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CO-FINANCIER **INOVATION AND NETWORKS**  **EXECUTIVE AGENCY** **Connecting Europe Facility**Project (Action) number 8.2.4-0031-LV-W-M-18 | Exemplar No.: |
| Phase:**Tender Documentation** |
| Project Name:Installation of Gas Compression Unit at Incukalns Underground Gas Storage | Contract No.:**CON-2020/364****0173/20/52** |
| **Document No.**: GCUI-TD-GOT-MEC-SPC-001 | Revision: **---** |
| Document Name:**Tender Documentation****DRAFT****Tender specifications for GCU package** |
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# GENERAL

## Scope of the Document

This specification outlines the minimum requirements for the engineering, construction, installation, commissioning and testing of the turbocompressor unit sets to be purchased and installed within the framework of the project ”Installation of Gas Compression Unit at Incukalns Underground Gas Storage” (the PROJECT) of Conexus Baltic Grid (the Employer).

Installation of Gas Compression Unit is a part of the Project of Common Interest (PCI) 8.2.4 Enhancement of Incukalns Underground Gas Storage. The aim of this project is to enhance the operations of the storage to allow the Incukalns Underground Gas Storage to maintain its functionality after pressure upgrade in Baltic transmission system and establish the compression withdrawn mode. Additional Gas Compression Unit will be installed and integrated as a part of existing gas compression station at Incukalns Underground Gas Storage and support also injection mode.

## Definitions

Table 1.1

|  |  |
| --- | --- |
| Term | Explanation |
| Project | Installation of Gas Compression Unit at Incukalns Underground Gas Storage  |
| Employer | Conexus Baltic Grid |
| Consultant | GasOil Technology a. s. |
| Scope of Supply | All equipment and services which shall be delivered by the Supplier to the Employer as per requirements and conditions specified in the CONTRACT. |
| Supplier | Vendor of the turbocompressor unit sets |
| Offer | Offer for the turbocompressor unit sets submitted to the Employer by the Supplier |
| SCS Supplier | Vendor of the Station Control System |

## Abbreviations

Table 1.2

| Term | Explanation |
| --- | --- |
| AC | Alternative Current |
| ACP | Anti-Corrosion Protection |
| AGM | Absorbent Glass Mat |
| AN | Air Natural |
| API | American Petroleum Institute |
| BTS | Border Transfer Station |
| CAPEX | Capital Expenditures |
| CS | Compressor Station  |
| CC | Centrifugal compressor(s) |
| C&I | Controls and Instrumentation |
| CU | Gas Compression Unit |
| DC | Direct Current |
| DCC | Dispatching Control Centre |
| DGS | Dry Gas Seals |
| DN | Nominal diameter |
| LVDG | Low Voltage Diesel Generator |
| LVS | Low Voltage Switchgear |
| EMC | Electromagnetic Compatibility |
| EN | European Standard |
| E&IC | Electrical and Controls & Instrumentation |
| EM | MV Electric Motor |
| EMD | Electric Motor Drive system |
| E-Motor | LV Electric Motor (general) |
| ESD | Emergency Shut-Down System |
| FAT | Factory Acceptance Tests |
| FFS | Fire Fighting System (fire detection, fire extinguishing system) |
| FGDS | Fire and Gas Detection System |
| FDS | Fire Detection System |
| FOC | Fiber Optic Cable |
| GDS | Gas Detection System |
| GT | Gas Turbine |
| HAZOP | Hazard and Operability Study |
| HAZID | Hazard Identification Study |
| HMI | Human Machine Interface |
| HP | High Pressure |
| HV | High Voltage |
| HW | Hardware |
| I&C | Instrumentation and Controls |
| IGBT | Insulated Gate Bipolar Transistor |
| IGCT | Integrated Gate Commutated Thyristors |
| IPPC | Integrated Pollution Prevention and Control |
| IS | Intrinsically Safe |
| JB | Junction Box |
| KVM-E | Keyboard, Video, Mouse Extender |
| LEL | Lower Explosion Limit |
| LV | Low Voltage |
| MAWP | Maximum Allowable Operating Pressure |
| MCB | Miniature Circuit Breaker |
| MCC | Motor Control Centre |
| MCCB | Molded Case Circuit Breaker |
| mcm/d | Million cubic meter per day at specified reference conditions |
| MOP | Maximum Operating Pressure |
| MOT | Maximum Operating Temperature |
| MT | Magnetic Particle Examination |
| MV | Medium Voltage |
| NDT | Non-destructive Testing |
| NPSH | Net Positive Suction Head |
| OEM | Original Equipment Manufacturer |
| ONAF | Oil Natural, Air Forced |
| ONAN | Oil Natural, Air Natural |
| OPC | Open Platform Communication |
| OPEX | Operational Expenditure |
| PAR | Peak to Average Ratio |
| PT | Liquid Penetrant Testing |
| PCC | Point of Common Coupling |
| PLC | Programmable Logic Controller |
| PMI | Positive Material Identification |
| PN | Nominal Pressure |
| PWHT | Post Weld Heat Treatment |
| PQR | Procedure Qualification Record |
| REPEX | Renovation Expenditures |
| RTD | Resistance Temperature Detector |
| RT | Radiographic Testing |
| RCD | Residual Current Device |
| RCM | Reliability Centered Maintenance |
| r.m.s. | Root Mean Square |
| rpm | Rotations per minute |
| ROW | Right of Way |
| SAE | Society of Automotive Engineers |
| SAT | Site Acceptance Test |
| SDRL | Supplier Document Requirements List |
| SIL | Safety Integrity Level |
| SCS | Station Control System |
| SF | Safety Factor |
| SL | Single Line Diagram |
| SPDT | Single Pole Double Throw |
| SW | Software |
| TC | Turbo-compressor |
| TELCO | Telecommunication Infrastructure |
| THD | Total Harmonic Distortion |
| TPS | Technical Protection Systems |
| QA | Quality Assurance |
| QRA | Quantitative risk assessment |
| UCS | Unit Control System |
| UGS | Underground Gas Storage |
| UPS | Uninterruptible Power Supply |
| US | Ultrasonic |
| UT | Ultrasonic Inspection |
| VSD | Variable Speed Drive |
| VSI | Voltage Source Inverter |
| WPS | Welding Procedure Specifications |

## References

Table 1.3

|  |  |  |
| --- | --- | --- |
| No. | Number | Title |
| 1 | GCUI-TD-GOT-MEC-DAT-001 | Mechanical datasheet of the Centrifugal Compressor (API 617 8th Ed template) |
| 2 | GCUI-TD-GOT-MEC-DAT-002 | Mechanical datasheet of the Gas Turbine (API 616 5th Ed template) |
| 3 | GCUI-TD-GOT-MEC-DAT-007 | Dry gas seals datasheet |
| 4 | GCUI-CD-GOT-GEN-SPC-001 | Composition of Process Gas |
| 5 | GCUI-TD-GOT-GEN-DWG-001 | Scope of Supply and Interface Matrix for GCU |
| 6 | GCUI-TD-GOT-GEN-DWG-002 | Mechanical Interfaces for GCU - Schematics |
| 7 | GCUI-TD-GOT-GEN-DWG-003 | Electrical and I&C Interfaces for GCU - Schematics |
| 8 | GCUI-CD-GOT-GEN-DIA-002 | Process Flow Diagrams (PFDs) & Utility Flow Diagrams (UFDs) (including packages) |
| 9 | GCUI-CD-GOT-IAC-DWG-002 | Typical Instrumentation Hook-ups |
| 10 | GCUI-CD-GOT-IAC-SPC-003 | General Requirements Installation and Startup of Control System |
| 11 | GCUI-CD-GOT-IAC-DWG-001 | Control System Architecture - Overall Block Diagram |
| 12 | GCUI-CD-GOT-IAC-DWG-003 | Typical Loops Diagram |

## Codes and Standards

Table 1.4 – Codes and Standards Quality Control, Certification

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN ISO 9000 | Quality management systems - Fundamentals and vocabulary |
| 2 | EN ISO 9001 | Quality management systems – Requirements |
| 3 | EN ISO 9004 | Managing for the sustained success of an organization - A quality management approach |
| 4 | EN ISO 14001 | Environmental management systems - Requirements with guidance for use |
| 5 | OHSAS 18001 | Occupational health and safety management systems – Requirements |
| 6 | EN 10204 | Metallic products - Types of inspection documents |
| 7 | EN 45020 | Standardization and related activities - General vocabulary |
| 8 | EN ISO/IEC 17000 | Conformity assessment - Vocabulary and general principles |
| 9 | EN 10274 | Metallic materials - Drop weight tear test |

Table 1.5 – Codes and Standards Turbo-compressor unit sets

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN 12583 | Gas Infrastructure - Compressor stations - Functional requirements |
| 2 | API RP11 PGT92 | Recommended Practice for Packaged Combustion Gas Turbine |
| 3 | API 613 | Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services |
| 4 | API 614 | Lubrication, Shaft-Sealing, and Control-Oil Systems for Special-Purpose Applications |
| 5 | API 616 | Gas Turbines for the Petroleum, Chemical, and Gas Industry Services |
| 6 | API 617 | Axial and Centrifugal Compressors and Expander – Compressors |
| 7 | API 670 | Vibration, Axial Position, and Bearing Temperature Monitoring Systems |
| 8 | API 671 | Special-Purpose Couplings For Refinery Service |
| 9 | API 676 | Positive Displacement Pumps—Rotary |
| 10 | ISO 10439-1 | Petroleum, petrochemical and natural gas industries Axial and centrifugal compressors and expander-compressorsPart 1: general requirements |
| 11 | ISO 10439-2 | Petroleum, petrochemical and natural gas industries Axial and centrifugal compressors and expander-compressorsPart 2: Non-integrity geared centrifugal and axial compressors |
| 12 | ASME PTC 10 | Performance Test Codes on Compressors and Exhausters |
| 13 | ASME PTC 22:2014 | Performance Test Code on Gas Turbines |
| 14 | ISO 1940 | Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state |
| 15 | ISO 2314 | Gas Turbines - Acceptance Tests.478 |
| 16 | ISO 3977 | Gas Turbine Procurement |
| 17 | NEMA SM23 | Steam Turbines for Mechanical Drive Services |
| 18 | ISO 7919-1 | Mechanical vibration of machines with non-reversible motion. Measuring on rotating shafts and evaluation criteria. Part 1: general requirements |
| 19 | 768/2008/EC | Uniform conditions for the marketing of safe products in the EU (conformity marking) |
| 20 | ISO 14694 | Industrial fans. Specifications for balance quality and vibration levels |
| 21 | ISO 2858 | End - suction centrifugal pumps (rating 16 bar). Designation, nominal duty point and dimensions |
| 22 | ISO 5199 | Technical specifications for centrifugal pumps |
| 23 | EN 837-1 | Pressure gauges. Part 1: Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing |
| 24 | ISO 8573-1 | Compressed air — Part 1: Contaminants and purity classes |

Table 1.6 – Codes and Standards Electrical and Control

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN 62061 | Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems |
| 2 | IEC 61 557 | Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC Equipment for testing, measuring or monitoring of protective measures |
| 3 | IEC 62443-1-1 | Technical specification: Industrial communication networks – Network and system security – Part 1-1: Terminology, concepts and models |
| 4 | IEC 62443-2-1 | Industrial communication networks – Network and systems security – Part 2-1: Establishing an industrial automation and control systems security program |
| 5 | IEC 62443-3-1 | Technical Report: Industrial communication networks – Network and system security – part 3-1: Security technologies for industrial automation and control systems |
| 6 | EN 61439, parts 1, 2 | Low-voltage switchgear and controlgear assemblies |
| 7 | EN 62305, part 1-4 | Protection against lightning set of standards |
| 8 | TNI CR 954-100 | Safety of machinery. Safety-related parts of control systems. Part 100: Guidance on the use and application of EN 954-1: 1996 |
| 9 | EN ISO 12100 | Safety of machinery. General principles for design. Assessment and risk reduction (ISO 12100: 2010) |
| 10 | EN 60034 | part Rotating electrical machines |
| 11 | EN 60204 | Safety of machinery – Electrical equipment od machines |
| 12 | EN 60445 | Basic and safety principles for man-machine interface, marking and identification of equipment terminals conductor terminations and conductors |
| 13 | EN 60332-2-1 | Tests on electric and optical fibre cables under fire conditions – Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable – Apparatus |
| 14 | EN 60870 | Telecontrol equipment and systems |
| 15 | EN 61508 | Functional safety of electrical/electronic/programmable electronic safety-related systems |
| 16 | EN 61131 | Programmable controllers |
| 17 | DIN VDE 0276-603 | Power cables – Part 603: Distribution cables of rated voltage 0,6/1 kV |
| 18 | DIN VDE 0276-627 | Power cables – Part 627: Multicore and multipair cables for installation above and below ground |
| 19 | EN 60079-10-1 | Explosive atmospheres. Part 10-1:Classification of areas. Explosive gas atmospheres |
| 20 | EN 60079 – 14 | Explosive atmospheres - Part 14: Electrical installations design, selection and erection |
| 21 | EN 60079 –17 | Explosive atmospheres. Part 17: Electrical installations inspection and maintenance |
| 22 | EN 50272 – 2 | Safety requirements for secondary batteries and battery installations. Part 2: Stationary batteries |
| 23 | EN 61140 | Protection against electric shock. Common aspects for installation and equipment |
| 24 | EN 60073 | Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators |
| 25 | EN 60446 | Basic and safety principles for man-machine interface, marking and identification. Identification of conductors by colours or numerals |
| 26 | EN 61310-1 | Safety of machinery. Indication, marking and actuation. Part 1: Requirements for visual, auditory and tactile signals |
| 27 | EN 50085-1 + A1 | Cable trunking systems and cable ducting systems for electrical installations. Part 1: General requirements |
| 28 | EN 60865-1 | Short-circuit currents. Calculation of effects. Part 1: Definitions and calculation methods |
| 29 | IEC 60947 | Low voltage switchgear and control gear |
| 30 | IEC 2/1276/CD:2003 | Rotating electrical machines |
| 31 | EN 12464-1 | Light and lighting. Lighting of work places. Part 1: Indoor work places. |
| 32 | EN 60529 | Specification for degrees of protection provided by enclosures (IP code) |
| 33 | EN 60909 | Short-circuit currents in three-phase a.c. systems - Part 0: Calculation of currents |
| 34 | EN 62305 | Part 1-4 - Lightning protection standards set |
| 35 | IEC/TR 60909-1 | Calculation of short-circuit currents in three-phase AC systems. Part 1: Coefficients for calculating short-circuit currents in three-phase AC systems according to IEC 60909 |
| 36 | TNI IEC/TR 60909-2 | Electrical equipment. Data to calculate short-circuit currents in accordance with IEC 60909: 1988 |
| 37 | EN 61310-1 | Safety of machinery. Indication, marking and actuation. Part 1: Requirements for visual, auditory and tactile signals |
| 38 | EN 12094-1 - 13 | Fixed firefighting systems. Components for gas extinguishing systems. - File norms |
| 39 | 94/9/EC and 99/92/EC | ATEX Regulations (94/9/EC is implemented into Slovak legislation by Ordinance No. 393/2006). |
| 40 | IEEE 519 | IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems |

Table 1.7 – Codes and Standards Firefighting equipment

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN 54 | Fire detection and fire alarm systems. |
| 2 | EN 15004 | Fixed firefighting systems. Gas extinguishing systems. Part 1: Design, installation and maintenance (ISO 14520-1:2006, modified) |
| 3 | ISO 6183 | Fire protection. Carbon dioxide extinguishing systems for use on premises. Design and installation |

