E.

Contractor shall arrange necessary design reviews with Company to determine relevant signals to be included for the SUS system/packages towards ESI SCADA and condition monitoring system (CMS) / information management system (IMS) to ensure that all necessary data for efficient remote operation and condition-based maintenance is accessible.

Contractor shall assess the requirements and give recommendation for standardization and limit types and numbers of PLC/controllers.

There shall be a separate SAS node/PLC containing function for handling of all interaction/trips between the different SUS system nodes.

Contractor shall have the overall design and interface responsibility for including necessary function/logic in the dedicated SAS PLC/nodes and PMS node for handling function and interfaces for interaction/trips between the SUS system nodes based upon Function Design Specification/Logic drawings from the sub-suppliers. Contractor shall make System Control Diagrams according to IEC PAS 63131:2017. The SCD's shall be made per process system and supported by a functional specification.

The acceptance testing shall be carried out in these stages:

- FAT
- Site Acceptance Test (SAT)
- Redundancy and Final Capacity Test (RFCT)
- Integration test

Company shall be invited for physical witness and in addition remote witness shall be facilitated:

The SAS PLC/nodes shall be up and running for enabling interface testing for these interaction/trip in due time before FAT of each system.

SUS shall be available by remote access in construction and commissioning phases.

All signals included in signal lists from the different packages shall be issued for review.

Contractor shall accommodate requirements set forth by ESI SCADA and perform all Work required for full implementation of SUS in ESI SCADA human machine interface (HMI).

Contractor shall establish a complete signal budget, for all equipment interfaced and integrated in the overall industrial automation and control system (IACS). The budget shall be kept updated by Contractor during the Contract period.

Contractor shall identify and develop all documentation within the automation discipline to complete the Work, including all documentation required in Appendix E.

Contractor shall document mean time to failure (MTTF), mean time to repair (MTTR) and lifetime expectancy for all Materials and perform and deliver a RAM analysis of SUS systems.

Company's change management tool, ProCoSys, shall be used for SCADA/SUS change management from the time of hardware freeze and software freeze for the respective systems. All loop/signal testing at site, shall be performed and documented in ProCoSys by Contractor.

#### **4.10.2 Infrastructure design and cyber security (IT/OT)**

Contractor shall work closely with Company and exchange relevant information to accommodate for Company network infrastructure on the Contract Object and to secure interface from automation and telecom systems to Company IT services, such as information management system (IMS), remote access, patching, antivirus, backup etc., and/or via ESI SCADA.

Contractor shall provide necessary information to Company regarding network requirements towards Company networks, i.e., number of ports, wireless access points, network routing, firewall openings, enabling Company to procure and deliver network components for administrative (office) and technical access network referred to in Appendix G. Contractor shall request necessary information for installation of these components in Contractor's cabinets.

Contractor shall have dedicated resources for Cyber security design for follow up of Cyber design towards ESON contractor and sub-suppliers.

#### **4.10.3 SUS integration testing towards ESI SCADA and other Equipment Packages**

Contractor shall identify and define necessary integration test towards ESI SCADA and other equipment packages.

Contractor shall deliverer relevant integration test procedures with input from relevant suppliers and ESON contractor.

The following integration testing shall be performed but not limited to:

1. Testing of communication links including protocols between Equipment Package and ESI SCADA
2. Testing of signals and relevant functions towards ESI SCADA HMI
3. Testing between equipment packages, i.e., fire and emergency system, HVAC, Diesel system, PMS

#### **4.11 Document deliverables**

These deliverables are in addition to deliveries listed in TR2381:

- Plan for all Automation deliverables and testing
- Functional Design Specification (FDS) for SAS node
- SUS specification including description of interfaces and systems
  - Detailed network drawing
  - Detailed VLAN network drawing
  - Update/develop specifications to sub-suppliers in line with Company requirements

- SRS, Safety requirements specification
- Factory Acceptance Test Procedures
- Integration Test Procedures
- Site Acceptance Test (SAT) Procedures.
- Redundancy and Final Capacity Test Procedures.
- Input to ESON integration test procedures
- Cable routing (Telecommunication and Automation cables)
- Condition monitoring system specification
- Interface matrix
- Interface documentation

## **4.12 Metering**

Power Quality Metering for 220kV and 66kV 6 incomer from IAC and 2 primary side of the 220/66 kV main power transformer shall be delivered by ESON contractor. The cabinet (metering equipment included) shall be installed, MC, hook-up, connected to metering network and tested by OSS EPC Contractor.

Dynamic System Monitoring for 220kV and 66kV shall be delivered by ESON contractor. The cabinet (equipment included) shall be installed, MC, hook-up, connected to metering network by OSS EPC Contractor

The cabinet of Energy settlement metering shall be prepared for by ESON Contractor as required.

## **4.13 Telecom**

### **4.13.1 General**

OSS Contractor is responsible for the local domain incl. telecommunication field and area design.

OSS Contractor shall work closely with ESON Contractor to ensure holistic design and incorporate global requirements with consistent performance.

OSS Contractor shall integrate in design and ensure provision of all required facilities like space, power and cabling for main telecom system components located on OSS and engineered and supplied by ESON Contractor.

OSS Contractor shall identify other discipline system requirements to the telecom infrastructure.

OSS Contractor shall perform necessary clarifications towards authorities, Certifying Authority and Company to verify the design.

Contractor shall secure any necessary interface issues between individual subsystems. This is to assure compliance and consistency with all telecommunication systems.

OSS Contractor SoW shall include requirements from Ministry of National Defence and Ministry of Internal Affairs PL given in Technical Expertise report project documents (C274-PM-Z-RS-00007, C275-PM-Z-RS-00007, C274-PM-Z-RS-00009, C275-PM-Z-RS-00009, C274-PM-Z-RS-00013, C275-PM-Z-RS-00013).

Following telecommunication system shall be considered as additional SoW due to requirements given in radio expertise and military expertise:

- Sonar Transponders as a part of hydroacoustic reconnaissance system to avoid collisions with submerged submarines
- 'X' band radar with antenna system to identify flying objects in the vicinity of the wind farms
- Land-Ship communication (VHF Marine Radio), 300 MHz and 512MHz band, to be installed on OSS
- Ground to Aircraft Communication (VHF Aeronautical Radio), 225MHz and 400MHz band, to be installed on OSS

As optional scope, OSS Contractor shall include design and installation of Bird Monitoring system. The system shall provide monitoring and detection of bird activity in the vicinity of the installation and data collecting for analyzing purpose.

#### **4.13.2 Deliveries**

The documentation deliverables shall be according to TR2381 LCI requirements substitution for Wind.

Additional to that following documentation to be delivered:

- Update the telecommunication philosophy
- Develop the technical and functional telecommunication specification per system
- Provide documentation for Company's communication with relevant authority in cooperation with Company
- Any temporary telecommunication systems, interfaces and communication links shall be documented and provided. This includes temporary equipment on other facilities and sites and shall apply for all project phases.
- Contractor shall identify and describe all required interface between telecom systems and telecom systems on other facilities and sites, both offshore and onshore. SOW split / battery limits to be documented.
- Contractor shall document and perform all cross-wiring and data/telephone patching within the central equipment frames/cabinets
- Contractor shall update calculations for telecommunication systems with area coverage requirements and system capacity calculations: GA coverage calculation, CCTV coverage and system capacity. Additional to that OSS Contractor shall provide a inputs for Calculation to be done by ESON Contractor or Company: UHF/VHF system coverage, LTE/4G coverage, WiFi LAN coverage and FO cable link budget calculation.

Contractor shall install and MC and preserve ESON Telecom delivered equipment and CPI's.

Contractor to supply and install Optical junction boxes for the IAC's and EC's. The optical fibres (including spare fibres) from IAC's and EC's shall be spliced and tested. Location of the optical junction boxes shall be discussed and confirmed with Cable Contractor.

## 4.14 Piping and layout

### 4.14.1 General

Contractor shall develop the facility layout and piping design and shall have the total responsibility for area and piping design of the Contract Object and in accordance with requirements Appendix E for Piping and Layout design.

Contractor shall ensure all necessary detail information about equipment, interfaces and components from sub-suppliers and other contractors to complete the design.

Contractor shall have the scope responsibility to interface with all relevant contractors and sub suppliers.

Multidiscipline 3D model design reviews shall be carried out by Contractor, to validate the maturity, functionality and quality of the design and to verify compliance with relevant technical requirements.

The number, timing and scope of reviews shall be agreed with Company. All findings / actions from the 3D model design review shall be documented in and all items shall be closed out at completion of detail engineering. Actions shall be closed out progressively in the period between reviews (and after the final review) and Contractor shall provide a status on the progress of closure at regular intervals.

Contractor shall define piping test packs and construction and commissioning boundaries in the E3D model.

Discipline shall provide input to the tie-in register ensuring that all tie-ins and hook up piping is uniquely numbered and that it is correctly identified in the 3D model and on drawings.

Contractor shall, throughout the duration of the project, advise Company in good time should any additions and/or revisions of the piping and valve material specification be required.

Due to new established TR2000 and change of pipe class sheet names, all line numbers shall be changed accordingly.

| PCS from FEED | New PCS name<br>TR2000 Baltyk | Material |
|---------------|-------------------------------|----------|
| AD200         | AD120                         | DX       |
| AD750         | AD230                         | SDX      |
| AS200         | AS330                         | 316      |

The line numbers shall also be updated with the insulation code according to TR0052

This applies to the P & IDs, line list, piping isometrics, the 3D model and all other databases or places in the documentation where line numbers are referred to.