Table 1.8 – Codes and Standards Vibrations

| No. | Number | Title |
| --- | --- | --- |
| 1 | ISO 10816-1 | Mechanical vibration. Evaluation of machine vibration by measurements on non-rotating parts. Part 1: General guidelines |
| 2 | ISO 10816-3 | Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts — Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15 000 r/min when measured in situ |
| 3 | ISO 7919 | Mechanical vibration on non-reciprocating equipment machines. Measurements on rotating shafts and evaluation criteria. |

Table 1.9 – Codes and Standards Noise

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN ISO 3746 | Acoustic. Determination of sound power levels of noise sources using sound pressure. Survey method using an enveloping measurements surface over a reflecting plane |
| 2 | ISO 10494 | Gas Turbines and Gas Turbine Sets - Measurement of Emitted Airborne Noise - Engineering/Survey Method |
| 3 | ISO 9613 | Acoustics - Attenuation of sound during propagation outdoors |
| 4 | EN ISO 11204+AC1 | Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a workstation and at other specified position applying accurate environmental corrections |
| 5 | EN ISO 1996-2 | Acoustics – Description and measurement of environmental noise Part 2: Acquisition of data pertinent to land use |
| 6 | ISO 9614 | Acoustics Determination of sound power levels of noise sources using sound intensity |
| 7 | ISO 11202 | Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections |
| 8 | EN 60034-9 | Rotating electrical machines. Part 9: Noise limits |
| 9 | LBN 016-15 | Building acoustics |

Table 1.10 – Codes and Standards Pressure Vessels and piping

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN 334 | Gas pressure regulators for inlet pressures up to 100 bar |
| 2 | EN 12732 | Gas infrastructure – Welding steel pipework – Functional requirements |
| 3 | EN 12327 | Gas infrastructure – Pressure testing, commissioning and decommissioning procedures – Functional requirements |
| 4 | EN 13445/Part 1-6 | Unfired pressure vessels |
| 5 | EN 13480 | Metallic industrial piping |
| 6 | EN ISO 3183 | Steel pipes for pipelines for combustible fluids – Technical delivery conditions – Part 2: Pipes of requirement class B |
| 7 | ISO 14313 | Petroleum and natural gas industries -- Pipeline transportation systems -- Pipeline valves |
| 8 | EN 13942 | Petroleum and natural gas industries - Pipeline transportation systems - Pipeline valves (ISO 14313:2007 modified) |
| 9 | EN 12266-1 | Industrial valves – Testing of metallic valves – Part 1: Pressure tests, test procedures and acceptance criteria – Mandatory requirements |
| 10 | EN 12266-2 | Industrial valves - Testing of metallic valves - Part 2: Tests, test procedures and acceptance criteria; Supplementary requirements |
| 11 | EN 14141 | Valves for natural gas transportation in pipelines – Performance requirements and tests |
| 12 | EN ISO 9712 | Non-destructive testing ― Qualification and certification of NDT personnel ― General principles |
| 13 | EN ISO 9016 | Destructive tests on welds in metallic materials - Impact tests - Test specimen location, notch orientation and examination |
| 14 | EN 1503-2 | Valves. Materials for bodies, bonnets and covers. Steels other than those specified in European Standards |
| 15 | EN 14141 | Valves for natural gas transportation in pipelines - Performance requirements and tests. |
| 16 | ISO 228 | Pipe threads where pressure-tight joints are not made on the threads |
| 17 | EN 1515-1,2,3 | Flanges and their joints – Bolting (series) |
| 18 | EN 10028-3 | Flat products made of steels for pressure purposes - Part 3: Weldable fine grain steels, normalized |
| 19 | EN 10216 | Seamless steel tubes for pressure purposes – Technical delivery conditions (series) |
| 20 | EN 10217 | Welded steel tubes for pressure purposes – Technical delivery conditions (series) |
| 21 | EN 10222 | Steel forgings for pressure purposes (series) |
| 22 | EN 10253-2 | Butt-welding pipe fittings - Part 2: Non alloy and ferritic alloy steels with specific inspection requirements |
| 23 | EN 12560-2 | Flanges and their joints – Dimensions of gaskets for Class-designated flanges – Part 2: Spiral wound gaskets for use with steel flanges |
| 24 | ISO 7-1 | Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation |
| 25 | EN ISO 6708 | Pipework components. Definition and selection of DN (nominal size) |
| 26 | EN 12627 | Industrial valves - Butt welding ends for steel valves |
| 27 | EN 14870-1 | Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 1: Induction bends (ISO 15590-1:2009 modified) |
| 28 | EN 14870-2 | Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 2: Fittings |
| 29 | ASME B16.5 | Pipe Flanges and Flanged Fittings NPS 1/2 through 24 |
| 30 | ASME B16.20 | Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed |
| 31 | ASME B16.47 | Large Diameter Steel Flanges: NPS 26 through NPS 60 |

Table 1.11 – Codes and Standards Coating and Painting

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN ISO 12944-1-8 | Paints and varnishes - Corrosion protection of steel structures by protective paint systems (series) |
| 2 | EN ISO 8501 | Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness. (series) |
| 3 | EN ISO 8502 | Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness. (Parts 2, 3, 4, 5, 6, 8 and 9) |
| 4 | EN ISO 8503-1-5 | Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates (Series) |
| 5 | EN ISO 11124-1-4 | Preparation of steel substrates before application of paints and related products - Specifications for metallic blast-cleaning abrasives (Series) |

Table 1.12 – Codes and Standards Welding and Nondestructive Testing

| No. | Number | Title |
| --- | --- | --- |
| 1 | EN 1011 | Welding - Recommendations for welding of metallic materials (Series) |
| 2 | EN 12732+A1 | Gas infrastructure – Welding steel pipework – Functional requirements |
| 3 | EN ISO 9692-1 | Welding and allied processes – Types of joint preparation – Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels |
| 4 | EN 1708-1 | Welding – Basic weld joint details in steel – Part 1: Pressurized Components |
| 5 | EN ISO 3834 | Quality requirements for fusion welding of metallic materials (Series) |
| 6 | EN ISO 15607 | Specification and qualification of welding procedures for metallic materials - General rules |
| 7 | EN ISO 15609-1 | Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding |
| 8 | EN ISO 15614 | Specification and qualification of welding procedures for metallic materials - Welding procedure test (series) |
| 9 | EN ISO 6520-1 | Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding |
| 10 | EN ISO/IEC 17020 | Conformity assessment – Requirements for the operation of various types of bodies performing inspection |
| 11 | EN ISO/IEC 17025 | General requirements for the competence of testing and calibration laboratories |
| 12 | EN ISO 9606-1 | Qualification test of welders - Fusion welding - Part 1: Steels |
| 13 | EN ISO 5579 | Non-destructive testing – Radiographic testing of metallic materials using film and X- or gamma rays – Basic rules |
| 14 | EN ISO 9712 | Non-destructive testing – Qualification and certification of NDT personnel |
| 15 | EN ISO 3452-1 | Non-destructive testing - Penetrant testing - Part 1: General principles |
| 16 | EN ISO 16810 | Non-destructive testing - Ultrasonic testing - General principles |
| 17 | EN ISO 10863 | Non-destructive testing of welds – Ultrasonic testing – Use of time-of-flight diffraction technique (TOFD) |
| 18 | EN ISO 11699 | Non-destructive testing - Industrial Radiographic Film (series) |
| 19 | EN ISO 17637 | Non-destructive testing of welds – Visual testing of fusion-welded joints |
| 20 | EN ISO 17638 | Non-destructive examination of welds – Magnetic particle testing |
| 21 | EN ISO 17640 | Non-destructive testing of welds – Ultrasonic testing – Techniques, testing levels and assessment |
| 22 | EN ISO 17635 | Non-destructive testing of welds – General rules for metallic materials |
| 23 | EN ISO 15626 | Non-destructive testing of welds – Time-of-flight diffraction technique (TOFD) – Acceptance levels |
| 24 | EN ISO 5817 | Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections |
| 25 | EN ISO 11666 | Non-destructive testing of welds – Ultrasonic testing – Acceptance levels |
| 26 | EN ISO 10675-1 | Non-destructive testing of welds – Acceptance levels for radiographic testing – Part 1: Steel, nickel, titanium and their alloys |
| 27 | EN ISO 23278 | Non-destructive examination of welds - Magnetic particle testing of welds - Acceptance levels |
| 28 | EN ISO 19232 | Non-destructive testing - Image quality of radiographs (Series) |
| 29 | EN 25580 | Non-destructive testing. Industrial radiographic illuminators. Minimum requirements (ISO 5580:1985) |
| 30 | EN ISO 16828 | Non-destructive testing – Ultrasonic testing – Time-of-flight diffraction technique as a method for detection and sizing of discontinuities |
| 31 | EN 12668 | Non-destructive testing - Characterization and verification of ultrasonic examination equipment (Series) |
| 32 | EN ISO 16811 | Non-destructive testing - Ultrasonic testing - Sensitivity and range setting |
| 33 | EN ISO 3059 | Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conditions |
| 34 | EN ISO 23277 | Non-destructive examination of welds - Penetrant testing of welds - Acceptance levels |
| 35 | EN ISO 6947 | Welding and allied processes - Welding positions |
| 36 | EN ISO 17636-1 | Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film |
| 37 | EN ISO 17636-2 | Non-destructive testing of welds - Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors |

Table 1.13 – Codes and Standards Civil

| No. | Number | Title |
| --- | --- | --- |
| 1 | LVS EN 1991-1-3 | Eurocode 1 – Actions on structures – Part 1-3 : General actions – Snow loads |
| 2 | LVS EN 1991-1-4 | Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions |
| 3 | LVS EN 1998-1 | Eurocode 8: Design of structures for earthquake resistance Part 1: General rules, seismic actions and rules for buildings |

## Directives of the European Community

* 2014/68/EU: Pressure Equipment Directive (formerly 97/23/EC)
* 2014/34/EU: Equipment and Protective systems intended for use in Potentially Explosive Atmospheres (ATEX) (formerly 94/9/EC)
* 2006/42/EC Machinery Directive (formerly 98/37/EC)
* 2014/30/EU: Electromagnetic Compatibility Directive (formerly 2004/108/EC)
* 2014/35/EU: Low Voltage Directive (formerly 2006/95/EC)
* 2015/2193/EU Limitation of emission of certain pollutants info the air from medium combustion plants
* 2010/75/EU Industrial emissions (integrated pollution prevention and control).
* 1999/92/EC Minimum requirements for improving the Safety & Health Protection of workers Potentially at Risk from Explosive Atmospheres

# GENERAL INFORMATION

## Scope of Responsibility and Addresses

Addresses

Employer Conexus Baltic Grid

Stigu street 14,

Riga, LV-1021, Latvia

Site Address Incukalns Underground Gas Storage

 Ragana

 Krimulda parish, Sigulda district, LV-2144, Latvia

The Site location is on the territory of the Incukalns UGS, the Krimulda parish of the Sigulda district of the Republic of Latvia, 0.25 km to the southwest from the highway of the state importance A3 Riga-Valmiera and 2.1 km to the southwest from the settlement of Ragana.

## Climatic and Environmental Conditions

The Supplier shall execute the Scope of Supply under full consideration of the site environmental conditions.

The general on-site climatic and environmental conditions to be considered are the following:

Table 2.1 - Site conditions

|  | Ambient temperature | Relative humidity (%) |
| --- | --- | --- |
| Min | -36,2°C | 66 |
| Avg | +6,4°C | 80 |
| Max | +33,2°C | 90 |

Altitude of the site is 70 m (1,005 atm).

Maximum ground freezing depth – 120 cm.

**Snow load value** to be considered for the compressor package design as applicable LVS EN 1991-1-3 «Eurocode 1 – Actions on structures – Part 1-3 : General actions – Snow loads”.

**Wind action value** to be considered for the compressor package design as applicable LVS EN 1991-1-4 “Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions”.

**Seismic zone** agR in % of g is 2. Value of the reference peak ground acceleration agr=0,20 m/s2 according LVS EN 1998-1 Eurocode 8: Design of structures for earthquake resistance Part 1: General rules, seismic actions and rules for buildings.

All control parameters must to transfer from equipment level to existing CS1 control room and to Incukalns UGS main control desk. Both rooms are not classified as hazardous area.

The temperature in these rooms is

 + 5 °C to + 35 °C

The equipment installed in these rooms shall be designed to operate in the given temperature.

## Operating Media, Auxiliaries

### Process Gas Composition / Transport Gas

The Supplier shall consider the process gas composition listed in document “Composition of Process Gas GCUI-CD-GOT-GEN-SPC-001” during the execution of the Scope of Supply.

Note: The possibility of the process gas blending by H2 to be considered – for further details see chapter 2.9 of this document

### Fuel gas

The fuel gas has the same composition and properties as the process gas specified in the document “Composition of Process Gas GCUI-CD-GOT-GEN-SPC-001”.

Site fuel gas conditioning unit (capacity = 24 000 Nm3/h) is providing the following fuel gas conditions:

Table 2.2 – Fuel gas pressure

|  |
| --- |
| Pressure (barg) |
| Min | Operational | Design |
| 23,6 | 24,8 | 34,5 |

Dew point of the fuel gas is the same like the process gas (not treated). Maximum value for water dew point to be considered is -10°C. Fuel gas is heated to 20°C at the conditioning skid outlet. Set point can be modified up to 30°C maximum.

The Supplier shall provide filtering and pressure reduction of fuel gas according to his requirements.

Note: The possibility of the fuel gas blending by H2 to be considered – for further details see chapter 2.9 of this document.

### Power Supply

Table 2.3 – Power supply

|  | Unit | LVS | UPS AC | UPS DC |
| --- | --- | --- | --- | --- |
|  |  | Power Grid  | Battery / Power Grid | Battery |
| Voltage | V | 400 | 230 | 1) | 1) |
| Type |  | AC | AC | 1) | 1) |
| Frequency | Hz | 50 | 50 | 1) | 1) |
| Power outage time | s | Up to 60 | Up to 60 | 1) | 1) |
| Network type |  | TN-S | TN-S | 1) | 1) |
| Network type for unit |  | TN-S | TN-S | 1) | 1) |
| Fuse rating |  | 3 or 4 poles | 1 or 2 poles | 1) | 1) |
| Max fuse size | A | 1) | 1) | 1) | 1) |
| Largest switchable load | kW | 1) | 1) | 1) | 1) |
| Max load | kW | 1) | 1) | 1) | 1) |
| **To be filled by Supplier:** |  |  |  |  |  |
| **Demand of station:** |  | 1) | 1) | 1) | 1) |
| Stopped | A | 1) | 1) | 1) | 1) |
| Starting | A | 1) | 1) | 1) | 1) |
| Operation | A | 1) | 1) | 1) | 1) |
| Emergency stop | A | 1) | 1) | 1) | 1) |
| Cool down | A | 1) | 1) | 1) | 1) |

1) to be defined by the Supplier

Stand-by power supply philosophy - GCU supplier shall guarantee within his scope of supply power back-up for GCU, to keep it in operation for min 3min (in case GCU is in operation and there is power supply failure, in last setup operational point). After 3min - UGS stand-by power supply will take-over or UCS shall ensure GCU safe and reliable shut-down/cool-down!

### Instrument air supply

Instrument air is available from existing station instrument air supply system at one single TIE-IN point for CU (location will be defined later). The quality of the instrument air at TC tie-in point is according to ISO 8573-1, class 1.3.1. The supply parameters for instrument air are as follows:

a) operating pressure 10 barg (16 barg max. available),

b) temperature (3-50)°C.