### 4.14.2 Deliverables

These deliverables are in addition to deliveries listed in TR2381:

- Piping isometrics
- Stress isometrics
- Critical line list

- Data sheet spring support if any
- Pipe stress calculations
- Project Pipe support standard
- Piping MTO for all sized piping. The MTO shall be traceable by reference and line number

#### Piping isometric

The piping isometric shall be arranged such that it gives a clear readability.

The piping line shall be split into reasonable large sections such that the drawing is not too crowded and at the same time avoid unnecessary small sections.

The following information shall be included:

- Position numbers for each piping item.
- Weld locations and numbers (field welds to be identified).
- Flow arrow
- All inline equipment and instrument connections with tag numbers
- Special items with coding
- Dimensioned pipe support locations and support numbers including spring supports, etc.
- Penetrations
- Penetrations, with ENS tag number
- Dimensions (including slope if relevant)
- Reference to connecting isometric drawings
- Reference to attached equipment with tag number and nozzle number • Bill of material including position numbers
- Line number (according to ENS)
- Design pressures and temperatures
- Pressure test requirements
- NDT requirements • Insulation requirements
- Heat trace requirements
- Surface treatment and top coat colour requirements
- Service colour coding requirements
- Post weld heat treatment (PWHT) requirements
- Chemical cleaning requirements
- Pressure directive (PED) category (for EU countries)
- Critical line and reference to Stress ISO no.
- Reference to P&ID
- Area code
- Material type

- Dry weight, wet weight (content) and CoG NOTE: For equipment packages where the amount and size of piping is moderate, or the piping might be mostly for support functions (cooling, lubrication, drain etc.), piping isometrics from the manufacturer are not necessary. For large packages with a considerable amount of larger piping, isometrics for the main piping should be delivered. Selection should be done early in the project.

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#### Piping Stress Isometrics

Piping stress isometrics shall be provided for all lines for which stress calculations or evaluation have been made, and include the following information:

- Line number
- Process data (temp. and pressure)
- Valve weights
- Equipment nozzle loads
- Stress summary
- Reference to P&ID Requirements:
- Restraint loading and displacement • Spring summary
- Calculation No.
- Separate document no with revision code on each stress iso (not stress report number) Special supports, typical: gap, adjustable, PTFE • Equipment nozzle with tag no
- Pipe specification break
- Reference to adjacent isometric drawings
- Special items
- Penetrations
- Pipe stress report no
- Dimensioned pipe support locations and support numbers including spring supports, etc.
- Node numbers from calculation model (as a minimum for each pipe support, valve, equipment nozzle, interface to other lines/sheets/isometrics and location for max utilization)
- Support function

NOTE: For equipment packages where the amount and size of piping is moderate, or the piping might be mostly for support functions (cooling, lubrication, drain etc.), piping stress isometrics from the manufacturer are not necessary. For large packages with a considerable amount of larger piping, piping stress isometrics for the main piping should be delivered. Selection should be done early in the project. Milestone LCI 1 Handover format DGN/DWG (TR1970)+PDF

#### Critical Line List

The stress critical lines shall be listed in the document. Critical lines are defined in TR1951. The list shall include:

- Line number

- Stress ISO document number (typically referenced on piping ISOs/support drawings)
- Pipe size
- Pipe class
- Service
- Max design temp
- Min design temp
- Design pressure
- PED category (applicable for installations that require conformity with Pressure Equipment Directive)
- P&ID document number
- Pipe stress report document number
- Piping stress isometric drawing number

Milestone LCI 1 Handover format DOC + PD

#### Data sheets - Spring support

A data sheet with technical information to the supplier shall be provided for each spring support assembly or damper/shock absorber. The data sheet shall include all the information necessary for the manufacture and supply of the assembly:

- Project name
- Manufacturer
- Line number
- Spring support assembly tag number
- Operating load (not relevant for dampers/shock absorbers) • Installation load (not relevant for dampers/shock absorbers)
- All ancillary items such as rods, turnbuckles, beam attachments etc.
- Supplier catalogue reference to type, figure, & size of spring/damper, etc. Note: The data sheet shall explain that installation load applies to each spring for double spring assemblies.

Milestone LCI 2 Handover format DOC + PDF

#### Pipe stress calculations

Electronic input files for pipe stress program to be delivered for each calculation no.

NOTE: For equipment packages where the amount and size of piping is moderate, or the piping might be mostly for support functions (cooling, lubrication, drain etc.), pipe stress calculations from the manufacturer are not necessary. For large packages with a considerable amount of larger piping, pipe stress calculations for the main piping should be delivered or optionally retained. Decision/selection should be done early in the project.

Milestone LCI 2 Handover format ZIP

#### 4.14.2.1 Layout and piping design

Layout and piping design shall be in accordance with TR1951, TR2323, TR2324, TR2320 and TR2325.

Contractor is responsible for the complete design of the Contract Object, including temporary equipment and loose items like material handling aids and large tools.

Contractor shall optimize the layout and routing of piping, tubing and cables for an operation and maintenance friendly design.

##### 3D CAD model

Contractor shall further develop/update the 3D model to fulfill requirements in TR2231.

Contractor shall ensure all necessary detail information about equipment, interfaces and components from sub-suppliers and other contractors to complete the design and shall take the lead position and coordinate all Global 3D model interface activities. Contractor shall integrate 3D models from other contractors and subcontractors into the 3D Global model to ensure compatibility during all phases from engineering to construction and as-built.

Contractor shall upon request provide reports from the 3D model.

Contractor shall perform regular clash and constructability checks in the 3D model

The model shall be used to extract construction and as built information. The final 3D model shall be clash free and shall present a true digital twin of the as-built Contract Object.

#### 4.14.2.2 Material handling

Material handling shall be in accordance with TR2324

##### Crane study report

Contractor shall further develop the crane study report. The full content of the report is to be agreed in advance with Company.

##### Material handling study

Contractor is responsible for delivery of Material handling report for all equipment that can be part of maintenance or repair in the operation period. Handling of the temporary equipment shall also be part of the document.

Material Handling report and individual Material Handling Data Sheets

Contractor shall do necessary updates of FEED design also relevant for Material handling.

Contractor shall make a Material handling that secure a correct function, correct system engineering and correct material handling also for interfacing Contractors, include Operation phase of the OSS. If all- electric platform crane: Contractor to assess the use of the walk-to-work area NE at cellar deck as lay down area for a 10 feet container landing with total weight 5 T. That includes but not limited to space, structural capacity, bumpers, access for people and access to SOV gates. Pipe stress

Contractor shall perform stress calculations for piping systems in accordance with ASME B31.3 and TR1951

The pipe stress analysis shall give due consideration to slugging and acoustic, and flow induced vibration where these are identified as being likely to be encountered.

#### 4.14.2.3 Pipe support

Pipe support design shall be in accordance with TR2320.

Field supporting of non-critical smallbore pipes is not acceptable unless with a written approval by company

Pipe support detail standard

Contractor shall provide a pipe support detail standard for the project.

The standard shall be submitted to Company for review at start of detail engineering

- Spring support data sheets.

#### 4.14.2.4 Piping Engineering

##### Piping and valve material specification

Contractor shall select pipe classes from TR2000 to achieve the most cost optimal pipe size, wall thickness and material combinations, and shall identify and advise Company in due time if additional pipe classes are required or if there is a need for changes to piping classes already established.

Piping specification in mechanical packages or system modules shall be according to TR2000. However, for equipment where it is unreasonable to use this specification, the supplier may request a deviation. The deviation can only be implemented after acceptance. Deviation request shall include details enabling Company to evaluate if the alternative solution shall be included in TR2000.

Piping classes for all piping shall be concluded at the start of the detail engineering. Contractor shall review and verify the need of adjustments and / or additional piping and tubing classes and valve data sheets to cover specific requirements within each system. Company's TR2000, ref appendix E, shall be used for piping, tubing and valve datasheets.

Any changes or additions to TR2000 Baltyk shall have a written approval from Company before proceeding.

Due to new established TR2000 and change of pipe class sheet names, all line numbers shall be changed accordingly. The line numbers shall also be updated with the insulation code according to TR0052

This applies to the P & IDs, line list, piping isometrics, the 3D model and all other databases or places in the documentation where line numbers are referred to.

##### Piping special item list

Contractor shall develop and make available a list that covers piping special items introduced as a result of the scope.

##### Piping special item data sheets

Contractor shall provide data sheets for listed piping special items

##### Piping component calculations

Contractor shall provide documentation of calculations (supplied by vendors) for components that, based upon experience, are not standardized e.g., weldolets, nipo flanges specific special items etc.

The range of components that shall be subject to this requirement to be discussed and agreed with Company.

Site run of smallbore pipes 2" or less is not acceptable unless with an written approval by company.

Tubing as a replacement for piping or tubing used as an alternative to small bore piping 2" or less the following shall apply:

Tubing shall not be used on pressurised HC system.

All tubing used as replacement for piping shall be defined with piping line number.

The tubing used shall be defined in the TR2000 piping class sheet

#### **4.14.2.5 Hoses and couplings**

Hoses and coupling design shall be in accordance with TR1803

### **4.15 Mechanical**

#### **4.15.1 General**

Contractor shall perform overall Mechanical system design, procurement and installation for the Contract Object. Contractor shall perform necessary reviews and establishment of specifications and equipment type selections. Contractor shall evaluate and review equipment selection impact on layout, operation/maintenance/service and material handling. Contractor shall secure correct interface handling so the Equipment can operate safe, with correct function and as a part of a system.

The equipment specifications developed in the FEED study (by Rambøll) shall be used as information for the EPC Contract. But Contractor needs to clarify interfaces still not solved in FEED documentation, to secure that the equipment can be used as intended, as a part of a system.

Note: An assessment shall be provided for selection of type of platform crane ref. "Offshore Crane Design and Functional requirements" chapter 3.1, and use of north east laydown/walk to work area at cellar deck for hook on/off a pendant wire if all-electric crane is selected. The selection shall be approved by Company.

The mechanical design and equipment selection shall have focus on safety standard, high reliability and energy optimization.

Input to piping/layout regarding material handling requirements for equipment shall be provided.

#### **4.15.2 Deliverables**

The Scope of work for Contractor's Mechanical discipline in the detailed engineering and Construction phase shall include, but not be limited to, the following activities and equipment deliverables:

Specify, procure, permanent install, certify and test onshore following equipment:

- Diesel System and Diesel Generator:
  - Diesel hose reel
  - Diesel storage tank skid
  - Diesel transfer skid
  - Diesel generator
  - Diesel day tank (part of Diesel Generator skid)

- Pollution prevention system:
  - Sump tank
  - Sump tank pump
  - Oil/water separator
- Cleaning water system:
  - Cleaning water tank
  - Cleaning water pump
  - Cleaning water pipe distribution
  - High pressure portable washers
- Lifting Equipment:
  - Main platform crane
  - Electric davit cranes
  - GIS room cranes/hoists
  - Jib cranes
  - Ultra low headroom monorail hoist (cable deck)
  - Other Material handling equipment
- FES - Foam, and Inert Gas system
- Storage cabinets and welfare equipment
  - Cabinets for small parts, tool kits, hazardous substances and welfare articles.
  - Incinerator type toilets, beds, emergency shower, mechanical work bench and other welfare equipment listed in MEL.
- Temporary install, but delivered by an interfacing Contractor or Company:
  - Cable Pulling Winch by Marine Operations Contractor (Clarify if it is same winch for Export- and IA-Cables.)
  - Temporary Diesel Genset and other equipment for Cable pulling operation
  - Temporary 10 feet Containers (Roof deck)

Document deliverables to be provided are listed in general in TR2381 (Appendix E).

Update Master Equipment List (MEL):

The document shall be updated in a multi-disciplinary process with the objective to ensure data quality and maturity during all project phases.

The Subcontractor data in MEL shall reflect the current design. MEL shall, for all disciplines, include all tagged equipment items, except for bulk equipment and in-line tagged items such as instruments and valves. MEL input shall be based on Subcontractor's information. Changes from previous versions of the MEL shall be clearly identified and tracked.

The MEL shall under the entire Project phase be kept updated and presented alongside the weight report monthly. The MEL shall be provided in an editable electronic spreadsheet format. Template provided by Company shall be used for this purpose and shall not be modified other than adding additional columns after "column BC" if needed.

Equipment specifications:

Contractor shall compile and prepare equipment specifications for Mechanical equipment that will be custom made and is not a regular stock item.

The equipment specifications shall include Company's general technical requirements and installation specific requirements. In addition, project specific requirements, and results from FEED study and Contractor's detail engineering work shall be included such as, but not limited to:

- Equipment capacities and design requirements
- System functional requirements
- Environmental loads
- Noise and vibration
- Size and Weight limitations (if any)

Equipment data sheets:

Contractor shall prepare equipment datasheets for all tagged permanent Mechanical equipment, and "Lifting equipment datasheets" for lifting equipment. The datasheets shall be prepared in a format agreed upon with Company. For temporary equipment for rental, standard vendor documentation is sufficient.

Technical input to purchase orders:

Contractor shall compile and prepare all necessary technical documentation required for Contractor to issue purchase or rental orders in the detail engineering phase for Mechanical equipment.

Risk assessment and CE marking:

Contractor shall perform risk assessment and design reviews of new and temporary mechanical equipment. Requirement for CE marking shall, where applicable, be stated.

Lifting Equipment Certification:

Contractor shall engage a reputable, competent person in agreement with Company for certification of all lifting equipment including lifting points and brackets and issue relevant certificates. Contractor shall engage third party design verification for all relevant equipment and lifting gear according to relevant requirement.

#### **4.16 Materials, surface protection and insulation**

Contractor shall perform all relevant materials engineering activities for detail engineering and construction. This includes:

- Material selection shall be based on LCC, weight advantages, operability, sour service conditions and material availability.
- Perform erosion and corrosion evaluations when appropriate and include the results in the materials selection report
- Verify that selection of materials, coatings and insulation defined in P&IDs and in package specifications.
- Ensure that only qualified and accepted manufacturers as listed in TR2000 are used when qualification is required by the material data sheets.

- The evaluation and recommendation of primary structural materials (plates etc.) manufacturer, including required weldability data, shall be submitted to Company for acceptance.
- Cross discipline reviews shall be performed to ensure coating friendly design. Company shall be invited to these reviews.
- The requirement to minimize the extent of insulation shall be subject to regular multidiscipline reviews throughout the Project period. Process, technical safety, piping, technical working environment and materials disciplines shall participate in such reviews. Company shall be invited to these reviews.
- Contractor shall ensure that design for insulation and correct materials for insulation is included in Equipment Purchase Orders.
- A final inspection of skids coated with TSA or TSZ shall be performed by qualified coating inspectors prior to application of subsequent coats and installation of equipment.
- Contractors Inspectors for welding, NDT, coating and insulation shall have formal qualifications as required by the specifications in Appendix E. This include also include inspection of equipment packages.
- Give input to “Heat tracing design and installation manual” to ensure that heat tracing is designed to be insulation friendly.

#### **4.16.1 Deliverables**

These deliverables are in addition to deliveries listed in TR2381:

- The Materials Selection Report from FEED shall be updated. A final update of the Materials Selection Report to reflect as-built status shall be performed.
- A detailed Positive Material Identification (PMI) procedure shall be established.
- Develop all necessary specifications and procedures to perform all phases of construction in accordance with the relevant fabrication specifications and design details.
- Establish a “coating friendly steel design” document that shall be according to ISO 12944-3:1988 Part 3: Design considerations.”
- Develop Coating Selection Matrix in accordance with TR0042.
- Further develop the Insulation Procedure Specification (IPS) as required throughout the project. Company provided generic IPS shall be used as basis for the development of project IPS.
- Further develop piping and equipment insulation design specification as required. A section on insulation friendly design shall be included.

### **4.17 Structures**

#### **4.17.1 General**

Contractor shall perform all engineering of all structural elements included in the Contract Object.

Contractor shall have the total responsibility for structural design and shall perform all necessary analyses including detailed design to document structural integrity of all

structural parts, including load transfer connections and temporary installation aids. Contractor shall ensure fabrication- and maintenance-friendly design.

Vibration evaluations for sea ice and rotating equipment shall be included early in detail engineering. Design of deck beams supporting rotating equipment shall take dynamic effects into account to avoid/limit vibrations in the deck structure. Design and analysis shall be performed in close cooperation with equipment supplier. See also 4.5.3 Noise and vibration control deliverables.

Contractor shall ensure integrity, redundancy and robustness in Ultimate Limit State (ULS), Accidental Limit State (ALS), Fatigue Limit State (FLS) and Serviceability Limit State (SLS). Contractor shall carry out all necessary global and local analyses of the loadbearing structures for operational and all non-operational design conditions, such as operation, Construction, weighing, Load-Out, transportation and installation.

Special consideration shall be given to vessel impact and extreme environmental conditions such as sea ice actions and sea ice induced vibrations.

Contractor must take into consideration the interaction and interface between the topsides and the substructure. The stiffness of the substructure and the topsides shall be accounted for in the analyses. Contractor shall include input from transportation and installation contractor regarding accelerations and global deformations.

Contractor shall perform motion response analysis of the transport and fatigue analysis of the Contract Object due to transport motions, forces, and possible vortex induced vibration.

Contractor shall develop detail design of weld preparations and welding details of the transition point between Units and all structural welding to be performed at Offshore Site. The welding preparation shall be verified by Company prior to Load-Out. Weld types and inspection categories shall be shown on the structural 2D drawings.

All governing loading conditions shall be included in the analyses. Analyses shall demonstrate that all structures can safely support the design actions during the entire design life.

The non-operational phases such as Construction, weighing, Load-Out, transportation and installation shall be treated in the same manner as the operational phase with respect to accuracy, analyses and design.

Contractor shall provide all structural elements for installation and sea fastening of equipment, including ESON contractor's equipment, (e.g., reinforced floor/deck, doubler plates, lashing points, etc.).

Final structural analyses shall be carried out based on the as-built geometry and documented in analyses reports.

All structural analyses shall be performed and delivered using program supplied by vendor and accepted by Company.

Contractor shall provide the final version of all structural analysis files, computer models and documentation to Company. Relevant documentation shall accompany the analysis model fully and adequately describing the model as per the LCI requirements.

The 3D model shall be used to extract 2D fabrication structural drawings.

Contractor shall identify and develop all documentation within the structural discipline to complete the Work, including all documentation required in Appendix E.

Contractor shall have scope responsibility to interface with all relevant contractors (including but not limited to Export Cable, Inter Array Cable, Transportation & Installation (T&I), ESON, building permit, certification body, equipment suppliers, SOV, CTV) to exchange relevant information and data to complete detail design.

The design of the EC and IAC installation on the OSS shall also include replacement of the cables after installation (i.e. during operation).

Due to future life reassessment analyses for lifetime extension evaluations, necessary monitoring equipment shall be defined, supplied and installed at the substructure.

#### **4.17.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381:

##### Structural design briefs

Structural design briefs shall be developed and used as basis for design and documentation.