The Supplier shall prepare where the maximum consumption for CU, considering all possible operational modes and the environmental conditions specified in Mechanical datasheet of the Centrifugal Compressor (API 617 8th Ed template) doc. No. GCUI-TD-GOT-MEC-DAT-001 and Mechanical datasheet of the Gas Turbine (API 616 5th Ed template) doc. No. GCUI-TD-GOT-MEC-DAT-002, shall be specified. The Supplier shall state List of Comments, Exceptions and Deviations all requirements for instrument air quality, pressure and temperature parameters if these deviate from the above listed parameters. The Supplier shall keep the instrument air consumption as low as possible. The Supplier shall provide filtering and pressure reduction according to his requirements within the scope of supply.

### Other operating media

The Supplier shall specify all operating media (instrument air, N2, oil, fuel gas etc.) required for the operation of the TC including all required parameters and all operating modes. There is no possible nitrogen in facility. If for CU driving the nitrogen is necessary the supplier must to include the costs of system production and delivery in proposal.

## Noise Emissions

The Supplier shall execute the Scope of Supply under full consideration of the specified noise limits, as follows.

### Outside the TC enclosure

The noise level shall be max. 80 dBA at 1m distance from the compressor package and 1,5 m elevation above the ground.

Requirements of EN ISO 3746 or/and ISO 9614

Acoustics-Determination of sound power levels of noise sources using sound pressure. Survey method use an enveloping measurements surface over reflecting plane.

Applicable for:

* Exhaust duct and stack outside the building
* Oil cooler
* Hot By-Pass Valve and the Anti Surge Regulation Valve
* Compressor related process piping system - pipeyard
* Air intake duct outside TS enclosure

Exceptions:

For Exhaust stack outlet the sound level shall be measured according to ISO 10494.

Turbines and turbine sets — Measurement of emitted airborne noise — Engineering/survey method.

Requirements of EN ISO 1996-2 LCpk < 137 dB,

Acoustics – Description and measurement of environmental noise

Part 2: Acquisition of data pertinent to land use.

All unit related depressurization and vent pipes - limit level is: LCpk < 137 dB

Guarantee noise emission measurement shall be performed by a Third Party, certified Authority on the account of the Supplier.

## EMISSION limits

Emission limits values are stipulated in Regulation 2015/2193/EU Coll. The following emission limits shall be guaranteed over the entire operating range:

NOx \*50 mg/m3 @ 15% O2

CO \*100 mg/m3 @ 15% O2

\* The emission limits apply for concentrations calculated for dry gas at standard conditions
101.3 kPa a 273,15 K and for oxygen content in waste gases 15% vol.

Emission limits shall be applicable for ambient temperature range (from -25 °C up to 40 °C) and from 100 % down to 50 % of gas turbine base load.

## Design Life

Equipment should be suitable for minimum 25-year design life.

Operating hours per year is from 4 000 to 6 000.

Machinery trains, valves, controls and auxiliary support systems shall be designed for a minimum of 30-year design life.

Equipment shall be well proven with suitable experience references.

## Area Classification and Ambient Conditions in Enclosures

The explosion – hazard zone classification shall be in accordance with European ATEX regulations 94/9/ EG, 99/927 EG and EN 60079 and will be defined by the Consultant.

Should the Supplier allocate further enclosures to a particular zone in line with the regulations quoted below, the Employer must be consulted. Operational equipment or components in Zone 2 with surface temperatures of more than 650°C shall be specified in the bid.

The machine enclosure shall be ventilated in line with the requirements stipulated by EN 12583 taking into consideration the area classification and the maximum ambient temperature permitted for electrical operational equipment.

In the event of machine standstill, a minimum temperature inside the machine enclosure of + 5°C shall be ensured. Any special heating required for this purpose shall be included in the scope of delivery. During any operating, start or shut-down mode the ambient temperature incl. radiation in the enclosure shall in no case endanger the electrical instrumentation.

The electrical operational equipment to be used must be permitted by the manufacturers involved for operation at the potential ambient temperature encountered at its site of installation. The Supplier shall provide evidence that the permitted ambient temperatures of the electrical operational equipment are not exceeded.

The electrical operational equipment must be suitable for hot area.

## Agreements

The following computer files are part of this specification and are attached to the Tender documentation in digital form:

* Mechanical datasheet of the Centrifugal Compressor (API 617 8th Ed template) doc. No. GCUI-TD-GOT-MEC-DAT-001
* Mechanical datasheet of the Gas Turbine (API 616 5th Ed template) doc. No. GCUI-TD-GOT-MEC-DAT-002
* Data Sheet Dry Seals document No. GCUI-TD-GOT-MEC-DAT-007
* Guaranteed Data (according Chapter 4.2.1 and 4.2.2)
* Power Supply Data Sheets for Unit (see Table 2.3)
* Noise Emission Requirements (see Chapter 2.4)

These files have to be completed (unprotected cells) and submitted in digital format with the bid.

All deviations from the quoted regulations and standards shall be expressly specified and approved by the Employer.

API data sheets shall be submitted with the bid. SI units shall be used exclusively throughout the documentation, data sheets, correspondence, labels, displays, etc.

Only bids including complete technical information’s will be further considered.

The Supplier shall specify the overall efficiency rating of the machine unit in line with ISO conditions and site conditions for the operating and guarantee points in compliance with the de-tails contained in the data sheet.

The Employer must be allowed to inspect the production and the requirements stipulated by the specification at any time. The Supplier shall be responsible for designing the complete units.

As regards the technical part, the bid and any correspondence in connection with this bid shall be produced in English. Documentation for approval or revision shall be provided in English language. The final documentation and all manuals shall be provided in Latvian and English language (See Annex 1).

All submitted documentation shall not be made available to third parties without the Supplier consent.

Special reference is made to the fact that provisional take-over and final acceptance can only be performed following technical acceptance by an independent expert.

## GCU readiness for H2 blended process gas

### General

Process gas composition for the Project to be considered for the GCU design - as defined in article no. 2.3.1 of this document - to reliably cover all defined operational points (ref to article no. 4.2.2) shall consider also the possibility of process gas blending with H2 without any impact to GCU capacity, reliability, lifetime and/or availability. The H2 blending limitations to be guaranteed for the Gas Turbine and the Process Gas Compressor are defined in following.

### Gas turbine fuel gas

The GCU supplier shall guarantee that the Gas Turbine will provide sufficient power output to fully cover all defined operational points at full range of Project defined ambient temperatures and other site conditions with fuel gas blended with H2 up to 15% (volumetric) without any impact to GCU capacity, reliability, lifetime and/or availability

### Process gas Compressor

GCU supplier shall guarantee that the Process Gas Compressor can fully cover all Project defined operational points at full range of Project defined process and site conditions with fuel gas blended with H2 up to 5% (volumetric) without any impact to GCU capacity, reliability, lifetime and/or availability.

GCU supplier shall provide optional technical solution and price for the Process Gas Compressor modification or replacement (whichever applicable) to guarantee that the Process Gas Compressor can fully cover all Project defined operational points at full range of Project defined process and site conditions with fuel gas blended with H2 up to 15% (volumetric) without any impact to GCU capacity, reliability, lifetime and/or availability. The option shall be valid and applicable for min 5 years from the Contract signature

# SCOPE OF SUPPLY

The Supplier shall execute the Scope of Supply in accordance with the content of this specification and specification of process coolers, and all related documents. The Supplier shall execute the Scope of Supply in compliance with the applicable legal provisions and official regulations, as well as in accordance with the established rules and the current best practice of the oil & gas industry and Employer internal standards. Subcontracting of relevant parts of the Scope of Supply to subcontractors is permitted only after approval by the Employer.

The Supplier shall deliver a complete, self-contained and brand new package. All activities, materials and supplies included in the Scope of Supply shall be provided by the Supplier, even if they are not mentioned and / or described in this document.

The Scope of Supply shall include the design, documentation, manufacturing, shop- testing, certification according to applicable regulations and standards, transport to Site, on-site installation supervision (as specified by the Employer), commissioning and testing up to the TAKEOVER by the Employer of the entire Scope of Supply.

## MinIMUM Scope of supply

The minimum scope of supply (equipment, components and documentation) shall be ONE functional complete package - gas turbine driven compressor unit. CU package including all necessary auxiliaries shall be standard configuration and shall include minimum as follows:

1. Suction duct for gas turbine including filtrating system, silencer, anti-icing system, anti-condensation heating (if necessary) etc.
2. Gas turbine enclosure including maintenance hoist suitable for outdoor installation, installed on common base frame with the compressor; base frame shall be supplied with all anchor bolts, lifting points for mechanical handling and levelling pads,
3. Flexible coupling incorporated with torque meter
4. Compressor enclosure including maintenance hoist suitable for outdoor installation, installed on common base frame with the gas turbine; base frame shall be supplied with all anchor bolts, lifting points for mechanical handling and levelling pads. It is acceptable to unified encloser for hole CU,
5. CU enclosure ventilation system – inlet/outlet ducting incl. filtration, anti-ice, fans (main, stand-by, emergency), fire dampers etc.,
6. Compressor suction strainers, designed for 1 year operation including differential pressure transmitter with process hook-ups, pipe spooling, flanges, counter-flanges, gaskets, bolts, nuts, washers and spacer (spacer shall be installed after removal of the suction strainer). The Supplier shall include additional sets of gaskets, bolts, nuts, washers for suction strainer for TC with the commissioning spares,
7. Complete lubricating oil system including oil tank, filters, pumps (main, standby and emergency) and air oil cooler. Oil system to be one common system for gas turbine and compressor.,
8. Complete Dry Gas Seal system for compressor sealing,
9. Complete starter system for the gas turbine,
10. Fuel Gas system including filtration, metering, control valve, main shutoff and vent valves,
11. Anti-Surge Control valve including flanges, counter flanges, bolts, washers, gaskets etc. incl. min SIL 2 and “fail open” certification
12. Hot bypass valve (if required), including flanges, counter flanges, bolts, washers, gaskets etc. incl. min SIL 2 and “fail open” certification
13. Local vents including all required vent valves, piping, restriction orifice, bursting discs, flame arrestors, noise silencer, etc. incl. min SIL 2 and “fail open” certification
14. All materials and special tools required for the installation and commissioning of TC including installation of all interconnecting piping included in the Scope of Supply,
15. Counter flanges for the suction and discharge flanges of CU including all consumables (bolts, nuts, washers, gaskets) and all required bolt tightening torque specifications and flange alignment criteria,
16. Pressurization / filling valve for CU including flanges, counter-flanges, gaskets, bolts, nuts and washers (to be installed in by-pass of CU main suction isolation valve) incl. min SIL 2 and “fail close” certification
17. Depressurization valve for CU including flanges, counter-flanges, restriction orifice, gaskets, bolts, nuts and washers (to be installed on CU main discharge piping) incl. min SIL 2 and “fail open” certification
18. Interconnecting piping between main and all auxiliary skids (within Supplier´s scope of supply),
19. Exhaust duct including stack, silencer and rain hood
20. Water wash skid (if required)
21. Supporting steel structures for all equipment supplied by Supplier including anchor bolts, nuts and washers,
22. Complete control and instrumentation systems, including the following as a minimum:
	* Unit control systems and cabinets
	* Instrumentation and sensors
	* Signal cabling and junction boxes for the unit control system
	* Hook-up and installation material
	* Software back-up / recovery CDs
23. Two (2) sets of operator and engineering workstations for CU, which shall be installed as per following:
	* one (1) set for TC including server and KVM-E to be installed in the local control room (UCS),
	* one (1) set for TC including KVM-E to be installed in the Main control room (SCS),
24. LV switchgear panels (MCC) for TC
25. UPS for compressor package auxiliaries including batteries, charger and related switching equipment,
26. All required junction boxes including LV, I&C, earthing, lighting,
27. Terminal boxes, local control stations including maintenance switches for each supplied skid / equipment,
28. All on-skid cabling (package cabling) including MV, LV, I&C, telecommunication, earthing, equipotential equalization, lighting,
29. Interconnecting cabling between all equipment in the Scope of Supply, including LV, I&C, telecommunication, earthing, equipotential equalization, lighting (estimated distance up to 150 m)
30. All cabling between UCS and I&C equipment controlled by the UCS and supplied by Supplier (ESD valves on suction and discharge lines, isolation valves in the recirculation and discharge lines, vent valve, pressure equalization valve),
31. All materials (cable trays, conduits, glands, gas sealed cable transitions etc.) and tools required for installation of all package and Site cabling within the Scope of Supply,
32. Earthing connection points for all equipment / skids included in the Scope of Supply. The Site common earthing network will be supplied by others (protective earth, functional earth),
33. Trace heating including insulation and cladding,
34. Lighting including emergency lighting inside the enclosure,
35. Enclosures for the TC to outdoor environment incl. ventilation system,
36. Package fire & gas detection
37. Enclosure firefighting system (CO2),
38. Gas process Coolers for each compression stage according the requirements of technical specification No. GCUI-TD-GOT-MEC-SPC-003 Tender specifications for process cooler,
39. One (1) set of Special Tools required for installation, maintenance and overhaul of all equipment included in the Scope of Supply,
40. One (1) set of Special Tools required for the first inspection,
41. Spare parts required for start-up, commissioning, guarantee period and first inspection,
42. Chemicals for first fills for all equipment must to be included in the Scope of Supply,
43. Documentation as per chapter 9,
44. Nitrogen production package, if necessary (option)
45. Guarantee period for the Scope of Supply according chapter 2.6

The design and selection of all equipment included in the Scope of Supply listed above shall be as per this specification and all documentation listed in paragraph 1.5.

## Scope of Services

The Scope of Supply shall include but not be limited to the following services:

1. Detail engineering for the TC and all auxiliary systems included in the Scope of Supply,
2. Detail engineering for all interconnecting cabling in the Scope of Supply,
3. Detail engineering for all cabling between UCS and I&C field equipment controlled by the UCS and supplied by others (isolation valves on suction, anti-surge and discharge lines),
4. Detail engineering for all cabling between MCC and field power equipment controlled by the UCS and supplied by others,
5. Detail engineering for all interconnecting piping in the Scope of Supply,
6. Detail engineering for all local TC vents (see chapter 4.2.12),
7. Detail engineering for all mechanical (document No. GCUI-TD-GOT-MEC-DWG-002), electrical and E&IC interfaces (document No. GCUI-TD-GOT-GEN-DWG-003),
8. Factory inspections and testing, certification, protocols, inspection and testing reports for all equipment in Scope of Supply according to chapter 5 and all specified regulations and standards, refer to chapter 1.5 (List of relevant Standards and Regulations),
9. Lateral and torsional analysis for the entire GT – CU train, including couplings (if applicable) as per API 617,
10. Conformity Assessment and CE Marking as per directive 768/2008/EC for the equipment in the Scope of Supply,
11. Preservation prior to shipping, packing and transportation to site,
12. Supervision for Site installation and assembly of all equipment included in the Scope of Supply; all tools and procedures required for Site installation and assembly shall be provided by the Supplier,
13. All required 3rd Party Site Inspections as well as Site inspections and examinations by Latvian authorities,
14. Start-up, commissioning, Site testing up to TAKEOVER by the Employer as per chapter 8,
15. Modification works on the material/equipment on site (if needed),
16. Training at Supplier premises and on-site including training documentation; shall include training for maintenance and operation personnel, as per chapter 12,
17. All inspections applicable during the Guarantee Period for the equipment included in the Scope of Supply.

The Supplier shall provide prices for the equipment and services listed in chapters 3.1 and 3.2 with considering the requirements (e.g. base scope, optional scope, etc.) and the project templates specified in the commercial part of the tender documentation.

## Scope for Maintenance

The Scope of Supply shall include maintenance works schedule for all equipment listed in chapter 3.1. The proposed maintenance works schedule shall include and specify all maintenance works for life time as per chapter 2.6 of this specification. The Supplier shall prepare the maintenance schedule and scope of work.