These documents shall be issued to Company for review and acceptance before start of analyses and design work. Design brief documents shall be valid for both permanent and temporary phases.

##### Drawing templates

Prior to starting drawing production, Contractor shall develop design drawing templates for Company review and approval. The templates shall cover primary, secondary and special structures. How weld details will be presented shall be clearly shown.

##### Weight budgets

Contractor shall create weight budgets for structural design for all relevant design conditions. The weight budgets shall be issued to Company for review and acceptance before start of analyses and design work.

##### No-go-areas

Fatigue sensitive areas in primary structure shall be communicated to other disciplines. Attachments or penetrations in these areas shall be avoided as far as possible. Drawings presenting "no-go-areas" for attachment welds or penetrations shall be established to ensure compliance with prerequisites from designer.

##### Structural analyses

Fatigue Wave Load Calculation: Wave inundation, free surface effects and variable buoyancy effects can be important for shallow water jackets with bracing located in the splash zone. Due to this the following must be described:

- how variable buoyancy effects are included.
- potential wave inundation and free surface effects.

The steepness of each individual wave is governed partly by wave period associated with the wave heights in the scatter diagram. Describe the sensitivity to the associated wave heights used for each wave height in the deterministic fatigue analyses.

The structural analysis reports shall include but not be limited to the following, where relevant, for all structures:

- Load-Out
- Transportation
- Installation and lifting
- Grillage and sea fastening

#### **4.17.3 Independent structural verification**

Company will perform an independent structural verification. The verification will normally consist of independent structural analyses, review of analysis reports and drawings.

Contractor shall submit required drawings, reports and other relevant information to the independent structural verifier through Company's document handling system.

The information to the independent structural verifier shall be identified on Master Document Register (MDR) and include dates for providing information.

Relevant comments from the verification shall be implemented in Contractor's design documentation.

#### **4.17.4 FEED HAZID**

Implement findings from the separate FEED HAZID – Sea Ice loading on substructure.

Reference is made to MFW Certification Report – Concept Certification – Ice loading on Offshore Substation Substructure, CR-C-DNV-SE-0190-9866-0.

### **4.18 Geotechnical**

Contractor shall review the Company provided geotechnical design basis and available soil data, ref. Appendix E, and produce an interpretation report with all parameters relevant for Substructure design.

Contractor shall perform installation analysis of the Substructure and specify all Substructure requirements and procedures for successful installation of the Contract Object.

Contractor shall design the Substructure piles based on installation contractor's nominated piling equipment, including pile handling and drivability analysis.

Contractor shall review FEED assessment of scour protection and perform all engineering related to scour protection of the Contract Object. J-tubes must be included in the engineering of the scour protection.

Based on the scour evaluation, Contractor shall perform a scour protection analysis, and design and document the scour protection to ensure that the seabed level around the Substructure and its J-tubes is maintained over the project lifetime, taking into account interfaces at the seabed e.g., the subsea cables. Company will provide and install required scour protection.

Contractor shall verify the scour protection design presented by FEED contractors.

Contractor shall identify and develop all documentation within the geotechnical discipline to complete the Work, including all documentation required in Appendix E.

#### **4.18.1 Deliverables**

Contractor shall develop and deliver:

- Geotechnical design brief with contractor understanding Company provided geotechnical design basis and available soil data, ref. Appendix E
- Geotechnical design report
- Substructure installation analysis report

- Scour protection analysis/design report

## **4.19 Architectural**

### **4.19.1 General**

Contractor shall develop the design of architectural areas and architectural items.

- Develop the architectural components and equipment throughout the installation.
- Secure standardization of elements such as doors, raised access floors, furniture, and signs.
- Contractor has an overall responsibility for platform colour coding schedule and signs.

### **4.19.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381:

- Architectural room layouts, sections and elevations of architectural areas showing furniture and equipment arrangements and with references to furniture and equipment list(s).
- Architectural furniture and equipment list(s) for the architectural areas.
- Room finishes schedule(s) containing all room surfaces and related material qualities.
- Door schedule(s) presenting door types, fire rating and additional equipment like electrical or pneumatical opening device, fire alarm release hold open device, glazing/vision panels, threshold types/solutions etc.
- Drawings of walls for weather, wind, explosion relief, acoustic & personnel protection, together with associated fittings etc.
- Room name and numbering list.
- Room program including room areas (m2)
- Signs: ID-, safety- and information signs
- Platform colour coding schedule

## **4.20 Weight control**

### **4.20.1 General**

Contractor shall carry out all activities necessary for accurate estimate and control of the weight and the centre of gravity that reflect 100% of as-built weight for the OSS topsides and jackets, including any temporaries for all relevant load conditions.

Contractor has the global responsibility to report weight and CoG for the complete OSS topsides and substructures, including weight report, Master Equipment List and weight database.

Contractor's method and premises for weight control shall be presented to Company before the weight control work starts.

Contractor shall ensure that weight and CoG (Centre of Gravity) information is communicated and reported in a consistent manner with transport and Installation contractor.

Weight and CoG follow-up and reporting shall be in compliance with ISO19901-5 and ISO19008 requirements and following clarifications to ISO standards:

- Weight summary table in weight report, MEL and material take-off as per Company template, following area split and ISO19008 COR. Tables shall also to be submitted in excel format. Area codes shall be in accordance with ENS.
- Establish weight budgets for all relevant load cases included in in weight reports.
- Weight allowances defined by Contractor and provided in weight procedure and management plan.
- Loading conditions shall as a minimum cover: transportation, lift, dry installed at field, operating installed at field, future dry, future operating. Temporary and future items shall be clearly defined and separated from installed items.
- Maintain the NTE (Not to Exceed) weights and monitor all reported weights against these weights. Any changes to the NTE weights shall be approved by Company.
- The weight report shall reflect the content of the master equipment list and weight database at report cut-offs and include an electronic excel copy of the weight database.
- Follow-up of Subcontractors' weight activities, obtain weight data from Subcontractors and follow up weighing of equipment and major bulk packages
- Contractor shall have a process for weight savings in order to stay within the weight budgets.

#### **4.20.2 Deliverables**

These deliverables are in addition to deliveries listed in TR2381:

Weight procedure and management plan

Weight report (monthly basis)

Weight database (monthly basis)

All pieces in weight database shall be continuously updated with installed items. These drawing references shall be implemented no later than first issue of construction drawings.

The weight control database shall be structured such that any combination of building blocks can be reported on Company's request.

Weighing prediction reports

Weighing reports

MEL in excel format

#### **4.21 Engineering Work Package (EWP)**

Contractor shall produce EWPs for the Offshore Work. Company and Contractor shall agree on the detail level of the EWP's.

The EWPs are single discipline, but multidiscipline EWP's can be used where it helps to simplify defining the scope Contractor shall hold preview meetings of EWPs to shorten review time.

An EWP shall include:

- Description of the work and detailed work procedures for installation including Subcontractor work.
- Identification of any significant predecessor or successor work related to similar activities.
- Description of risks associated with work and/or special safety precautions.
- Material requirements, Material Take Off (MTO) and logistics.
- Weight monitoring input form according to Appendix E.

Contractor shall develop an EWP schedule that includes all EWPs with defined scope and corresponding activities in construction and commissioning. The plan shall follow the sequence in commissioning schedule. Contractor shall prepare and present the plan and EWPs for Company review and acceptance.

## **4.22 Engineering for procurement**

### **4.22.1 General**

Contractor shall establish multidiscipline procurement package teams with required competence for both establishing and following-up of Equipment Package purchase orders.

Contractor shall establish procurement packages for all Materials not established in FEED.

The battery limits for Equipment Packages shall be defined to ensure maximum extent of testing at Subcontractor's sites prior to release for shipment and minimise installation scope both at construction site (if part of a module) and the Platform. Further, a systematic design-to-cost approach shall be used during system design to ensure selection of cost optimal solutions, scope and use of standardised equipment and equipment packages.

Meetings with potential suppliers shall be held to get a good overview of possibilities for cost savings at an early stage in the package specification and scope definition work. The goal is to define a as standard as possible scope for the equipment package, with focus on cost effective system design.

Reference is made to Appendix H for instructions regarding appointed Company Frame Agreements, appointed brands and approved suppliers.

### **4.22.2 Specification of procurement packages**

Contractor shall establish Package Specifications (PS) for all Equipment and Equipment Packages not developed in FEED. Package specifications developed in FEED shall be updated if necessary due to design development, this shall be agreed with Company.

The PSs shall be issued for review (IFR) for Company consent.

A price breakdown for the package scope is required for the procurement packages for benchmark purposes. Factory Acceptance Test (FAT)

Subcontractors shall propose and develop FAT procedures and acceptance criteria for all Equipment. FAT procedures and acceptance criteria for each Equipment Package shall be approved by Contractor before commencement of any FAT.

Contractor shall ensure that Subcontractor provides all necessary temporaries, supplies, personnel, instruments and tools needed for the FAT.

Integrated testing of equipment such as transformer, frequency converter, motors, and pumps shall be executed at Subcontractor's location. These tests are denoted FAT or Unit Final Acceptance test (UFAT).

The relevant parts of the SUS automation system shall be included in the FAT/UFAT test for equipment, both control class 1 and 2 functions shall be tested. Contractor shall identify relevant Equipment Packages where the SUS node shall be included in the FAT/UFAT. This list shall be presented to Company for acceptance early in the execution phase and Contractor shall ensure that the agreed SUS nodes, SUS hardware, interfaces and HMI are configured, available and included in the FAT/UFAT.

For packages with dedicated logic solvers, a SUS application test shall be conducted prior to FAT/UFAT at equipment package Subcontractor. The SUS application tests shall involve equipment package Subcontractor.

SUS hardware FAT shall be performed for all SUS units prior to shipment from SUS Subcontractor.

Company shall be invited and given access to attend and witness all FATs /UFAT.

14 Days prior to performance of each FAT, Contractor shall notify Company of the equipment item, the time and the location of the FAT.

Prior to start FAT Mechanical Completion Check Records (MCCR's) shall be given a legal status code in ProCoSys and punch items shall be entered in ProCoSys.

## **4.23 Life Cycle Information (LCI)**

Life Cycle Information (LCI) is technical information developed during project planning and execution, required for procurement, fabrication, construction, mechanical completion, commissioning, preparation for operations, start-up, operation, maintenance, repair, modification and decommissioning of a Wind Farm.

All engineering and equipment LCI that is not standard documentation, shall be numbered in accordance with TR0052 - Engineering Numbering System (ENS). LCI shall be delivered electronically in the original format and as PDF files in accordance with Company's LCI requirements.

Documentation for Standard Equipment (SEMI) shall be stored in Company's database for standard equipment. The delivered equipment shall be unambiguously identifiable in the documentation by Supplier's model and variant. Standard documentation shall not be customized and shall not contain tag or plant specific information, no cover sheets added or Company drawing borders shall be used.

Contractor shall include the LCI requirements in Subcontracts and Equipment Purchase Orders. Contractor shall verify the LCI delivery as part of the Factory Acceptance Test (FAT), and shall be responsible for the quality, completeness, and handover to Company.

Contractor shall ensure that redline markups are implemented in as-built documents and drawings.

Contractor shall establish multidiscipline databases both for tags and documents in order to produce master tag and document registers. Documents and drawings shall continuously be cross-referenced to relevant tag number(s).

All Company's projects shall be executed within Company's global framework, performed in the asset's global 3D CAD model, and shall be delivered according to TR2231.

## **5 PROCUREMENT**

### **5.1 General**

Contractor shall apply a commercial mindset and continuously seek for opportunities to lower the overall cost.

It is expected that Contractor comply to Company's strategic objectives regarding:

- Overall portfolio considerations, e.g., common procurement process with other projects.
- Total Cost of Ownership. (TCO).
- Identify potential local and regional opportunities

Contractor shall ensure Company's access to contracts and documents, incl. all correspondence, related to Subcontractors and their contractors, right to participate in meetings with Subcontractors and their contractors, and to access relevant manufacturing Sites to inspect purchased materials.

### **5.2 Organization and execution of procurement**

The Work includes technical and commercial procurement activities from design through technical requisition, establish bidders list, issue enquiry, perform bid evaluation, supplier recommendation and issue of Purchase Orders incl. call-offs. Contractor shall also carry out all Subcontractor follow-up activities including final release, shipment to fabrication Site(s), close out of the delivery of the goods (including documentation) and follow-up of any warranty issues.

Contractor shall establish and secure close cooperation between Contractor's procurement, engineering, - planning and construction disciplines and Subcontractors to plan, execute and deliver quality goods and services in according to defined need dates.

Contractor shall appoint a Package Responsible Buyer (PRB) and Package Responsible Engineer (PRE) with appropriate competence for each relevant PO, to secure the total delivery of the equipment packages. This team shall be co-located.

The PREs shall have the overall technical responsibility for equipment/equipment packages. This includes the following:

- Single point of contact for the Package Responsible Company (PRC).
- Responsible for multidiscipline coordination incl. discipline input towards the Subcontractor.
- Prepare PS and technical documents for procurement packages.
- Plan, coordinate and attend package follow-up activities throughout the delivery.
- Ensure on-time delivery of the Equipment to site.
- Ensure documentation in accordance with Company's LCI requirements.
- Ensure quality of equipment according to specifications.
- Handle and provide response to site-queries and commissioning queries.

### **5.3 Procurement file index/files**

Contractor shall establish a procurement file. The procurement file shall represent a complete library of the POs and any correspondence related to these. This includes a

complete library of strategies, enquiries, bids, evaluation reports and POs. In the event Company requires that a PO shall be assigned to Company, then Contractor shall submit the related procurement file to Company. A complete procurement file in native formats shall be submitted to Company upon request.

## **5.4 Procurement strategy and planning**

Contractor shall, in close cooperation with Company, prepare an overall procurement strategy for the Work. The overall procurement strategy shall comply with all requirements in this Contract and with a special focus on simplification, standardisation and industrialisation issues and it shall reflect a balanced risk view and a cost-efficient mindset.

Contractor shall for each enquiry prepare a specific procurement strategy including evaluation criteria. In the strategy Contractor shall assess and propose bidders list and the optimal sourcing method, i.e., competitive bidding, use of options from previous projects or carry out direct negotiations. When competitive bidding is decided, local, regional and global competition shall be used to the extent possible and reasonable. Contractor shall also ensure that cost saving opportunities and/or alternative solutions are fully assessed and implemented. To achieve this; Contractor shall, when submitting the enquiries, adapt for and encourage the tenderers to include an alternative solution for cost effective industry standards in addition to the solution described in the enquiry.

Procurement follow-up strategy for each individual subsupply shall be prepared immediately after PO placement.

Contractor's systems used for executing procurement, procurement planning, material control system and engineering for procurement shall be able to provide sufficient reports stating procurement status for any procurement performed by Contractor.

### **Procurement Milestone Plan (PMP) and follow-up plan**

Contractor shall, develop and maintain a level 5 PMP.

The PMP shall be based on engineering and fabrication need dates. The PMP shall reflect a balanced risk view and a cost-efficient mindset and shall be presented for Company's consent.

The PMP shall identify all procurement activities to be carried out by Contractor. Each item in the PMP shall be identified by the package number and structured as tagged equipment or engineered bulk material packages and further by discipline. Integration with associated engineering activities shall be defined. A defined set of PMP milestones shall be developed in close cooperation with Company, covering activities from specific procurement strategy to final delivery.

The PMP shall for each package item show planned, actual and forecast dates for achievement of each milestone. The PMP must be developed with adequate float to secure timely deliveries. The PMP shall be submitted to Company.

The dates in PMP shall be updated and in line with Contract Schedule at all times.

Procurement follow-up plans for each individual subsupply shall be prepared immediately after PO placement.

Contractor shall prepare for a simplified procurement process for single discipline/standard equipment not part of a multidiscipline package in accordance with Company's Standard Equipment List (SEL). SEL is developed to reduce Company specific requirements and is based on common accepted standards throughout the industry. SEL is a common basis and a guide for projects to choose standard equipment and is not a complete list of all equipment.

## **5.5 Material availability reporting**

Contractor shall prepare shipping plans and logistic reports as required as additional information to the PMP. The reports shall include total material and equipment by tag/stock number required per construction Site, PO status and shipment information.

## **5.6 Procurement estimates reports**

Contractor shall prepare procurement estimate reports showing historical control estimates (including Company input) and estimates per procurement package number. The reports shall classify all changes including reasons for this such as changes caused by Contractor, instructions by Company, options, etc. Estimates shall be reported based on the Actual Cost of Work Performed" (ACWP) principle. The procurement estimate report shall be attached to the monthly report to Company.

## **5.7 Establishing and maintaining POs**

Contractor's procurement activities shall include the following:

- Ensure that applicable confidentiality requirements and Specific Compliance Requirements are adhered to and implemented into all POs.
- Pre-qualification of tenderers and request experience transfer from previous projects, when relevant.
- As a part of necessary prequalification and/or when establishing bidders list, ensure that relevant tenderers have necessary service facilities and spare parts availability in a proximity to the operations that matches the equipment's criticality.
- Ensure that binding bids have adequate validity.
- Ensure that binding bids and POs can be assigned to Third Party.
- Continuously update a critical equipment and LLI list.
- For reimbursable Subsupplies:
  - Evaluate and establish evaluation reports incl. recommendation prior to purchase. Risks shall be considered in all evaluations and included in the total assessment and award recommendations.
  - To ensure an efficient evaluation process and selection of cost-efficient solutions, technical and commercial personnel shall work integrated when performing the evaluation.
  - Total Cost of Ownership (TCO) considerations shall be a part of the evaluation.
  - Cost related to environmental emissions shall be included as part of the evaluation.
  - Contractor shall ensure competitive Agreement for Technical Services (ATS) conditions. These shall be included as part of the evaluation of each PO.
  - Any options for training courses shall be included as a part of the evaluation.
  - All PO documents shall be presented to Company prior to PO placement.
- Variation Order Requests from Subcontractors shall be submitted as agreed with Company. Contractor's technical and commercial justification, incl. the detailed cause for the change shall be presented for Company's consent.
- Invoice control and approval including assessment of cost, progress, quality etc.

- Maintain a register and status of the receipt, inspection and control of Subsupplies, including marking and identification of ship loose items for later installation.
- Manage claims and warranty issues.
- Timely and efficient closeout of PO.

Any use of liquidated damages towards Subcontractors, shall be in full agreement with Company for purchase orders where Contractor shall be compensated on a reimbursable basis. Company shall endorse any evaluation regarding application of and/or waiving of liquidated damages.

## **5.8 Material control, transportation and customs clearance**

Contractor shall have a material control system for registration of all items in the POs with the possibility to track all movements of the procured items from ex works delivery until registered as delivered to and received by Contractor.

All materials shall be punch free at the time of release/dispatch. If punch items are open, then shipment shall only be authorised when the open punch items are approved by Company.

Contractor shall be responsible for managing the transportation and customs clearance activities related to purchased materials by Contractor.