The scope for maintenance shall include as a minimum the following information for all maintenance levels:

* All maintenance tools required,
* All Site maintenance personnel required from the Supplier and Employer,
* Requirements and extent for equipment dismantle.

As the option (not included in offer) Supplier could provide the financial proposal to provide the maintenance service for 15 years and the 1st major overhaul.

## Accepted technical solutions

The Supplier shall offer the one set of back-to-back or tandem centrifugal compressors driven by gas turbine. As the tandem centrifugal compressors provide wider efficient working field, that type will be evaluated higher.

Compressor(s) shall be designed, manufactured and tested as per API 617 8th or any later edition. Compressor(s) shall be barrel type (vertical split) and complete with dry gas seal system and pressurized lube oil system.

Bidder can consider the possibility of having two sections in one body arrangement (back to back) or tandem configuration to allow operation in serial/parallel mode to fulfil all required operating conditions, as defined in chapter 4.2.2.

The gas turbine will be designed, manufactured & tested by selected producer as per API 616 5th Ed.

Gas turbine can be industrial or aero-derivate type, two shafts assembly (GG + PT), dry low emissions (DLE) and single fuel (gas).

The typical requirements for equipment and auxiliaries are shown in the table below:

Table 3.1 - Requirements for equipment and auxiliaries

| System | Requirements |
| --- | --- |
| Gas turbine drive |  |
| Natural Gas Compressor  |
| Gearbox | If required |
| Bearing system | Hydraulic bearings |
| Seal system | Dry gas seals |
| Load Coupling | Required |
| Starter system for the gas turbine | Required |
| Instrumentation & Controls | Required |
| Oil lubrication systems including oil cooler | Required |
| Suction duct for gas turbine including filtrating system, silencer and antiicing system | Required |
| Exhaust duct including stack and silencer | Required |
| Gas turbine and compressor enclosure | Required for outdoor installation |
| Suction strainers | Required |
| Anti-surge valve | Required |
| Hot-bypass valve if required | Required |
| Depressurization - vent valve | Required |
| Pressurization / filling valve | Required |

# TECHNICAL DESCRIPTION

The CU shall be designed for outdoor installation and for fully automatic and unmanned operation. The CU shall be designed to operate to a large extent independently of operator intervention and with the primary emphasis on maximum efficiency and maximum availability.

All equipment provided by the Supplier shall be part of an established and proven product range, shall meet the requirements (explicit or implicit) of this specification, and serve the intended purpose. Unproven or prototype equipment or components shall not be delivered by the Supplier unless such equipment has been accepted in writing by the Employer.

The Supplier shall confirm that the proposed CU and main auxiliary equipment – has completed min. 15,000 operating hours in similar projects as unified system.

The Supplier shall consider the following documents which specify all battery limits for the equipment included in the Scope of Supply:

* + 1. Mechanical Interfaces (document No. GCUI-TD-GOT-MEC-DWG-002,)
		2. Electrical and I&C Interfaces (document No. GCUI-TD-GOT-GEN-DWG-003,)
		3. Civil interfaces referred to in this specification: for the installation on foundation connection all necessary connection equipment (foundation guiding template, anchor bolts, nuts, earthing lugs, etc.) and drawings in the Scope of Supply shall be provided by the Supplier.

## Gas turbine

The engineering, manufacturing, testing, installation and commissioning of the GT and auxiliary systems shall be performed in compliance with the specified regulations and standards listed in chapter 1.5 and in compliance with this specification and all referenced documents.

The Supplier shall list all comments, exceptions and deviations from API RP11 PGT92 Edition and from all documentation and in the this technical specification and its annexes.

In certain points, API RP11 PGT92 requires that decisions are made by the Employer. These amendments as well as clarifications and additional requirements to the different components are specified in the following paragraphs where applicable with reference to the corresponding API RP11 PGT92 paragraphs.

### Design Basis

The Supplier shall consider the following technical requirements as a minimum for the design and selection of the GT:

* The performance requirements of the gas turbine package are the specified operating points of the natural gas compressor described in in chapter 4.2.1 and 4.2.2
* Process gas composition as specified in chapter 2.3.1,
* Environmental conditions as specified in chapter 2.2,
* API 616 Gas Turbine Data-Sheet in document No. GCUI-TD-GOT-MEC-DAT-002 Mechanical datasheet of the Gas Turbine (Supplier shall fill in the blank spaces in the Data-Sheet),
* All relevant information as per chapter 1.5,
* Mechanical Interfaces as per document No. GCUI-TD-GOT-MEC-DWG-002,
* Electrical and I&C interfaces as per document No. GCUI-TD-GOT-GEN-DWG-003.

The Supplier shall consider the Employer deviations to API 616 5th Edition for the design and selection of the GT. These are listed in chapter 4.2.3, chapter 4.2.5 and chapter 4.2.14.

### General Construction Data

In general, the gas turbine shall be designed in accordance with API RP11 PGT92 edition. The following item numbers refer to the appropriate sections of this API standard.

* Item 2.1 - The gas turbine package shall enable easy access to all bare gas turbine components and auxiliaries incl. all flange connections and joints in the intake, exhaust and anti-icing system.
* Item 2.1.4 - The start-up time through to the "ready for loading" status shall be specified in the case of a pressurised natural gas compressor.
* Item 2.1.6 - See Chapter 4.11 ("Control and Instrumentation").
* Item 2.1.8.1 - The delivery periods shall also be specified.
* Item 2.1.9.1 - See Chapter 2.2 ("Climatic and Environmental Conditions").
* Item 2.1.9.2 - See Chapter 2.7 ("Area Classification and Ambient Conditions in Enclosures").
* Item 2.1.10 - Noise abatement measures are to be realised in order to avoid pure tones in the entire frequency range, so that the difference between the attenuated linear sound power level and the specified power level is always less than 20 dB(A).

The un-damped sound power level for all components including a frequency analysis between 63 - 8000 Hz must be given. Noise will be measured and the results evaluated for acceptance in line with ISO 9614, ISO 9613, EN ISO 3746 and ISO 10494.

The required limits for noise emissions are defined in Chapter 2.4.

Note:

The gas turbine and the CU are installed inside the enclosure. The oil cooler will be installed outside the enclosure.

* Item 2.1.11 - Water or steam injection and catalyser is not permitted in order to comply with maximum pollutant emission levels or for boosting gas generator power.

Emission limits values are stipulated in Regulation No. 2015/2093/EU Coll defined in Chapter 2.5 and as follows.

Nitrogen oxides 50 mg/m³ and for CO 100 mg/m³ at 0°C and 101.325 kPa referred to 15% O2 in dry exhaust gas. Emission limits are applicable for individual turbines at the basic load higher than 70%.

* Item 2.1.12 - Reference shall be made to "Gas composition (see Chapter 2.3.1).

The gas turbine must be operational at all operating points (see Chapter 4.2.2) with gas composition values as defined in Chapter 2.3.1).

* Item 2.2.3 - See Chapter 3 ("Scope of Supply").
* Item 2.2.5 - See Chapter 1.5 (Codes and Standards)
* Item 2.2.12.2 - Standstill periods of up to one year shall be taken into consideration in the design. Any necessary maintenance work shall be specified.
* Item 2.2.17 - See Chapter 2.7 ("Area Classification and Ambient Conditions in Enclosures").
* Item 2.3.1.2 - The gas turbine shall be designed in compliance with API 616 5th edition, Section 2.
* Item 2.3.2.2 - The connection between the power turbine and the natural gas compressor shall be designed in line with API 671.

In order to determine the power output, a torque meter system shall be included.

The accuracy rating of the systems shall be specified. The variables involved shall be available in the UCS for further calculations (including for further processing in the trend monitoring system) as well as for archiving purposes.

* Item 2.3.4.1 - A load gear shall be avoided.
* Item 2.6.2 - Material certificates and traceability of parts subjected to pressure shall be provided.
* Item 2.7.3 - All data shall be specified as SI units.
* Item 3.1.1 - After an abortive start, the system must permit as a minimum two immediate re-starts. The necessary waiting time (if any) required in connection with a re-start shall be specified. The starting system has to be absolutely reliable (see also Chapter 4.1.4).
* Item 3.2.1 - The necessary concrete foundations will be provided by the Employer in coordination with the Supplier.
* Item 3.2.3.2 - Height adjusters, e.g. shim plates, for the TC base frame shall be provided.
* Item 3.3 - Gas turbine enclosure shall be accessible for inspection and maintenance activities including suitable crane for maintenance.
* Item 3.3.1.1 - See Chapter 2.7 ("Area Classification and Ambient Conditions in Enclosures").
* Item 3.3.2.1 - Conservation shall be adjusted in line with the climatic conditions involved and selected so that remedial work only proves necessary after a minimum period of five years.
* Item 3.3.2.2 - Suitable hoisting facilities shall be provided for maintenance work. In particular, the Supplier shall outline the necessary dismantling and reinstallation work for the following modules and specify the relevant time required for these purposes:
	+ Gas generator
	+ Power turbine rotor
	+ Coupling (s)
	+ Compressor bundle (in case of tandem configuration inner compressor bundle shall be maintenance free without removal or disassembly of the outer compressor)
* Item 3.3.3.2 CO2-fire-fighting system will be provided by the Supplier. The Employer will review and approve the design. CO2 concentration has to be maintained in the acoustic enclosure over a period of min. 20 min without additional CO2 consumption. Supplier shall perform tightness test of acoustic enclosure during commissioning. See also Chapter 4.10.
* Item 3.3.3.4 - Unit fire detection system to be provided by the Supplier. Employer will review approve the design.
* Item 3.3.3.5 - Gas detection system to be provided by the Supplier. Employer will review and approve the design.
* Item 3.3.4.1 - The enclosure shall be equipped with a forced ventilation system to ensure the maximum allowable temperature of the electrical equipment is not exceeded; the air temperature (incl. heat radiation) shall in any case be kept below 70°C. Everything with a surface temperature > 60°C shall be protected from direct contact.

The voltage level for the AC-motor of the fan must be 400 V (plus/minus 10 %). The motor type of protection shall be in accordance with EN 60079-14 and suitable for installation in ATEX Zone1.

The design of the venting system shall ensure a successful start-up and operation of the TC even by the lowest outside temperature.

The ventilating system must be equipped with a back-up allowing normal operation.

The emergency ventilation system shall be designed to enable a continuous operation of the GT during an electrical power outage for at least three minutes.

* Item 3.3.4.2 - The ventilation system shall be fitted with air filters, silencers and automatic fire dampers
* Item 3.4.1.2 - The air intake system shall also be equipped with an air dryer which conserves the air intake ducts, the gas turbine and the exhaust gas system when the GT is not in operation. For this purpose, an electrically actuated (manual operation must also be possible) louver shall be installed at a suitable location at the intake duct. Both of these shall be suitable for automatic operation and tied into the UCS.

The scope of delivery shall also include the following items:

* + Anti-icing system (to be discussed in detail with and approved by Employer)
	+ Walkways, railings, platforms and ladders for maintenance and repair purposes
	+ Inspection openings for each filter stage and silencer
* Item 3.4.1.3 - The pressure drop under the specified conditions shall be indicated.
* Item 3.4.1.7 - All metal surfaces directly in contact with the air flow shall be made of stainless steel.
* Item 3.4.2.1 - A two-stage air filter (cassette filter) shall be provided; the first stage shall correspond to filter grade EU 6 and its final stage shall be High Efficiency (H)EPA E12 or equivalent. Any different solution preferred in line with the manufacturer’s experience shall be offered as an alternative and described as appropriate.
* Item 3.4.2.2 - The filter elements shall be fully incinerable.
* Item 3.4.7.1 - An anti-icing system shall be included in the Proposal. The activation criteria of the anti-icing system shall be indicated.
* Item 3.5.2 - Design of the exhaust system shall also take into consideration the following aspects:
	+ In general the exhaust stack design shall be in accordance with Supplier’s standard. There shall be the possibility of sampling exhaust gas at a suitable point. An inspection opening shall also be installed. Within Supplier’s scope of supply shall be implemented preparation for installation of Emission Monitoring System – sample nozzles on exhaust stack. Specification of sample nozzles as well as their location on the stack shall be provided to Owner for review and approval.
	+ Platforms and ladders (if applicable) shall be provided at the stack. The accident prevention regulations shall be observed.
	+ Exhaust stack height shall be up to the 22 m.
* Item 3.7.7 - The lubricating oil system shall be designed in line with API 614 with an air-cooled, vibration-monitored oil cooler, oil filter, oil heater and venting system including oil mist extractor. The venting has to be equipped with the oil fog separator to ensure that there is no oil content in the gas vented to atmosphere.

System must be designed in the way that the environment (soil, air) will not be endangered.

The tank shall be electrically heated (400/230 V AC system).

The oil tank and lube oil piping shall comply with European valid legislation.

Flanges shall be minimised and configured in such a way as to prevent any oil from contacting the hot machine parts in the event of any leakages.

The Supplier shall specify a firm value for maximum oil consumption for gas turbine and compressor.

* Item 3.8.2.3.1 - In addition to the components specified by API, a fuel gas shut-off valve will be integrated by the Supplier. This valve shall be tripped by the ESD system.

A "Fuel Gas Vent Pipe Section Free" message shall be sent to the unit control system via a pressure switch in the fuel gas line.

* Item 3.9.3.9 - Dry air for purging will not be available.
* Item 3.10.2 - See Chapter 4.12 ("Electrical requirements").
* Item 4.3.5.3 – See Chapter 5

### Base Frame

The base frame of the CU shall accommodate the CC, the GT, and all required instrumentation racks as well as oil tank.

Anchor bolts and all connection materials (refer to chapter, point c) as well as all required alignment equipment shall be part of the Scope of Supply. The base frame construction must allow good accessibility for inspection and maintenance purposes and shall be provided with access platforms.

### Start system

Complete starter system will be supplied by the Supplier. The Supplier shall supply his standard type of starting system.

Depending on the type, TC starter system shall be integrated into CU skid or as separate package/skid to be located as close as possible to the CU, in order to keep the distance to the unit at minimum.

The maximum noise emission of the starter system shall also meet general requirements indicated in chapter 2.4.

The system shall be designed for the operation at the extreme min/max ambient temperatures specified in chapter 2.2.

Available power supply for electrical starting system shall be 400 V AC, 50 Hz.

### Fuel system

The system will be supplied with all necessary devices for an automatic, safe and reliable operation of the GT at any speed and load.

Complete fuel gas system including filtration, pressure regulator, pre-heating (if applicable) and metering shall be designed, supplied and installed by the Supplier from Employer battery limit up to the TC. The maximum available fuel pressure and other parameters is accordance chapter 2.3.2. The battery limits are defined in document No. GCUI-TD-GOT-GEN-DWG-002 and GCUI-TD-GOT-MEC-DWG-003.

The Supplier will install fuel gas line including filter, pressure regulation and fuel gas flow metering (for emissions control purpose). Inlet flange of fuel gas coalescer including electrical heating system for the separation of condensate and ESD fail-safe shut-off valve with the venting valve controlled by UCS and located outside the acoustic enclosure. All fuel gas system related piping installed by the Supplier shall be stainless steel. The ESD fail-safe shut-off valve shall be equipped with the function slow open.

In case the actual gas analysis is required by UCS for emissions control, performance test or any other purposes it is available and can be provided by Employer. The details of related battery limits and interface will be defined in engineering process. The Supplier should point out this need in its Proposal.

## Natural Gas Centrifugal type Compressor Unit

The Supplier will supply compressor including dry gas seal system with heater and booster of pneumatic type. Supplier will provide either well known reliable DGS producer (Eagle Burgmann or John Crane or adequate).

The Compressor must be switched from serial to parallel operation and vice versa in fully automated mode, without any operational maintenance staff activities during the changeover.