Contractor shall liaise with Subcontractor to:

- Resolve Over, Shortage and Damage (OS&D) reports. OS&D's may relate to material or documentation that is required to be shipped with the equipment.
- Ensure that any open punch items are identified in ProCoSys.

## **5.9 Package follow-up and expediting**

A complete list, Package Responsibility Matrix (PRM), of all packages shall be established and maintained by Contractor. The PRM shall include names of both Company and Contractor personnel, categorise level of monitoring activities and a technical categorisation (bulk, tagged bulk, discipline packages and multidiscipline packages).

The expediting, examination and MC activities shall ensure that all quality related activities relevant to Materials are executed efficiently. The activities shall facilitate the elimination of any deficiencies in Materials and outstanding work prior to delivery. All Materials shall be delivered mechanically complete.

Relevant MC personnel from Company shall be integrated in the Contractor's package follow-up and expediting organisation.

For all issued POs Contractor's follow-up and expediting activities shall include:

- Follow-up compliance to Company's technical requirements through the entire supply chain via Subcontractors and their contractors.
- Monitor the fabrication of the Materials and the associated MC activities.
- Organise regular follow-up/meetings including a Project Procurement Follow-up Plan (PPFP) based on fabrication plans and inspection and test plans from Subcontractors. Company shall in due time have the option to sign up for participation.
- Perform regular procurement meeting with Company to report and discuss procurement status, critical activities and areas of concern.
- Communicate with fabrication site on delivery.

## **5.10 Spare Parts procurement and coordination**

Spare Parts including special tools shall be handled in accordance with Contract requirements.

Contractor shall ensure that SPIR lists are based on Subcontractors last revisions for deliverables to Company.

Contractor shall identify and propose Capital Spares and special tools required and procure both Capital Spares and special tools in accordance with Company's instructions when awarding the relevant POs. The Capital Spares and special tools shall be included in the SPIR list and given a Company SAP number.

Contractor is responsible for identification and procurement of commissioning spare parts. The proposal for commissioning spare parts shall be accepted by Company. Such spares shall be marked with real manufacturer part number and Company SAP number and stock inventory prior to delivery.

Operational spares on stock will on request be made available for Contractor with the conditions that it is replaced by Contractor.

Contractor shall ensure overall liability (including Subcontractor's and suppliers) of having access to Spare Parts which are required to maintain the operational and safety capabilities of the equipment during its normal operational lifetime.

## **5.11 Training courses for equipment packages**

The Contractor shall ensure provision of the training programmes set out in section 3.13.

Contractor shall include option for training courses for Company's operation and maintenance personnel in relevant POs and in agreement with Company. Training courses to be valid until twelve months after the Contract Object is put into operation. Contractor shall provide lump sum prices for training, specifying location of the course, max participants and duration for each specific procurement package.

The training shall reflect operational and maintenance issues. Training to be performed at Subcontractor's place, at Company's site or as a digital training course.

Contractor shall ensure that Subcontractors provide relevant documentation necessary for Company to perform training of its maintenance and operating personnel.

## **5.12 Agreement for Technical Services (ATS)**

Contractor shall include ATS provisions in relevant POs covering technical services for construction, MC, commissioning and start-up.

Contractor is responsible for all required ATS attendance. ATS management shall also be provided for the Commissioning and start-up activities.

## **5.13 Surplus materials**

Surplus materials paid by Company on a reimbursable basis are Company's property.

Contractor is responsible for disposal of surplus materials (If applicable: and disassembled equipment) under this Contract. Contractor shall credit Company according to conditions given in Appendix B.

In case of Company's request, Contractor shall arrange for preservation of surplus materials and transportation to Company's storage location.

Surplus materials shall be documented for traceability according to requirements.

Contractor shall submit a surplus report to Company prior to completion of the Work.

#### **5.14 Material receipt and shipment offshore**

All transport to the OSS shall take place from Supply Base, using Company's ordinary sea transport service, unless otherwise instructed by Company.

Contractor shall supply Materials to the quayside appropriately packed and documented ready for Company transportation to the Platform.

Company will take over responsibility for Materials during transportation to the OSS. After arrival at the OSS, the responsibility for the Equipment and Material shall return to Contractor.

Contractor shall establish a warehouse function that will ensure satisfactory storage of the Materials and Company Materials prior to dispatch to the platform.

Transport to Supply Base shall be ordered by Contractor directly. Contractor shall prior to transport delivery assure that all shipments are packed, marked, protected, preserved, stored and localised with regards to transport, installation and commissioning.

The Equipment and Materials shall be packed per Work Order (SAP PM10) according to Level 5 schedule and marked with the SAP Work Order number upon arrival to Supply Base.

Company reserves the right to use up to three (3) working days on controls and any necessary coordination activities at the Supply Base prior to forwarding to the OSS.

Large units which cannot be transported by Company's ordinary sea transport service from Supply Base will be transported by a Company provided vessel or cargo barge from Contractor's quay at the construction site, or another shipping location by agreement between Contractor and Company.

## **6 CONSTRUCTION**

### **6.1 General**

Contractor shall have the total responsibility for all construction activities and work processes required to complete the Contract Object including Company Provided Item e.g. including but not limited to ESON HV equipment.

The Contractor shall minimize offshore construction work. Contractor shall maximize modularization, pre-assembled units and pre-cut of stick build at Contractors premises onshore.

All construction work is subject to the ITP requirements as further detailed in Appendix D.

### **6.2 Method statement**

Contractor shall develop and deliver a method statement visualizing the project construction activities. The purpose of the method statement is to provide co-ordination and understanding of the construction phase and the sequence of activities.

The Method Statement shall be visualized by use of screen shots and animations of relevant parts from the 3D model, MEL and MTO's, schedules and method studies.

Following shall be covered:

- Split between onshore and offshore construction work.
- Logistics and transportation between sites.
- Heavy lifts at any site.
- Main and critical lifts and laydown areas onshore and offshore.
- Offshore installation, material handling, crane usage and hook-up work.
- Construction HSE risk assessment to address work at height, exposure to potential dropped objects, moving objects, material handling, ergonomics, access, egress and other relevant hazards.
- Temporary phases and required temporary equipment.
- Engineering and procurement deliverables critical to construction schedule.
- Methods and sequences considered critical to construction schedule.

A brief of relevant alternatives shall be included focusing the preferred one. To the extent possible, the statement shall make relevant references to onshore and offshore frame conditions that may impact on method, sequence, or manning levels.

The method statement presentation shall include a timeline clearly indicating in which phase and related to which contract milestone the presented work will take place.

The statement shall highlight which parts of the work that is assumed to be subject to early mechanical completion to meet the overall commissioning schedule and requirements.

The method statement shall be developed as required throughout the execution of the project.

## **6.3 HSE in construction and commissioning**

Contractor shall as minimum follow the guidelines and recommendations of the IOGP577 and IOGP459 as a framework for preparing and executing construction work at any site relevant for the Contract Object.

### **6.3.1 Working at heights and scaffolding**

Contractor shall ensure that working at height and scaffolding are in accordance with IOGP577.

All work above ground level and adjacent to excavations shall be risk assessed and suitable fall protection measures implemented including need for handrail at low height working, e.g. between 1 and 2 meters.

Procedures for work at heights, use of scaffolding and fall protection shall be developed before construction work is starting for each site. Procedures shall be accepted by Company.

Contractor's procedure for scaffolding shall be in accordance with national standards (e.g. EN-12811-1, EN-12811-2, EN-12811-3, EN-12811-4 and EN-74, EN-39)

Contractor's procedure for system scaffolding shall include the manufacture's installation guide for the specific type used for the project.

Contractor shall provide the project with certificated scaffolder or more than (2) years documented professional experience building scaffolding.

Contractor shall document all hanging and suspended scaffolding included brackets scaffolding and mobile scaffold by proper strength calculations, wind loads included. Company will reserve the right to require contractor to document strength calculation for all other types of scaffolding

Contractor shall install non-flammable net (including heavy duty net if required) based on risk assessment to prevent falling objects.

### **6.3.2 Rope access technique for work at heights.**

Rope access technique procedure shall be established in accordance with IRATA International Code of Practice or equivalent national standards for each site. Rope access (abseiling) shall be carried out by personnel who are certified in accordance with «IRATA International Code of Practice» or equivalent national standards.

The team shall have a supervisor for access technique that is certified according to level 3.

It is not allowed to mix rope access personnel certified according to different standards within a rope access team.

Work procedures and rescue plan for rope access shall be available at the site before the work is started.

Personal flotation devices shall be used when rope access techniques are carried out above sea. Personal flotation devices must be compatible with the harness that shall be used.

### **6.3.3 Lifting and rigging**

In addition to requirements stated in IOGP Report 577, Contractor shall include the following requirements related to control of lifting and rigging operations:

- A system and detailed procedure shall be created outlining the requirements for establishing and controlling cordoned off areas.
- All personnel involved in the lifting operation shall always make sure they have a clear escape route
- The lifting device operator shall not leave his cabin or position when a load is suspended
- Documented training for operators of Lifts/cherry pickers
- Device-specific training for the specific equipment that is to be used
- Training in the use of fall prevention and evacuation equipment

### **6.3.4 Personal Protective Equipment (PPE)**

PPE requirements shall be according to IOGP report 577. To avoid finger and hand injuries a risk assessment shall be performed. Additional safety equipment on tools shall be risk assessed e.g., user-friendly grinder with brake. In addition, Contractor shall risk assess expected work task and ensure suitable gloves, (e.g. general purpose, anti-cut, impact gloves, gloves for fine detailed work) are available and used.