The engineering, manufacturing, testing, installation and commissioning of the CC and auxiliary systems shall be performed in compliance with the specified regulations and standards listed in chapter 1.5 and in compliance with this specification and all referenced documents.

The Supplier shall list all comments, exceptions and deviations from API 617 8th Edition and from all documentation and in this technical specification and its annexes.

In certain points, API 617 8th edition requires that decisions are made by the Employer. These amendments as well as clarifications and additional requirements to the different components are specified in the following paragraphs where applicable with reference to the corresponding API 617 8th edition paragraphs.

### Design Basis

The Supplier shall consider the following technical requirements as a minimum for the design and selection of the CC:

* Design and guaranteed operating points listed in chapter 4.2.2,
* Gas compositions as specified in chapter 2.3.1,
* Environmental conditions as specified in chapter 2.2,
* API 617 8th edition Compressor Data-Sheet in document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor (Supplier shall fill in the blank spaces in the Data-Sheet),
* All relevant information as per chapter 1.5,
* Mechanical Interfaces as per document No. GCUI-TD-GOT-MEC-DWG-002,
* Electrical and I&C interfaces as per document No. GCUI-TD-GOT-GEN-DWG-003.

Furthermore, the Supplier shall design and select the CU such that:

* the Design Point W1 specified in chapter 4.2.2, shall exhibit the highest compressor efficiency,
* the operating points specified in chapter 4.2.2 and document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor shall exhibit polytrophic efficiencies above 80% as far as possible,
* all operating points specified in chapter 4.2.2 and document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor shall be located in the compressor operating envelope,
* all operating points specified in chapter 4.2.2 and document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor shall be at min. 10% (flow) from the anti-surge line.

The Supplier shall consider the Employer deviations to API 617 8th edition for the design and selection of the CU. These are listed in chapter 4.2.2, chapter 4.2.3 and chapter 4.2.13.

### Operating points

Operating points are indicated at the compressor flanges. Operating points are listed in the following table:

Table 4.1 – Compressor operating points

|  | P inlet (barg) | P discharge (barg) | Q (Nm3/h) | Q (MNm3/day) |
| --- | --- | --- | --- | --- |
| Injection – I1 | 25 | 105 | Min-Max TBA (\*) | Min-Max TBA (\*) |
| Injection – I2 | 40 | 80 | Min-Max TBA (\*) | Min-Max TBA (\*) |
| Withdrawal – W1 | 25 | 55 | 500 000 | 12 |
| Withdrawal – W2 | 30 | 55 | 625 000 | 15 |

(\*) will be determined by the Consultant based on compressor unit potential suppliers’ inputs and shall indicate the minimum/maximum flowrate possible during engineering. For minimum flowrate (without recycling), it shall be considered the minimum acceptable load of the turbine to respect emissions levels as per European directives.

Withdrawal – W1 point shall be the guaranteed point.

### General Construction Data

In general, the centrifugal compressor shall be designed in accordance with API 617, 8th edition. The following item numbers refer to the appropriate sections of this API standard.

API 617, Point4.4.1.1.2 - operating points specified in chapter 4.2.2 and document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor

API 617, Point 4.4.1.2 – See chapter 8.3.3.

API 617, Point 4.4.1.4 – No liquid injection.

API 617, Point 4.4.1.6 – According chapter 1.5

API 617, Point 4.4.1.9 – Installation of all CU (GT and CC) will be if it is possible, installed in one solid enclosure. The environmental conditions are specified in chapter 2.2.

API 617, Point 4.4.1.10 – Regarding the guaranteed noise level reference is made to chapter 2.4

API 617, Point 4.4.1.11 - Noise abatement measures are to be realised in order to avoid pure tones in the entire frequency range, so that the difference between the attenuated linear sound power level and the specified power level is always less than 20 dB(A). The un-damped sound power level for all components including a frequency analysis between 63 - 8000 Hz must be given. Noise will be measured and the results evaluated for acceptance in line with ISO 9614, ISO 9613, EN ISO 3746 and ISO 10494. The required limits for noise emissions are defined in Chapter 2.4.

Note:

The gas turbine and the CC are installed inside the enclosure. The oil cooler will be installed outside the enclosure.

API 617, Point 6.4.4 – Alignment and testing of the installed connection piping by separation of the flanges shall be performed by the Supplier as part of the Scope of Supply.

API 617, Point 6.4.5 – Regarding selection and execution of the electrical components the Supplier shall refer to chapter 2.7, chapter 4.2, chapter 4.11 and chapter 4.12.

### Materials

API 617, Point 4.5.1.3 – No corrosive agents so far see chapter 2.2 and chapter 2.3.1.

API 617, Point 4.5.1.19.3 – the minimum design metal temperature is -36,2°C

### Housing and Connections

#### Design Pressure

API 617, Point 4.6.1.1 - The design pressure of the CC casing shall be at least 105 barg (in no case shall it be less than 1,25 × maximum discharge pressure ).

A high integrity pressure protection system shall protect the CC against overpressure events. This shall include safety loops with certified pressure transmitters operating in a 2 out of 3 voting configuration and having direct access to the medium voltage feeder of the VSD Transformer (ESD). The system shall guarantee that the maximum allowable working pressure of the station (105 barg) will not be exceeded.

#### Process Gas and Auxiliary Connections

The process gas connections of the CC i.e. suction and discharge flanges shall be preferably arranged in horizontal position.

The flange connections shall be designed according to ANSI B16.5; the counter flanges with corresponding bolts, nuts, washers and gaskets including the required bolt tightening torque specifications and flange alignment criteria shall be part of the Scope of Supply.

The CC shall be designed to resist external forces and moments of the connection piping which sums to at least 10 times NEMA SM23.

Drain connections shall be provided for both in- and outlet sections as well as for the section between the inner and outer housing.

### Dynamics

API 617 8th edition, Points 4.8.1 - 4.8.8 – An analysis of the critical rotation speeds (lateral and torsional) shall be performed and issued for the complete CU.

These data shall also be used for the torque analysis according to ISO/API617, Annex D.3, D1 and D.5.

### Dry Gas Seal System

Dry gas seal system will be with duplex coalescer filters, heater (if confirmed necessary) and booster. Supplier will provide either Eagle Burgmann or John Crane DGS, or equal.

API 617, Point 4.10.1.8 – composition and conditions of process gas according chapter 2.3.1, separation gas air according chapter 2.3.4.

### Nameplates and Rotation Arrows

API 617 87th edition, Point 4.12.4 - SI units shall be specified for use on the nameplate.

### Base Frame

**API 617 8th edition, Point5.4.2**

The base frame of the CU shall accommodate the CC, the GT, and all required instrumentation racks including lube oil tank.

Anchor bolts and all connection materials (refer to chapter, point c) as well as all required alignment equipment shall be part of the Scope of Supply. The base frame construction must allow good accessibility for inspection and maintenance purposes and shall be provided with access platforms.

Non-skid decking or grating covering all walk and work areas shall be provided on the top of the baseplate. When grating is provided, it shall be removable.

### Surge Control Valve

The Supplier shall deliver a surge control valve including actuator as required by this specification (see chapter 3.1). The anti-surge protection system including the anti-surge valve shall protect the CC against surge events during all operating conditions.

A pneumatic actuator shall be selected. Instrument air of the same quality and pressure as described in chapter 2.3.4 will be provided by the Employer at one supply point. Filtering and final pressure reduction is the responsibility of the Supplier.

The Supplier shall deliver the surge control valve. This shall include the following technical data as a minimum:

* Technical valve data,
* Desired diameter,
* Requirements to the valve construction and its characteristics with respect to the quick opening and recirculation function as well as the noise level.

The anti-surge control valve shall be certified according to EN 10204-level 3.2.

The anti-surge control valve shall be designed to ensure safe start without using any further auxiliary equipment.

If the Supplier is of the opinion that an additional hot-bypass valve in parallel with the surge control valve is required (simulation shall be provided), this shall fall under the requirements of this specification as for the surge control valve. The hot-bypass valve shall be included in Scope of Supply as required in chapter 3.1.

### Suction Strainer

The Supplier is responsible to provide a suction strainer which shall be installed in the suction line of the CC. The clean suction strainer shall have a maximum pressure loss of 0,3 bar at maximum performance. The suction strainer must be designed for a differential pressure of 5 bar. During operation the pressure difference across the suction strainer shall be monitored continuously by a transmitter; the differential pressure transmitter shall be included in the Scope of Supply. The differential pressure transmitter shall be included in the CC safety system and shall include an alarm and shut-down function. Details of the suction strainer have to be approved by the Employer. The suction strainer shall be designed for a continuous operation equal to life cycle of CU. Strainer must to ensure at least for one (1) year after TAKEOVER. It must to be easy maintain. The spacer and spool-pieces shall be part of the Scope of Supply as required in chapter 3.1. The Supplier shall include an additional set of bolts, gaskets, nuts and washers for each suction strainer (totally six additional sets) as required in chapter 3.1.

### Local Vents

All local vent piping included in the Scope of Supply shall be routed above roof of the CU enclosure. The design including the extension of the hazardous area shall be performed by the Supplier during detail design and shall be submitted to the Employer for review and approval.

The Supplier shall design the vents as per project specifications and standards specified chapter 1.5.

The vent termination outside of the CU enclosure shall be designed to avoid intrusion of water. All local vents included in the Scope of Supply shall be provided with flame arrestors.

### Performance Data

The Supplier shall the following CU performance data as a minimum:

* performance curves in the coordinates polytrophic head [kJ/kg] vs. actual suction flow [m3/h],
* performance curves in the coordinates polytrophic head [kJ/kg] vs. actual suction flow [m3/s],
* performance curves in the coordinates polytrophic head [kJ/kg] vs. normal daily flow [mcm/d],
* performance curves in the coordinates isentropic head [kJ/kg] vs. actual suction flow [m3/h],
* performance curves in the coordinates isentropic head [kJ/kg] vs. actual suction flow [m3/s],
* performance curves in the coordinates isentropic head [kJ/kg] vs. normal daily flow [mcm/d],
* Polytrophic efficiency [%] vs. actual suction flow [m3/h],
* Polytrophic efficiency [%] vs. actual suction flow [m3/s],
* Polytrophic efficiency [%] vs. normal daily flow [mcm/d],
* Isentropic efficiency [%] vs. actual suction flow [m3/h],
* Isentropic efficiency [%] vs. actual suction flow [m3/s],
* Isentropic efficiency [%] vs. normal daily flow [mcm/d],
* performance curves in the coordinates discharge pressure [bara] vs. actual suction flow [m3/h],
* performance curves in the coordinates discharge pressure [bara] vs. actual suction flow [m3/s],
* performance curves in the coordinates discharge pressure [bara] vs. normal flow [mcm/d],
* performance curves in the coordinates compressor power [kW] vs. actual suction flow [m3/h],
* performance curves in the coordinates compressor power [kW] vs. actual suction flow [m3/s],
* performance curves in the coordinates compressor power [kW] vs. normal daily flow [mcm/d]

The reference conditions which shall be considered for the normal daily flows are specified in chapter 4.2.2 and document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor.

The Supplier shall plot all operating points defined in chapter 4.2.2 and document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor on the CU performance curves required above. The CU performance curves shall include all operating limitations:

* surge line incl. anti-surge control line,
* stonewall control line,
* speed curves including min. and max speeds,
* max. power limitations.

### Additional Employer comments and deviations to API 617

**API 617 8th edition, Point 4.2**

See chapter 1.5

**API 617 8th edition, Point 4.4.4**

The Supplier shall review the layout of the CU piping system.[[1]](#footnote-1)

**API 617 8th edition, Point 4.4.5**

See document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor, chapter 2.2 and chapter 2.7

**API 617 8th edition, Point 4.4.7**

Operation on air/ not applicable

**API 617 8th edition, Point 4.5.1.6 and 4.5.1.7**

Not applicable

**API 617 8th edition, Point 4.5.1.16**

Not applicable

**API 617 8th edition, Point 4.5.1.17**

Not applicable

**API 617 8th edition, Point 4.6.3.2**

The Supplier shall perform non-destructive testing (NDT) of all for welds of pressure containing parts.

**API 617 8th edition, Point 4.6.4.1.7**

Manual drains at the lowest point are required.

**API 617 8th edition, Point 4.8.1.3**

Mandatory

**API 617 8th edition, Point 4.8.2.5 and 4.8.2.6**

Mandatory

**API 617 8th edition, Point 4.8.7.2**

Torsional analysis must cover the entire system, including GT, NGC, coupling and gearbox (if applicable).

**API 617 8th edition, Point 4.9.3**

Axial bearings and labyrinth must be rated for continuous operation under the characteristic curve of the NGC.

**API 617 8th edition, Point 5.1**

See chapter 4.1.

**API 617 8th edition, Point 5.4.1.1**

In addition, the Supplier shall deliver the base plate screw joints / anchor bolts, leveling equipment, foundation guiding template and injection for grouting.

**API 617 8th edition, Point 6.1.4**

See chapter 5 of this specification.

The Supplier shall deliver the Inspection and Testing Plan (ITP), this shall be subject to Employer review and approval during the tender evaluation.

**API 617 8th edition, Point 6.2.1**

Mentioned items shall also be part of the final documentation, which shall be submitted to the Employer for review and approval.

**API 617 8th edition, Point 6.2.1.5**

Shall apply for all piping in Scope of Supply which will be installed on-Site.

**API 617 8th edition, Point 6.2.1.6**

Shall be discussed during the conclusion of the CONTRACT.

**API 617 8th edition, Point 6.3.1.2.**

The Supplier shall notify the Employer no later than 10 working days prior to the date the equipment is ready for testing.

**API 617 8th edition, Point 6.3.5.2 and 6.3.5.9.4**

All values measured during the vibration test must be recorded within a prescribed system of monitoring of vibration and sent to the Employer for review and approval.

**API 617 8th edition, Point 6.3.7.2**

See chapter 5

**API 617 8th edition, Point 7.3**

See Annex 1.

## Lubricating oil system

The lubricating oil system shall be designed in line with API 614 with an air-cooled, vibration-monitored oil cooler, oil filter, oil heater and venting system including oil mist extractor. The venting has to be equipped with the oil fog separator to ensure that there is no oil content in the gas vented to atmosphere.

System must be designed in the way that the environment (soil, air) will not be endangered.

The tank shall be electrically heated, using power supply voltage 400/230 V AC, 50 Hz.

The oil tank and lube oil piping shall comply with Latvian valid legislation.

Flanges shall be minimised and configured in such a way as to prevent any oil from contacting the hot machine parts in the event of any leakages.

The Supplier shall specify a type of oil and firm value for maximum oil consumption for gas turbine and centrifugal type compressor.

## Vibrations, Axial Position and Bearing Temperatures

The CU shall be equipped with a system for monitoring shaft vibrations, axial position and bearing temperatures in line with ISO 10816, ISO 10816-1, ISO 10816-6, ISO 7919-1, ISO 7919-3, ISO 7919-4, and API 670. Axial position must be monitored by two axial displacement sensors. Depending on the model involved, the gas generator and the power turbine shall be equipped with the above-mentioned system or with a system for monitoring the vibrations of the bearing casing respectively housing.

The units with slide bearings shall be equipped with vibration monitoring carried out on non-rotating components and on rotating shafts.

The units with antifriction bearings shall be equipped with vibration monitoring carried out on non-rotating components only.

The Supplier shall specify precise alarms and shutdown values for all monitored data. These values shall be below the maximum values stipulated by API 617 8th edition and API RP 11 PGT.

## Performance Trend Monitoring Systems – OPTION

If the Supplier can provide a system for supporting maintenance work which is integrated in the UCS, this system shall be described and included in the Proposal as an OPTION (the price shall be presented separately).

## Instrument Air system

The Employer will provide compressed (instrument) air in accordance chapter 2.3.4 at one common tie-in point – to be defined and mutually agreed during engineering phase. The tie-in point is output flange of manual valve.

The Supplier shall specify the individual users within his scope and the relevant required flow rates, pressure and quality into the Utility Consumption List – for all possible operational cases including start, stop, stand-by and including information about simultaneous consumption For the distribution and regulation of the instrument air the Supplier shall perform the design, engineering, supply, installation and test of the instrument air up to the TC, equipment, instruments which are in the scope of Supplier.

The other operational media, e. g. Nitrogen or others are not available at existing area!

## Local Vents

All local vent piping included in the Scope of Supply shall be routed above roof of the enclosure. The design including the extension of the hazardous area shall be performed by the Supplier during detail design and shall be submitted to the Employer for review and approval.

The Supplier shall design the vents as per project specifications and standards specified in chapter 1.5.

All vent lines to safe atmosphere including all fixing materials, flame arrestors and sealing at roof or wall break through to the safe atmosphere from the Gas turbine - CU package, such as gas, air, oil vapour, etc., shall be supplied and installed by the Supplier.

All venting pipes required for the CU supplied hereunder shall be piped over the roof of the acoustic enclosure or over the roof of the shelter (whatever is applicable).

The routing and length of vent pipes shall be agreed with the Consultant during the detail engineering. Each venting pipe with flammable or explosion potential gas or gas mixture shall terminate with a flame arrestor in Employer scope of supply.

CC and process gas piping vent system shall be equipped with - minimum but not limited to - separate vent stack including the silencer, check valve, control valve or restriction orifice (whatever is applicable). Employer requires the Supplier to design and supply the CC vent system with possibility of operation manually by the Operator or automatic by UCS and ESD system of the CU.

## Common drain System

Supplier shall collect all the drains by pipes/tubing to the common drain tank which is in the scope of the Supplier as well. Each drain pipe/tubing shall be equipped with isolation valve. The arrangement and the location shall be agreed with Employer.

## Oil Cooling System

### Design Basis

The cooling system shall include the following equipment as a minimum:

* Oil cooling system

All cooling systems shall be controlled by the UCS.

The Supplier shall be responsible for sizing all cooling systems included in the Scope of Supply. All cooling systems shall be designed with considering the following operating conditions:

* Environmental conditions: as per chapter 2.2,
* Load conditions: maximum load of the compressor train / rated power of the drive system,

Under no circumstances shall the CU shut-down if the environmental conditions exceed the highest ambient temperatures specified in chapter 2.2.

#### Lubricating Oil cooling

**Central Back Cooler**

The back cooler shall be constructed as a finned-tubed cooler fitted for outdoor installation. It shall meet the following requirements:

* Seal welded and rolled in finned-tubes (“extruded type”) shall be preferred as bundled tubes on both ends in the chambers. The inside diameter of the finned-tubes should not be less than 16 mm in order to enable cleaning.
* The chambers are welded with threaded plugs corresponding to the number of tubes or realized in separable construction. In case of welded construction the dimension of the thread plugs shall permit the use of protective sleeve corresponding to the diameter of the finned-tubes in order to prevent damages of the thread pitches during cleaning.
* As fan blade only aluminium or GRP (glass fibre reinforced plastic) fans shall be operated. The fan (min. 2 × 100 %) shall be provided with three-phase current able to cover the maximum power requirement. Each fan cooler drive motor should be provided with a safety switch. The safety switch shall be installed in the central back cooler.
* Fan, motors and gear boxes shall be easily accessible for maintenance operations.
* Electric drives shall be three phase squirrel cage induction motors Motor data:
	+ Type of protection acc. to EN 60079-14
	+ Power supply: 400 V AC, 50 Hz
	+ Insulation material class: F, utilized according to insulation material class B
* Each fan shall be provided with a vibration switch. The vibration switch ensures that – in order to prevent further damages in case of the occurrence of vibrations – an alarm is issued and the respective fan is shut-down,
* Fan drives may be controlled by variable frequency,
* Fan belts, if applicable shall be electric conducting. Preferably, drive belts which do not require clamping device shall be used for each drive. Alternatively, 3-5 piece narrow V-belts according to ISO 254 or 1-piece Poly-V-belts (with clamping device) could be used. Belt protection mechanisms shall be provided. The calculation of the fan belts shall include a safety factor S = 1,5,
* In case a gear box is needed this shall be so dimensioned to be able to transfer 2,8x the moment of the total transmissible power for one minute without any additional heating. A shock factor of at least 1,5 shall to be employed. Slope-meshed or spiral bevel gears shall be employed,
* The cooler shall be assembled on a steel construction. The connection shall be designed such that it excludes the occurrence of tension or noises through thermic expansion (e.g. friction bearing). The motor vibrations shall be damped in accordance to ISO 14694, category BV3. The certification needs to be carried out at full and partial load measurement by an authorized expert. Walk-in platforms shall be provided for assembly, disassembly, cleaning etc. All platforms must have lanyard rails in accordance to valid guidelines. Lanyards shall be self-locking. Steel constructions, in particular staircases, platforms and gangways shall be hot-dip zinc coated,
* The fan construction should comply with the requirements for noise emission,
* The maximum noise emissions shall be 80 dB(A) sound pressures at 1 meter from equipment and 1,5 m above ground with fans running.

**Pump-Skid**

The centrifugal pumps of the cooling shall be certified to ISO 2858 and ISO 5199.

The scope of delivery shall include the following as a minimum:

* Centrifugal pumps in redundant configuration (2 × 100%)
* Drive electric motors,
* Emergency (cool down) pump or system
* Couplings,
* Fittings (shut-off valves and fittings, check valves),
* Sifter,
* Instrumentation according to principle flow diagram (minimum),
* Base plate (pump-skid)

The pump-skids will be installed in CU enclosures. The Supplier shall consider the environmental conditions as specified in chapter 2.2.

In case of failure, the change-over from operating pump to the spare pump shall be done fully.

Process Engineering

The pumps shall possess stable and permanent increasing characteristics for decreasing flow-rate.

The “shut-off” discharge head shall be at least 110% of the nominal discharge head according to construction conditions.

The required NPSH values of the circuit shall be at least 1,0 m under the pump NPSH value in all operating conditions.

Mechanical Design

Wall thickness of the pump housing (casting) inclusive valve cup shall be certified in accordance with ISO 5199.

Nozzles shall be supplied in flanged version in accordance with ANSI B16.5.

Pump housing shall be provided with venting and discharge connections.

Impellers shall be made of precision casting parts. They shall be balanced to degree G6.3 according to ISO 1940.

The shafts shall be provided with rolling bearings (ball- or roller bearings) and mechanical seals.

Coupling between pumps and E-motor shall be provided with a flexible application and factor 1,75 constructed.

The pump vibrations shall not exceed “Zone A” values according to ISO 10816-3.

Factory Tests

Factory test shall be carried out according to ISO 5199.

LV E-Motors

The E-Motor drives shall be designed and selected with considering the environmental conditions specified in chapter 2.2 and shall be controlled by UCS.

The ingress protection shall be IP55 as a minimum. Type of protection must be chosen according to EN 60079-14, if they are located in hazardous areas. The motors shall be of the three phase squirrel cage induction type, with totally enclosed fan-cooled (TEFC) construction.

The motors shall be fitted with ball or rolling contact bearings, supplied with life time grease. Motors which require surplus grease discharge openings shall not be considered.

The E-Motor drives shall comply with the Low Voltage Directive (LVD) 2014/35/EU.

Interfaces - Engineering of the Integrated Cooling Circuit

In relation to the interface engineering, the Supplier shall submit all necessary information about the on-site Scope of Supply for construction to the Employer and Consultant. This information shall include the following as a minimum:

* Space needed
* Basement load
* Electric connections
* Indications about sensors and actuators.

## CO2 (Fire-Fighting) System

The CO2 - based fire extinguishing system shall be provided by the Supplier. The Employer shall approve the design. The Supplier shall install fire dampers activated by the CO2 system at ventilation system inlet and outlet of the gas turbine acoustic enclosure. The Supplier shall provide the certified CO2 system including CO2 cylinders meeting the requirements of EN 12094 and EN 15004.

Regarding the tightness test of the acoustic enclosure please consider the ISO 6183 requirements.

The system shall be activated by the FDS and will be active also when the CU is not in operation. The system shall be strictly in compliance with Latvian laws and shall be approved by the Latvian Fire Prevention Authority prior Unit first start-up. The description below is to be considered the minimum requirement. All the electric equipment and measuring and regulating equipment installed at the site and in the acoustic enclosure shall be explosion-proof.

Min requirements to CO2 fire protection system are governed by ISO 6183 as follows:

* + 1. provide for alarm signalling in the rooms (enclosure) protected by a CO2 stationary fire suppression system, which is to be different from all other alarm signals and would be engaged immediately after fire has been detected and CO2 released,
		2. provide for opening of a self-closing (automatically closing) door in the protected rooms (enclosure) outward only; at the same time, it must be possible to open the door from inside even if it is locked from outside,
		3. provide for non-stop visual and sound signalling until safe atmosphere has been established,
		4. provide for aeration of the area after the fire has been extinguished,
		5. provide for information and warning lighting signs at the entrance
		6. signalling of the activation of CO2 extinguishing must lead to the space with permanent operating personnel
		7. all supply and signalling cables must be fireproof
		8. automated detection of CO2 concentration (CO2 detector in the enclosure of the TURBO-SET must be active until CO2 concentration does not decrease bellow the safe value (5% vol.)
		9. 100% Back-up of extinguishing medium CO2 is required

The Supplier shall proof the tightness of CU enclosure by the test to ensure correct function of the system during commissioning.

The bottle rack shall be provided including winterization if needed

Interconnection cabling and piping between the bottle rack and TS enclosure shall be fully within Supplier’s scope.

## Control and Instrumentation

### General

The complete electrical and I&C equipment shall include the following components as a minimum:

* Unit Control System including cabinets
* All on-skid and field control valves (anti-surge valve, hot-by-pass valve, pressurization valves)
* Interconnecting cabling and junction boxes between packages / cabinets in Scope of Supply
* Complete sensor/instrument technology
* Complete actuator technology
* ESD System
* Vibration monitoring system
* Cyber security solution hardware and software

The battery limits for instrumentation and valves to be controlled by the unit control system are shown in the process P&IDs referenced in document No. GCUI-TD-GOT-MEC-DWG-001 and GCUI-TD-GOT-GEN-DWG-003.

All systems shall be designed to operate under the environmental conditions specified in chapter 2.2.

### Functional requirements

In this chapter the functional requirements are described, which shall be carried out by the Unit Control System and related instrumentation and actuators.

#### General functions of the Unit Control System

The freely programmable Unit Control System (UCS) carries out all required instrumentation and control functions, covering all operation cases under consideration of all CU imposed boundary conditions. It shall be set up and constructed in a way to ensure in every operation case safe and reliable operation. The following functional hierarchy shall be applied:

1. Safety of personnel
2. Protection of machinery
3. Remote control
4. Local control

The UCS shall cover the following operational cases:

* Local start and stop of the units
* Remote start and stop of the units
* Closed loop speed control
* (Emergency) stop in case of exceeding certain thresholds
* At the unit control system it shall be possible to smoothly switch the operation from

1. Local to Remote

2. Remote to Local

#### Control philosophy of the compressor station

The control hierarchy is as follows:

1. Operation from local control room in exceptional cases (failure of Dispatcher Centre, failure of communication system, test of station equipment, etc.). During times when the site is normally manned (Monday-Friday during the day), the stations are normally still under remote control.
2. CU control by the Unit Control System. The UCS is equipped with a local HMI-system (operator workstation) in order to control the unit especially for commissioning, tests and service works.

The station control system is controlling the whole station, with the following main tasks:

* + 1. Station start / stop sequence
		2. Unit start / stop
		3. Station shut down
		4. Automatic closed loop control of station flow, inlet-pressure and outlet-pressure with override control by the outlet temperature

Furthermore the station control is responsible for supervisory and control, event and alarm listing, reports, signal archiving and trending etc. of the whole station.

#### Operating modes

The following operating modes shall be provided:

**OFF-Mode**

The CU is turned off and cannot be started. Selection of OFF mode shall be possible through OFF/LOCAL/REMOTE key switch.

**LOCAL Mode**

The CU can manually be started and stopped. The starting and stopping shall be carried out with an automatic sequence. The set-point values of the speed control shall be manually adjustable at the HMI/workstations of the UCS. LOCAL mode shall be selected through OFF/LOCAL/REMOTE key switch.

**REMOTE Mode**

The CU is started and stopped via the higher level Station Control System. The set-point values are also provided by the Station Control System. REMOTE operating mode shall be selected through HMI screen selector of the UCS.

**TEST Mode**

The CU can be tested or maintained; e.g. manual operation of valves, safety related functions are fully in operation. The Test Mode shall allow manual operation of the single equipment as for example pumps on/off and test of all process valves. Interlocks for safety reasons shall be provided according requirements of CU protection. For selection of TEST mode a software HMI screen pushbutton shall be provided.

#### Sequential functions

Supplier shall describe all sequences in logic diagrams and shall provide the descriptions for approval prior to implementation.

**Switching of operation modes**

In order to switch between operation modes an operating mode selector switch shall be provided at the Unit Control System. It shall always be possible to switch between “Remote”, “Local” and “Test Mode”.

Switching between control modes shall be smooth.

Leak test - as part of the Start sequence - shall be provided for the check valve.

The following sequences shall be provided:

**CU - Start**

The CU start shall be initiated as soon the starting preconditions are fulfilled, such as unit vales are in the required position. As soon as the nominal speed is reached the CU speed control is taken over by the Station Control System – load sharing. The speed is increased via a ramping function.

**CU – Stop**

Independent on the operation mode (local/remote) the TC can be stopped either locally or remotely. This command carries out the standard stop procedure. The TC piping stays under pressure until the provided limit of the hold time has been exceeded.

**CU – Emergency Stop**

Independent on the operation mode (local/remote) the CU can be stopped in emergency either locally or remotely with or without depressurisation.

#### Safety functions

The design requirements for all safety-related systems of the CU shall be issued based on the results of a HAZOP and SIL-risk assessments performed according to EN 62061 or EN 61511 and requirements as per EN 12583.

The safety functions shall meet the requirements set in the SIL assessment reports. All components part of SIL safety function must be SIL certified and suitable for the required SIL level.

The Supplier shall deliver risk analysis reports (HAZID, HAZOP, SIL and QRA) including calculations, technical as well as functional specifications for all SIL safety related loops in the Scope of Supply.

The UC shall be protected against improper operating conditions. The shut-down functions of the CU and all auxiliary systems shall be managed by the Unit ESD system which is part of the UCS (document No. GCUI-TD-GOT-GEN-DWG-003).

The ESD of the UCS shall be based on not programmable devices at least SIL2 certified.

The ESD of UCS shall forward the required signals to the CU and others systems of the CU as required. The shutdown signal to the power feeder (CU circuit breaker) shall be provided in the required SIL level. The ESD system of the CU shall control all CU process valves (document No. GCUI-TD-GOT-MEC-DWG-002).

The Supplier shall verify and validate that the SIL of the protection loops has been implemented correctly and the required SIL (Safety Integrity level) is achieved.

The Supplier shall use for the SIL calculation the SIL data of the actuators provided by Employer. The actuators provided by Employer will be generally suitable for SIL2 according to IEC 61508/61511. Any other requirement which is necessary to achieve compliance with SIL assessments shall be stated by Supplier in the offer.

The station shut down signals (plant shut down) will require a SIL certified interface to the ESD of the station.

Short-circuit and wire break monitoring shall be provided for all safety-related loops. Potential free contacts shall be provided with appropriate resistor modules.