## **6.4 Construction strategy**

Contractor shall update and maintain the construction strategy delivered in FEED. The strategy shall be subject to Company acceptance.

## **6.5 Work Order**

Work Orders (WO) for offshore work shall be based detail engineering. The Work Orders shall contain all necessary information to perform the Work.

Contractor may use its own system for work preparation if Company approval is obtained.

Work Order data for offshore work shall be transferred to Company, including MTO with material status

Contractor's man-hour norms for estimation shall be adjusted in line with Company's estimation norms if Contractor uses own system for work preparation

Work Orders (WO) data for onshore work shall be transferred to ProCoSys on a continuous basis. The level of WO information shall be agreed and approved by Company.

## **6.6 Offshore work**

All offshore work shall be ready for execution at mobilisation offshore according to the installation activities in the schedule. This work shall be organized to naturally fit the sequential plan of performing the Offshore Work. Work ready for execution means WO order package available offshore and material fully delivered at offshore base packed and marked with WO number.

Contractor shall on a weekly basis report work status. The report shall show released available work order manhour distribution.

## **6.7 Site frame condition**

### **6.7.1 At Contractor premises**

Contractor is the principal enterprise at Contractor premises.

Contractor shall have a permit to work (PTW) system implemented at any construction Site relevant for Contract Object.

Prior to starting any commissioning activity, Contractor shall provide and implement a work permit system capable of dealing with the inherent risks related to parallel execution of construction and Commissioning. The PTW system shall be jointly audited by Contractor and Company to ensure that its adequate to handle parallel construction and commissioning work at any of the Contractor's Sites.

## **6.8 Clean and dry building**

Contractor shall implement the principles for clean, dry buildings during the construction and HUC period. This is to prevent pollution and humidity during construction having a negative effect on the indoor environment in the completed building or development of corrosion within the structure.

Contractor shall develop procedures and detailed implementation plan in compliance with GL0573 Guideline for clean and dry building (ref. Appendix E), and NS-INSTA 800 for moisture measurement and moisture acceptance criteria. The procedures and

implementation plan shall reflect the geographical location and the required environmental control in each case.

The procedures and the implementation plan shall be reviewed and approved by Company prior to first steel cut.

Contractor shall provide equipment and assure procedures are fulfilled during the construction period up to load out.

Necessary equipment for Clean and dry building during hook up to be provided by Company as listed in Appendix G.

## **6.9 Welding, inspection and NDT**

Welding repair percentage shall be calculated continuously and reported to Company on a regular basis together with an analysis of causes of the faulty work. For structural welds, the percentage shall be length of repairs related to inspected length. For girth welds in piping system the percentage shall be reported as both number of repaired welds related to number of inspected welds, and length of repairs related to inspected length.

All welders shall be subject to volumetric NDT. Contractor shall establish a system to ensure that all welders are included.

The main principle is that the welding activities shall be performed indoors or in a sheltered area with roof and walls, e.g., tarpaulins. Any outdoor welding shall be protected from the effect of weather conditions (e.g., wind, rain, etc) that may affect the weld quality.

Radiographic Testing (RT) films shall be submitted electronically to Company.

Positive Material Identification (PMI) shall be performed on installed piping as specified in NORSOK M-601. 100% PMI for a piping system means all pipe sections, all fittings, all welds, all valves and 1 bolt and nut per flange (if fasteners are in CRA material).

The PMI procedure shall be implemented in all workshops and Subcontractor.

## **6.10 Procedures and qualification testing**

### **6.10.1 Qualification of welding procedures**

Contractor shall present a detailed plan for qualification of welding procedures at all sites prior to start of construction.

### **6.10.2 Site testing of welders and NDT operators**

All welders for 25% Cr duplex steel shall perform and pass a site test that shall include a corrosion test. If the corrosion test fails, contractor shall perform necessary training prior to a re-test. The site test shall be performed on pipe 3" - 6" diameter and thickness minimum 10 mm or as agreed with Company. Site test position of pipe shall be H-L045 (6G).

The welder site test shall include:

- Visual testing with acceptable result to NORSOK M-601.
- X-ray with acceptable result according to NORSOK M-601.
- Corrosion testing for 25% Cr specimens at temperature 35° C according to NORSOK M-601.

Company will perform a site test program of NDT operators. The program will be based on the principles in ISO 9712 and will mainly focus on the technical skills of the operators. Company will bring a third party to perform the testing. Test blocks with relevant defects for the actual systems and NDT methods will be provided by Company. Contractor shall facilitate the testing and ensure that NDT operators are made available for the testing. Candidates that do not achieve 70% or better score in the test will be rejected.

### **6.10.3 Production weld testing**

Production testing of welds shall be performed by Contractor in accordance with the requirements in this Contract.

A detailed production test plan for all sites and subcontractors shall be prepared and agreed with Company prior to start of construction.

All welding procedures for primary structural steel (DC1 and DC2) shall be covered

Production testing shall be performed as prolongations for structure whenever possible or as separate weld coupons when prolongation is not possible.

Production tests shall be performed as early as possible after start of construction and shall be witnessed by Company.

### **6.11 Material traceability**

Contractor shall establish and implement a material traceability system at all construction sites.

Contractor shall ensure that the traceability of surplus materials and their certification is maintained at all times.

There shall be full traceability on pressure retaining items and primary structural steel, from materials certificate to installed item, throughout the entire Contract period. Contractor shall receive and check all bulk materials certificates against supplied items.

Contractor shall keep complete and accurate material control records, and ensure that dedicated areas are prepared, preservation is planned and carried out, and materials are marked for the Contract Object

### **6.12 Surface and corrosion protection, fireproofing and insulation**

All surface protection and insulation Work shall be carried out in accordance with specified requirements in this Contract.

Before start-up at each construction Site, all personnel engaged in surface protection and insulation shall participate in familiarization meetings to clarify and agree on the procedures, quality requirements, inspection program, report forms and any other necessary requirements in order to achieve the correct job execution.

Site testing of operators shall be performed at each construction site. The site test shall be supervised and examined by qualified Quality Control (QC) personnel from Contractor in accordance with App E. The QC personnel from Contractor shall sign the examination certificate.

#### Surface protection

Any Contractors or Subcontractors performing surface protection and passive fire protection shall document a proven relevant track record and shall be accepted by Company.

Coating Procedure Tests (CPT) shall be carried out on each construction site.

Traditional sandblasting that generates dust is in general not permitted after block stage. The specified surface preparation shall be obtained by alternative methods that minimizes spreading of grit and dust.

Representative(s) from the coating manufacturer(s) shall be present at the construction site for familiarization meetings, qualification of procedures and personnel, and during coating work when requested by Contractor or by Company.

The representative from the coating manufacturer shall issue an inspection report after each site visit to both Contractor and Company.

#### Insulation

All insulation work shall be performed by nominated insulation Contractors in App H.

New insulation build-ups shall be qualified with a test (Insulation Procedure Test (IPT)) on a test object with the same complexity as the object to be insulated. (e.g. bend, T-piece, welded and bolted pipe supports) The IPT may be performed on a representative work package in production. The qualification test shall be performed by all companies performing insulation work.

Measurement of boxes shall be performed by dedicated personnel that can document experience with such work. Digital tools, e.g., 3D scanning or apps, should be used to do the measuring.

### **6.13 Material receipt and storage offshore**

Contractor shall establish a material management system and facilities to coordinate all material receipt and storage offshore.

This includes an administration system for arranging return loads.

### **6.14 Weighing of the contract objects**

Weighing of the contract object shall be performed according to ISO19901-5.

### **6.15 Mechanical Completion (MC)**

Contractor shall be responsible for the MC in all phases of the Work according to Contract requirements. ProCoSys shall be used to prepare, execute and document the MC.

Contractor shall update as required the MC strategy developed in the FEED. A detailed plan for MC activities shall be developed.

### **6.16 Preservation**

Contractor shall plan, prepare reports and carry out preservation and maintenance in all phases of the Work according to Subcontractors' manuals, procedures and specifications and Company's preservation requirements. Contractor shall use ProCoSys for planning, execution, and reporting of preservation.

If any part of the Contract Object is operated for a duration where the routine maintenance interval is met, Contractor shall perform the necessary maintenance and document it in ProCoSys.

Contractor shall update as required the preservation strategy developed in the FEED.

### **6.17 Receipt, handling, storage, protection and Preservation**

Upon receipt of Materials and Company's Materials at Site(s), the Contractor shall make an immediate arrival inspection. The inspection shall include a verification of the quantities received and the materials and the packaging shall be inspected for external damages. The inspection procedures shall be approved by Company. Contractor shall perform receipt, Preservation and storage of all Materials and Company's Material.

J-tube shall be gauged to remove all unnecessary debris, sharp edges etc. that could compromise cable during pull in operation. J tube shall be then protected with blind flange on the top which connected with messenger wire and bell mouth plug (ROV friendly) as specify in C256-EQ-Z-SP-00012.

### **6.18 Mockup Trial**

Contractor shall upon request by cable contractor perform the cable pull in mockup trial at fabrication yard prior to sail away. Detail for this trial shall be discussed through interface with relevant contractors.

### **6.19 Sea transport preparation**

Contractor is responsible for design of all temporary steel, lifting lugs, pad-eyes, sea-fastening, grillage, and other structural arrangements that is necessary for assembly, lifting, transportation, installation, and integration of the Contract Object.

Contractor shall install, complete, and preserve sea fastening required for transport of the equipment on Contract Object to location. The sea fastening shall be accepted by Company.