The safety functions of CU shall include the following instrumentation loops as a minimum:

1. Process compressor discharge pressure max.
2. Process compressor discharge temperature max.
3. Emergency shutdown from ESD of the station with depressurisation
4. Emergency shutdown from ESD of the station without depressurisation
5. Emergency shutdown from local emergency pushbuttons
6. Emergency shutdown from SCS (not SIL classified)
7. Failure ESD of CU
8. Wrong position CU´s process gas valves (i.e. suction, discharge, venting)
9. Criteria by Supplier (temperature windings, vibrations, speed, etc.)

The Supplier shall the design philosophy for the Unit ESD system. The Employer could accept the standards of the Supplier’s ESD functions based on the Supplier’s risk analysis after mutual approval. If the HAZOP and SIL yields action points for the TC, these shall be implemented by the Supplier at no additional costs.

#### CU Control functions

The following control loops are foreseen:

* Unit Speed Control, implemented in UCS
* Anti-Surge Control, implemented in UCS

**Anti-Surge Control**

In case the compressor flow falls below a minimum threshold, instable operation conditions are caused (surge). The rapid and unstable reversal of pressure and flow through the compressor can cause considerable mechanic and thermal cyclic stress for the CC.

The operating curve of a CU is divided by the surge line into a stable and an instable area. The anti-surge control shall keep the flow above the minimum threshold and shall ensure a stable operation, utilizing predefined control curves, control algorithms and the anti-surge valve (ASV).

Surge protection of CU can be carried out by individual or one common (for both stages) anti-surge valve, to be evaluated and confirmed by CU Supplier.

The anti-surge control is implemented in the UCS and receives the required input process parameter signals to determine the actual unit operating point in relation to a pre-defined surge safety margin line. The anti-surge control shall control the opening of the anti-surge valve (ASV) as the surge safety margin line is approached. The definition of the required process input signals, as well as ASV control loop parameters, is responsibility of the unit Supplier. Furthermore, the unit Supplier shall define the characteristics of, and supply, the ASV, based on a detailed calculation model of the system considering piping volume, geometry, etc. – to be provided by Employer/Consultant. The surge safety margin line shall be finally defined during commissioning.

Anti-Surge Control to include override function, triggering quick-open solenoid of anti-surge valves, in case safety line is passed.

The control output signal to the anti-surge valve is to be provided as a 4-20 mA signal by Supplier. The manual control of the ASV shall be allowed via AUTO/MANUAL selector switch and OPEN/CLOSE pushbuttons installed at the Unit Control Panel.

The fast stop valve (if applicable) is for protection in case of unit trip and shall be actuated by the unit ESD system (i.e. open in case of unit trip).

Flow, pressure and temperature measurement shall be provided by Supplier for anti-surge control. This shall be flow element differential pressure, pressure and temperature RTD. Maximum accuracy shall be ensured; type and accuracy shall be provided within Documentation. ASV to be standard proven design and philosophy.

**Unit speed control**

Unit speed control is implemented in the UCS to achieve the speed set point as received from the SCS or manual set in the UCS. The UCS forwards the speed set point to the TC. Unit speed control has additional input signals, over-rides, ramps, interlocks, etc. to protect the machine as defined by, and under full responsibility, of the unit Supplier. For Start – and Stop of the CU ramping shall be applied.

**Gas Cooler Control**

Gas cooler control will be implemented in the UCS.

**Interface SCS – UCS**

At least the following feedbacks to SCS shall be available over serial communication (Control network):

* Unit in emergency shutdown condition with depressurization
* Unit in emergency shutdown condition without depressurization
* Remote/local control mode
* Unit not ready for operation
* Unit not in operation
* Unit pressurized (e.g. Pressure > 2 bar)
* Unit ready to start, waiting start command
* Starting, start sequence activated
* Minimum speed, unit rotating at minimum speed
* Max load, depending on the operating conditions, the maximal load has been reached; increase of speed set point from SCS is not possible (for example max speed oder max power drive)
* Minimum load, depending on the operating conditions, the minimum load has been reached; decrease of speed set point from SCS is not possible (for example min speed).
* Speed set point from SCS is active for regulation
* Unit in operation
* Stop sequence active
* Alarm summary, at least one alarm active
* Warning summary, at least one warning active
* Operating position of the unit in the compressor map (mandatory for load sharing, 0% surge line – 100% stone line)
* Actual speed (preferably %, to be defined)
* Actual flow in [Nm3/h], calculation based on the dP compressor inlet
* Actual flow in [m3/h], calculation based on the dP compressor inlet
* Pol. head in [m] or [kJ/kg]

The definition of the feedback signals in detail will be provided during project execution. Depending on unit P&ID and specific requirements for the control/regulation in the SCS, the feedback signals might be extended.

At least the following commands from SCS to UCS shall be available over serial communication (control network):

* start
* stop
* speed set point
* permissive to start

At least the following signals shall be exchange for Station ESD and unit ESD over hardwired interface:

* ESD shutdown without depressurization
* ESD shutdown with depressurization

Time Resolution shall be 500 ms or better for all signals.

Functions of each signal will be defined during detail design.

All signals necessary for the HMI-screens of the TC in the SCS-Workstations shall be exchanged over Terminal Network.

#### Specific functions

**Electrical systems MCC**

The following functions shall be integrated in the UCS

* Monitoring
* Start/Stop/ESD commands and permissive to start

**Oil system**

The following functions shall be integrated in the UCS

* Monitoring
* Start/Stop/ESD commands and permissive to start

**Filter Separator of the unit**

Monitoring and control of filter separator is implemented in the SCS.

**Unit process valves**

The unit process valves shall be controlled and monitored by the UCS. At least the following interlocks shall be implemented:

* Differential pressure over main process valves: it shall be not possible to open the main process valves if the differential pressure over the valve is greater than 2 bar (adjustable).
* Vent valves: the vent valve(s) can be open only if the unit is isolated (main process valves and pressurization valves are closed)
* Unit shut down shall be activated in case of wrong position of the process valves.

Further details and functions shall be defined and agreed with Employer during project execution.

### Unit Control System

This chapter describes in more details the requirements for the UCS in particular:

* the HMI-System, Workstations and Servers
* the PLCs for standard - and SIL-classified functions

If the Supplier can provide the UCS on more platforms, the Employer will prefer the same platform type in used for the SCS. The SCS system will be defined during project execution.

All automation tasks shall run on embedded functions as well as functions programmed directly in the PLC.

User roles in operating system of UCS shall be clearly segregated at least for administrator, operator and technician.

Redundancies are required for:

* Power supply
* Network interfaces of HMI-workstations and servers

Reference is made to architecture diagram of the SCS and Battery Limits for TC (document No. GCUI-TD-GOT-GEN-DWG-003 and document No. GCUI-CD-GOT-IAC-SPC-003 General Requirements Installation and Startup of Control System and document No. GCUI-CD-GOT-IAC-DWG-001 Control System Architecture - Overall Block Diagram).

#### HMI System

All automation system architecture shall be in accordance to requirements laid out in IEC 62443 standard set (IEC 62443-1-1, IEC 62443-2-1, IEC 62443-3-1).

The UCS shall be provided with a HMI supervision system to serve unit generally based on:

* Operator workstation in the control room
* 2nd operator workstation in the electrical room with engineering features
* Redundant servers
* Redundant HMI Network

Reference is made to the architecture station control system (document No. GCUI-CD-GOT-IAC-SPC-003 General Requirements Installation and Startup of Control System and document No. GCUI-CD-GOT-IAC-DWG-001 Control System Architecture - Overall Block Diagram) and the electrical and I&C battery limits as per document No. GCUI-TD-GOT-GEN-DWG-003.

The requirements for the workstations are as follows:

* 19’’ rack mounted system chassis mounted in server cabinet
* Redundant LAN cards
* LCD Monitors, Screen diagonal 24”, borderless display, 1920 × 1200 native resolution (HOLD)
* Keyboard and mouse

The servers and the computers of the workstations shall be installed in a suitable server cabinet, 19” rack type, door with window, accessible from both front and rear side.

The operator workstation (monitors, keyboard and mouse) shall be interfaced with the servers and computers over KVM-E preferably over FOC.

One remote access LAN card shall be installed in the Engineering Workstation (OWS1) as spare for future.

#### HMI-Displays

The appearance and the handling (look and feel) of the HMI must be consistent over all applications, for example:

* Consistent sequences of action
* Identical terminology shall be used in prompts, menus, help screens and dialogs
* Consistent colour, layout, capitalization and fonts
* Consistent layout of process views and symbols
* As standard language for the HMI Latvian shall be used; The HMI shall be anyway in English and Latvian programmed with switch to select the language

The system shall be designed to prevent errors, for example:

* Commands and Menu items, which cannot be selected, shall be greyed out.
* The system shall not accept wrong input.

Each Display call up must be completed within 1 second, independently of the number of objects within a display and independently of the number of displays already opened. I.e. all data visualized within the display are updated and full usability is provided.

The Main Menu shall be configurable for the full range of actions which can be carried out within the Unit Control system. It shall support cascading. Depending on the level of user rights, the menu shall be user specific.

The project specific displays shall be as follows:

* reflect the process of the CU according P&IDs
* reflect all the sub-systems, especially the seal system, oil system, MCC and related equipment
* provide overviews of UCS hard- and software status (fault in the CPU, communication, etc.)
* provide dedicated displays for maintenance, tuning and commissioning
* display of compressor map and cause and effect matrix of the unit
* displays of the counters, status, etc.
* dedicated display showing the status of the actuators in the different operating conditions, also those provided by Employer
* displays showing the sequences of the unit (pressurisation, start, etc.)
* displays for settable parameters, available only with special password.

Operational state like CU start, shut-down, shut-off with and without interlocking, etc. shall be included in text form. Moreover, process malfunctions, run-time errors and stop position faults shall be displayed.

Visualisation of step-sequences i.e. for the start- and stop operation of the CU shall be as follows:

* Each condition, which must be fulfilled in order to continue the sequence, shall be visualized.
* Each step shall be monitored that time limits are not exceeded.
* It shall be possible to switch the step-sequences to manual, i.e. manual input is required to proceed with the step-sequence

All Symbols shall support blinking and shall be capable of changing appearance (shape, colour, position, visibility) according to the actual device status.

The displays shall be optimized for ergonomic supervision and control. Problem oriented, hierarchical presentation of information shall be provided. Important items shall be fast and easy to access. Seldom used, less important features shall not distract the operators or continuously cover display space. The displays shall offer informative feedback, enabling easy error handling; this includes fast access to information - reducing selecting and searching (scrolling) to a minimum.

The characteristics of the HMI displays (i.e. screen resolution, graphical objects, headers, etc.) shall be in compliance with the standard of the Employer, which are also in use in the SCS. The Employer will hand over in the design phase typical screens and additional basic information accordingly. Dedicated meetings with the Employer and SCS Supplier shall be held to define the requirements HMI screens.

#### Events and Alarms

Events and alarms shall be configured. It shall be possible to assign three different levels (severities) of alarm

* alarm level 1
* alarm level 2, (warning)
* event (shutdown)

The alarm and event window is presented in a list, sorted in a chronological order; the latest alarm and event is listed on the top of the list.

All alarms and events are archived. The depth of the archive shall be at least six months and shall be only limited due to hardware limitations.

The alarms and events shall be presented according to their severity level in different colours.

Each alarm and event entry is listed with the following attributes and descriptions:

* Data point key with textual description
* Nature of event or alarm (LL, L, H, HH etc.)
* Point of origin (which application generated the alarm)
* Value and corresponding unit
* Timestamp of alarm or event
* Acknowledgement status (alarms only)
* Timestamp of alarm acknowledgement
* Tag of Operator who acknowledged

#### Unit ESD

All safety functions as described in the chapter 4.11.2.5 “Safety functions” shall be implemented in the unit ESD as part of the UCS, which shall be based on not programmable devices at least SIL2 certified according to IEC 61508.

All data of the unit ESD (status, values, etc.) shall be forwarded to the UCS over Profibus DP for implementation in the HMI-workstations, including visualization in the screens, alarms, trends, etc.

The detail C&E Matrix of the CU shall be implemented in the UCS HMI-screens.

#### Trends

Signal trends shall display the trend of one or more signal graphs against time. It shall be possible to display each signal trend in one window as far back as the archiving function for this signal was activated. The scale, the time domain and the range of values shall be adjustable online while the signal trend is selected.

Signal trends shall be shown as line charts with up to 10 graphs in a common time domain but in different ranges of values. It shall be possible to save trend selections.

Trend Performance:

* Historical data shall be available for at least 12 months
* The trend call up time shall be finished in 2 seconds, independently of selected time, number of signals or number of data point entries called up.

Trends of the UCS shall include the signals of the different TC subsystems such as for example VSD and magnetic bearing at least.

#### UCS layout

Requirements for control cabinets are defined in the chapter 4.11.4.

As references following cabinets shall be considered:

Field 1 – Power supply and CPU

Field 2 – Unit ESD, including ESD normal and Ex-i signals

Field 3 – I/O cards and interfaces of normal signals

Field 4 – I/O cards and interfaces of ex-i signals

#### Process interfaces

The process interfaces shall be constructed with interface components for analogue inputs/outputs and digital inputs/outputs process signal acquisition. Process interfaces must meet the following as a minimum:

* I/Os shall have minimum 20% spare capacity, this shall include VSD and the ESD system
* Ex-i signals with intrinsically safe barriers located in the control cabinets is the preferred solution, with HART protocol available
* All I/O’s with cables laid outside the UCS building shall be provided with suitable overvoltage protection on the UCS sides, type Phoenix PT-IQ or equivalent.
* Acquisition and transformation of process dependent signal types and signal level as described in the tables below,
* Potential free and total decoupling of any signal from the process
* Short-circuit proof and voltage drop feeding circuits to the field
* Independent and autonomous routines for fault detection and error notification
* Circuit faults, wire break and short-circuit monitoring

The following system interface components shall be employed:

Table 4.2 – UCS system interface

|  |  |
| --- | --- |
| Signal | Type |
| Analog input | 4 – 20 mA/HART |
| Binary input | Contact 24 V DC / Namur |
| Analog output | 4 – 20 mA |
| Binary output | 24 V DC |
| Potential free relay outgoing circuits | 24 V DC |

Table 4.3 – Unit ESD system interface

|  |  |
| --- | --- |
| Signal | Type |
| Analog input | 4 – 20 mA |
| Binary input | Namur |
| Binary output | 24 V DC |
| Potential free relay outgoing circuits | 24 V DC |

### Control Cabinets

Layout of cabinets shall be provided in an early stage of the project, showing dimensions, all major PLC components, circuit breakers, size of HMI screen, IS and non IS areas, IS-segregation. Control cabinets will be located in an existing building at territory of CS.