A Marine Warranty Surveyor (MWS) will be appointed by Company for approval of all Marine Operations. Marine Operations shall only commence after the MWS has checked and accepted all preparations, procedures, equipment and vessels involved and issued the declaration confirming readiness to commence marine operations. Contractor shall obtain all necessary approvals and declarations from the MWS. Company shall have access to all technical correspondence between Contractor, Contractor's marine Subcontractors and MWS, and be invited to all meetings with these Subcontractors.

Contractor shall provide mooring crew and assist in the arrival of unladen barges or transport vessels

The Contract Object shall be delivered after completion of Contract Object on the transport barge or vessel provided by Company and delivery of Certificate of Approval from the Warranty Surveyor. Storage

Contractor is responsible for necessary assistance to T&I contractor and Marine Warranty Surveyor associated with readiness of Contract Object for offshore transportation and taking care, store and perform the necessary Preservation of the Contract Object for a period up to 60 days after its deemed ready for Load-Out.

### **6.20 Custody of Contract Object**

Contractor shall have custody of the Contract Object until it is preserved and delivered FOB (free on board) on transportation vessel, prepared for transfer to agreed location and Certificate of Approval from Warranty Surveyor is issued. Custody is then handed over to Company and simultaneously to the nominated T&I contractor. Company will be fully responsible for the Contract Object and the operation from this transfer location. Contractor shall allow Company to operate parts of the Contract Object, prior to delivery of the Contract Object.

## **7 COMMISSIONING**

### **7.1 General**

Contractor has the responsibility to plan, prepare and execute commissioning of the Contract Object including issue of TAC to Company. Additionally, Contractor shall have the lead responsibility for coordinating the planning and execution of commissioning interface activities towards Company's other contractors to verify functionality and integrity.

Company shall have the right to, but not be obliged to second Company personnel to Contractor commissioning organization. In such case Contractor and Company shall agree to which positions they shall take.

On Company request Contractor shall provide assistance to Company during start-up and early operation. Commissioning scope shall be subject to the ITP requirements as described in Appendix D. Witness and hold points shall be included in the Commissioning Preparatory Check Lists (CPCL) and procedures for Company's signature.

### **7.2 Commissioning strategy**

Commissioning strategy shall include onshore commissioning of the Contract Object and assistance to ESON contractor during commissioning at the Contractor's Yard.

For offshore commissioning Contractor shall assist the offshore contractor.

Contractor shall develop and maintain a commissioning strategy for onshore commissioning at Contractor's Yard(s) based on contractor scope of work and the FEED commissioning strategy C274-RA-A-RA-01010. in App E. The strategy shall be developed according to GL0417 Commissioning Strategy and subject to Company acceptance. In the strategy Contractor shall plan to maximize onshore commissioning and minimize offshore commissioning to the extent feasible. Any transfer of planned onshore commissioning to offshore shall be agreed with Company.

Contractor shall issue Technical Acceptance Certificate TAC for Company acceptance and signature for any completed onshore commissioning as part of the onshore Work.

### **7.3 Provision and facilities to energize HV system at Yard**

Contractor shall provide facilities for high voltage AC system energization at Yard for the purpose to fully/partly commission the HV equipment prior to Load-Out.

Contractor shall be responsible for all test equipment and spare parts needed in order to execute the commissioning, as part of contractor scope (including but not limited to Duresca busbar system, HV and MV connection between main equipment).

The facilities shall provide 66 kV 50 Hz supply through one of the 66 kV GIS bays installed on the Contract Object. The duration of such an energization test is assumed two weeks for the full scope but is subject to change based on Contractors available test facilities. The intention is to perform this test immediately following the completion of the ESON onshore Commissioning works.

Contractor shall provide all provisions, Materials and consumables for the proposed facility, including termination and termination testing toward the 66 kV GIS bay.

The Contractor is encouraged to outline a "low hanging" test setup reflecting the current facilities at the Yard. It will be beneficial to explain what the largest power demand that has been satisfied during Commissioning phase previously has been. Important aspects are kV, MVA, MW, available grid connections, generator types, fuel types etc.

## **7.4 Handover**

Contractor shall establish and implement a handover process from construction to commissioning (RFCC) and from Contractor to Company (TAC) based on template provided by Company. The handover processes including the timing for the different handover meetings shall be accepted by Company.

## **7.5 Consumables and first fill**

Contractor is responsible for selection and procurement of consumables and first fill. The selection shall be accepted by Company. Contractor shall strive to use pre-approved chemicals, and clearly identify not pre-approved chemicals. Contractor is responsible for following the Company chemical management process.

Consumables and first fill are materials and fluids required for executing in the commissioning.

Contractor is responsible for provision of representative and certified calibration gases needed during commissioning and start-up of the gas analyser systems offshore.

## **7.6 Deliverables**

Contractor shall issue the following documents:

- Commissioning network schedule.
- Commissioning procedures.
- Commissioning work instructions.
- Temporary systems proposal..

# **8 FOLLOW ON ENGINEERING**

Contractor shall assist on follow on engineering during HUC and commissioning until the OSS is completed

# **9 OPERATIONS**

## **9.1 General**

The Contractor shall ensure that all aspects and phases in its scope of work consider and minimise operations and maintenance obligations on the Employer in the operational phase.

## **9.2 Operations and Maintenance Strategy**

Contractor shall update and maintain the Operations and Maintenance strategy delivered in FEED. The strategy shall be subject to Company acceptance. The Operations and Maintenance Strategy shall include but not be limited to:

- The operating model and operational philosophy
- Main/critical spare part strategy
- Strategy to meet Company's requirement of minimum 12-month maintenance frequency, including input from suppliers and Subcontractors.

- Methods and recommendations to achieve maximum availability and to avoid unplanned operational outages/curtailment of the OSS.
- Strategy to meet Company's expectation towards remote operation of the offshore substation.

### 9.3 OPEX and Availability Estimate Report

Contractor shall update and maintain the OPEX and Availability Estimate report delivered in FEED. The report shall be subject to Company acceptance and shall include but not be limited to:

- A detailed Reliability, Availability and Maintainability (RAM) report. RAM analysis shall be performed per piece of equipment, to ensure sufficient redundancy and durability of equipment. The analysis shall be performed for all systems. Availability shall be production-based.
- Life cycle cost study, with an estimated cost for each year throughout the lifetime (25, 30 and 35 years) and a breakdown of the life cycle cost into the following categories: spare parts, consumables, tools, man-hours, planned/un-planned maintenance and inspections.
- List of spare parts assumed to be replaced over the lifetime including:
  - Number of spare parts to be replaced/failure rates.
    - Development over the lifetime.
    - Whether replacement is assumed to be planned or unplanned.
  - Cost per spare part.
  - Impact on production (criticality, modularity, redundancy).
  - Monitoring and predictability.
- Planned maintenance schedule including frequency, man-hours and estimated curtailment of the wind farm.
- Unplanned maintenance schedule including assumed number of events, frequency, man-hours, duration, predictability, and description of the most typical failures.
- Failure Modes, Effects and Criticality Analysis (FMECA).
- Be developed according to Reliability Centred Maintenance (RCM).

### 9.4 Deliverables

These deliverables are in addition to deliveries listed in TR2381.

- Operations and Maintenance Strategy (as outlined in 8.2).
- OPEX and Availability Estimate Report (as outlined in 8.3).
- Preventative maintenance programme; incorporating maintenance plans for all equipment.

Operations and Maintenance documentation relevant for all equipment, as may be referred to elsewhere in Appendix A.

## **10 OPTION**

### **10.1.1 Option 1: O&M Service agreement**

Upon exercising this option, Contractor shall provide O&M services to Company for the first 10 years of operation. This includes all spares, consumables, personal protective equipment for personnel, training of personnel, tools and logistics shipment to O&M Base to perform the maintenance service.

Company will make O&M base services available and logistics for shipping of personnel, tools and spare parts to OSS by CTV. Company is to provide CTV transport services during daytime only with a typically 07:00 departure and a 19:00 return. No overnight stay at the substations is envisaged. Contractor is to define the number of workstations needed onshore in the O&M base, during service campaign. The Contractor is further to define the estimated responds time needed for an unplanned visit/service from point of request.

### **10.1.2 Option 2: Implementation of active bird deterrent system**

OSS Contractor shall include design and installation of Bird Monitoring system. The system shall provide monitoring and detection of bird activity in the vicinity of the installation and data collecting for analyzing purpose

### **10.1.3 Option 3: HV cables between ESON 220 kV transformer and step-up power transformer**

Upon exercising this option, Contractor shall engineer and procure HV cable and terminations on the Contract Object. For the avoidance of doubt, testing, commissioning and installation is already part of firm scope

### **10.1.4 Option 4: Pre install topside Export cable (EC option)**

Contractor shall pre-install 220 kV topside cables between 220 kV GIS and export cables.

Contractor shall be responsible to terminate and test pre-installed 220 kV topside cables to GIS at OSS yard.

Contractor shall be responsible to splice pre-installed 220 kV topside cables with export cables after OSS topside is installed offshore.

### **10.1.5 Option 5: Temporary equipment for Dry clean building during load out and HUC**

Contractor shall provide HVAC system and temporary generator during load out and HUC.

Contractor is responsible for installing and hook-up up all related equipment.

### **10.1.6 Option 6: Lifetime extension**

Five (5) to ten (10) years lifetime extension for the structural design of the Contract Object.

### **10.1.7 Option 7: HVAC fan coil unit and wall mounted heater**

Contractor shall provide fan coil units and wall mounted heaters if required to regulate room temperatures in certain rooms.

#### **10.1.8 Option 8: Transport of Contract Object to Offshore Site**

Contractor shall provide Barge/Transportation vessel for transport of the Contract Object/Unit to the Offshore Site.