The requirements for the control cabinets shall be as follows:

* I/O required reserve of 30% shall be provided. The equipment in the cabinets shall be easy accessible.
* Control Cabinet shall be of standalone type height: 2000mm depth: 600 mm, suitable for indoor conditions of natural ventilation. Server cabinet shall be with depth 1200mm.
* Colour: RAL 7035, plinth 200 mm
* Every centralized power supply input of a cabinet group or stand-alone cabinet is provided with overvoltage protection
* Ingress protection level: min. IP 31, for opened cabinets minimum IP 20
* Control cabinets shall be provided with internal LED illumination controlled by a door switch. The lights shall be energized only when the door is not closed.
* Each cabinet shall be equipped with one 230VAC service socket
* Each cabinet group shall have a pocket for documentation.
* Cabinets shall be standing on the false floor. Cabling shall be directly routed through the false floor into the bottom of the cabinets, where they shall be tied to a rail for strain relief, connected at segregated terminals strips individually dedicated (labelled min. 6mm letters) to the related unit. Internal wiring shall be clearly tagged on both ends according to the documentation.
* The cable ducts for Ex-i-cables shall be blue. Segregation shall be provided between normal and Ex-i signals.
* 230 VAC will be supplied by redundant power cables from the UPS power distribution board. The two feeds shall be individually supervised and individually reported to the SCS in case of a failure. Other possibility is that cabinets shall have power supply from UPS (DC or AC) which will be a part of delivery of Supplier.
* Insensible to interference according to the IEC standards

### Requirements for programming

1. For programming software tools in the latest edition shall be used.
2. Programs shall be modular structured, system wide the same functions, procedures and names shall be used.
3. Programs shall be well documented; English and Latvian shall be used for program comments.
4. Programs should not have functions or unused source code, which are not required for this project. Such code shall be preferably be deleted or as a minimum well documented that such parts are not required for this project.
5. Programs shall provide extensive support for debugging and trouble shooting. Especially concerning the communication, statistics shall be recorded.
6. Programs shall use the exact same data point naming and unit as used for the HMI, I/O list and P&IDs.
7. Programs shall provide easy access to set points. Set points must be readable in SI units (human readable) and shall be programmed as input parameter of functions or procedures.
8. Function block diagram (FBD), graphical programming shall be used as far as possible.
9. The Supplier shall hand over the source code without restrictions (i.e. password).
10. Third party modules should be listed and should be supported from producer during lifecycle.
11. Critical vulnerabilities of system and third party modules should be patched free of charge during lifecycle of product.
12. End of lifecycle should be clearly communicated.

### Licences

Permanent and transferable licenses for all computers and software’s of the system shall be provided. All required licenses shall be written out on behalf of the Employer and shall be submitted latest after installation of the system/licenses on site.

All workstations shall be provided with antivirus software according to the standard of the Employer. Operating system of all PCs should be MS™ Windows 20H2 (minimum) with latest patch.

### Engineering Workstation

The Supplier shall provide an engineering workstation for development, modifications, administration and maintenance of the UCS according to architecture diagrams (document No. GCUI-CD-GOT-IAC-SPC-003 General Requirements Installation and Startup of Control System and document No. GCUI-CD-GOT-IAC-DWG-001 Control System Architecture - Overall Block Diagram).

The engineering station shall serve all CU by individual connection to the UCS. The access to the engineering applications shall be restricted by software passwords.

The following software shall be preinstalled, at least:

* MS™ Office 2019 or newer
* Programming software for all PLCs and HMI visualisation system. All files for downloads shall be provided and finally updated after acceptance.

In addition the Supplier shall supply one (1) engineering laptop for development, modifications, administration and maintenance of the TC auxiliaries.

The Supplier shall provide specialised training for the Employer operating personnel who will use the engineering stations. These includes training courses, certifications and rights for modifications of all delivered systems after guarantee period and should respond to above mentioned requirements for development, modifications, administration and maintenance knowledge and authorization.

### Field operator interfaces

The cabinets of the CU shall be provided with local push buttons such as start, stop, local/ remote, etc. and indicators lamps such as failure, running, etc. where required providing local operator interfaces in all cases when HMI is not available.

ESD push-buttons shall be located on the skid and at the doors of the cabinets and shall be easily accessible for the operating personnel. The number and location of all ESD- buttons of equipment in the Scope of Supply shall be verified based on a risk analysis.

#### System Diagnostic

All control systems shall provide comprehensive information about the status of each component. The proper function of all system components shall be continuously supervised; any failure or interruption (e.g. I/O failure, power supply error, communication failure, etc.) must be logged with timestamp. If the detected error can have consequences on the proper operation of the system, the error shall be brought to the attention of the operator.

### Remote Diagnostic and Maintenance

Remote monitoring, programming and online program observation shall be quoted as an option.

### Time synchronisation

The time of the UCS shall be synchronized with the station SCS over NTP protocol.

The UCS shall forward the time and synchronized the other subsystems of the TC.

### Cyber Security

The underground gas storage shall be regarded as a critical infrastructure. All requirements (Regulation on Cyber Security)’ must be fulfilled.

In addition, the following standards and regulations shall be taken into account:

* ISO/IEC 27001 Information technology – Security techniques – Information security management systems – Requirements
* ISO/IEC 27002 Information technology — Security techniques — Code of practice for information security controls
* ISO/IEC 27004 Information technology — Security techniques ― Information security management ― Monitoring, measurement, analysis and evaluation
* BDEW Whitepaper Requirements for Secure Control and Telecommunication Systems

A Risk analysis will be performed during the Basic Design phase according to ISO/IEC 27004. The main concept of cyber security will be developed according to the requirements of the risk analysis.

The cyber security of the compressor unit must be designed and implemented in such a way that all threats from a cyber-attack (locally or remote) are detected in time, so that the effects of a cyber-attack can be minimized.

It shall be possible to restart or even to restore (disaster recovery) the UCS and all other critical systems of the compressor units within 8 hours, or less.

Following measures shall be considered for network security, as minimum:

* All relevant equipment shall be installed in lockable cabinets.
* Multiple access levels shall be provided. The command power will be clearly defined.
* Access to the management systems shall be restricted.
* Unused ports shall be disabled.
* A communication matrix with information about the communication relationships (source and destination, protocols, ports (physical, UDP, TCP), IP addresses, etc.) has to be created.
* Restore, automatic restart and disaster recovery procedures of the control equipment shall be implemented.
* Network segmentation is mandatory, separating administrative zone from other network segments.
* All components are in their lifecycle including third party modules.

The cyber security concept for the compressor unit will be coordinated with the Employer according Employer’s overall guidelines, based on the risk assessment according to the standards listed above.

After the award of the contract the Supplier has to prepare a concept for cybersecurity for the CU in close coordination with the supplier of the Station Control System SCS and submit it to the Employer for approval.

The recommendations of the concept are to be implemented by the Supplier in the detailed planning and execution phase of the project.

### Hazardous Area

All equipment and associated auxiliaries which are located in hazardous areas must be in compliance with applicable standards EN 60079 and ATEX Directive.

For reasons of standardization all equipment shall be certified for Zone 1 also if they shall be installed in Zone 2 (Equipment Category II 2G).

Field-mounted electrical equipment shall generally utilize the methods of protection Ex-i, Ex-e or Ex-de with minimum degree IIB T3. Other type of protection may be used only after written agreement of the Employer.

As far as technically achievable the Ex-i execution shall be preferred. All components forming part of the Ex-i loop shall comply with the relative standard and regulation in use and being documented accordingly. All Ex-i loops shall be implemented with typical RAL 5015 colour (Sky Blue). For all Ex-i loops a calculation according to IEC 60079 shall be provided by Supplier. Data of equipment and cables shall be available for the specific type in use.

An Ex-Device List shall be provided by the Supplier for all devices which are installed within the hazardous area. In this list all installed mechanical and electrical devices together with their Ex-Certificate and types of Ex-Protection definition shall be included as minimum.

### Vibration Monitoring

The Supplier shall provide a vibration monitoring. All related signals, alarms and values shall be available in the HMI-system of the UCS.

Position and temperature sensors at bearings and shall be foreseen and integrated in the UCS.

### Process instrumentation

All necessary instrumentation required to guarantee a safe and reliable operation, monitoring and control/adjustment of the unit shall be included in the scope by Supplier.

The Supplier shall consider the following for the design and selection of all instruments:

* All instruments shall be new and of high standard industrial type;
* All instruments shall be solidly built using well proven high quality components of the latest up-to-date technology;
* All parts of the instruments in contact with the process fluids shall be fully compatible with those fluids and shall not deteriorate under operational environment;
* Particular attention shall be paid to the ease of access to all instruments. The instruments shall be suitable for mounting in visible positions with easy access for adjustments;
* Measuring errors and response time shall be as low as possible;
* Electronic type instrumentation with incorporated local digital displays shall be used, if applicable.
* All instruments shall return to accurate measurement without manual resetting upon restoration of power after power failure;
* It shall be possible to isolate the systems from the main process.
* Use of smart/intelligent transmitters with HART communication protocol facility, which have remote accessibility and can provide useful information for maintenance and operation. (e.g. zero point calibration, range calibration, remote diagnostic, etc.);
* Special attention shall be given to the outdoor and indoor ambient temperature if corresponding requirements for analysis equipment;
* All instruments and components shall be suitable for the test pressure and temperature of the corresponding pipe class.

All instrumentation shall comply with Typical Hook Ups (document No. GCUI-CD-GOT-IAC-DWG-002 Typical Instrumentation Hook-ups).

Marshalling loops shall generally comply with GCUI-CD-GOT-IAC-DWG-003 “Typical Loops Diagram”. As far as technically achievable the instrumentation shall be provided as pre-fabricated, work-shop tested and calibrated in order to reduce to minimum installation works at site.

All equipment shall be provided with complete documentation (ATEX certificates, Material certificates according to EN10204, SIL certificates, etc.) demonstrating compliance with applicable regulations and standards.

#### Pressure Measurement

Transmitter or instrument connections to the process shall be designed with at least a 12 mm stainless steel material with Swagelok, Parker or equivalent of one brand only, no mixing of systems permitted connection.

Bourdon type pressure gauges filled with glycerine and designed in compliance with operational safety requirements of EN 837-1 standard shall be used (WIKA 233.30 or equivalent, Dial 160mm).

Gauges shall be able to withstand, without zero or calibration shift, over-range pressure of 1.3 x calibrated range as standard. Gauges exposed to vibration or process pulsations shall be fitted with pulsation dampers to the same material as the element. Pulsation dampers shall both absorbs pressure shocks and average out pressure fluctuations. SMART transmitters for remote indication shall be provided with a local indicator in two-wire system (type Emerson 3051C or equivalent). The transmitter shall be 24 VDC loop powered, providing 4-20 mA output signal. SMART series with HART protocol is required for remote maintenance and parameter setting.

The instrument body and all connection parts must be of corrosion resistant material, at least high quality CrNi-steel shall be used for the body and the process connection part.

Pressure transmitters and differential pressure transmitter shall be provided with a 3-way respectively 5-way valve manifold block.

#### Temperature Measurement

The Supplier shall provide bimetallic thermometers (Type WIKA TM54.01 or equivalent) for local indication, Dial 160mm. The temperature gauges should be selected in such a way that the normal operating temperature shall be between 30% and 75% of their full scale measuring range. Tolerance class shall be "Class A" in accordance with EN 60751, calibration in degree Celsius (°C).

The type of transmitters shall be digital type SMART series transmitters with HART Protocol for remote calibration and troubleshooting (type Emerson 3144P or equivalent). The electronic output shall be two wire 24 VDC loop powered, providing 4-20 mA output signal. Resistance thermometer (Platinum Resistance Thermometers,Pt100/RTD 3-wire in accordance with EN 60751) shall be provided.

Temperature element stem shall be AISI 316L stainless steel as minimum. Suitable thermal paste shall be filled into the thermo-well before insertion of the temperature element. The Supplier shall provide temperature measurements of process fluids in pipes with thermowells according to the pipe class and Typical Hook Ups (document No. GCUI-CD-GOT-IAC-DWG-002 Typical Instrumentation Hook-ups). The Supplier shall provide design certification including weak frequency calculation to proof compliance with strength and resonance frequency requirements.

## Electrical requirements

The electrical part of the scope includes the delivery, installation and final commissioning of all electrically controlled and supplied equipment necessary to operate the CU in the specified manner. As battery limit the power connection terminals of the existing low voltage power distribution board (LVDB) and the UPS distribution board (if necessary) are defined.

Any upstream power switch(es) for the TC equipment in the LVDB and UPS distribution boards will be delivered by the Employer while the engineering data (also settings of thermal and instantaneous releases) of these switches will be under responsibility of the Supplier. Any necessary engineering data for switch (-es) must be handed over to the Employer at least 6 weeks after contractual agreement.

The Supplier installs the power, control and instrumentation cables interconnecting LV/MCC/UCP – cabinets and all consumers and other installations within the scope. In the power building the cables will be laid in indoor cable trays and ducts provided and installed by the Employer. The detailed engineering of these cables and the individual cable routing is part of the Supplier’s scope as well as the timely provision of the related engineering results to the Employer.

The cableway construction within the skids is carried out by the Supplier in accordance with its needs. Sufficient space for inter skid cabling has to be provided.

The cables between Power building and CU skids shall be laid in ground in protective ducts. Excavation works, cable duct supply and backfilling of cable trenches have to be provided by Employer.

The power cables from the LVPD and UPS distribution boards towards Supplier’s LV/MCC-cabinets will be installed in indoor cable tray systems, provided and installed by the Employer. The detailed engineering of these cables considering the individual cable routing is part of the Supplier’s scope as well as the timely provision of the related engineering results to the Employer. The Employer himself will separately organize cable installation work for the commissioning phase of the plant to aim a concentrated cable installation works for all cabling between buildings for any discipline on site. In this issue, the outer walls of the CU enclosures are the boundaries of responsibility between the Employer and Supplier, regarding cable route preparation.

Any installation and deliverables on-skid is under Supplier’s scope.

### Scope of Equipment

The scope of electrical equipment supply consists mainly of:

* MCC for TC,
* Control, instrumentation and low voltage power cabling interconnecting the single components of the scope of supply as well as to the specified terminals for connection to equipment provided by others,
* Trace heating including insulation and cladding,
* Lighting and emergency lighting within the enclosure,
* Terminal boxes, local control stations, maintenance switches,
* Potential equalization of all components of the scope of supply and connection to the grounding network of the overall plant, provided by others.

All electrical interfaces are shown schematically in document No. GCUI-TD-GOT-GEN-DWG-003 Electrical and I&C Interfaces for GCU - Schematics.

All cabinets shall be painted in RAL 7035.

### Noise Emission and Noise Protection

All auxiliary drives and equipment noise shall be well below the EN 60034-9 sound power level limit value. The achievable values shall be given for the complete operating range.

A type-testing protocol must be provided as a proof.

### Electric Power Supply

Electric power supply for all electrical consumers of the new CU shall be provided from new MCC switchgear, which shall be also Supplier’s scope of supply. The MCC shall be placed in existing Power building. MCC shall be fed from existing LV main switchgear. Available voltage system is 3x400/230 V, 50 Hz, TN-S. Any auxiliary necessary voltage levels for CU equipment shall be generated by Supplier’s converters.

Electric power for main LV switchgear is provided from two transformers 20/0,4 kV, 1,6 MVA. For emergency purposes also stand-by diesel generator with power of 440 kW is available. Power from diesel generator shall be used (if necessary) only for CU safe shut down in case of power grid outage.

As a connection point (or points) of new CU power supply the spare outputs in mentioned existing main LV switchgear shall be utilized.

The power requirements have to be provided to the Employer as part of the offer.

Necessary uninterruptible power sources for CU shall be Supplier’s scope of supply (batteries, converters, inverters etc.).

### Scope of Supply: Technical Description

#### General Requirements

Equipment

Supplier must ensure that selection of all equipment and components is based on simple maintenance, trouble-free fault detection and long maintenance intervals.

Equipment and utilities have to be designed for continuous operation with nominal power and in due consideration of the ambient conditions. Only components of proven industrial standard and high technical availability shall be used. They shall as far as possible be part of Suppliers standard supply program.

Equipment and components of identical kind and type must be used for equal or similar functions. In any case exchangeability must be guaranteed.

Tagging

All equipment, components and installations must be tagged with suitable nameplates of corrosion free material with long-lasting, light and weather proof labelling. Plates on cabinet front sides or other housings must be screw fastened. The Supplier shall apply his tagging procedures.

Units

All scales and displays must adopt the metric system based on SI units.

Design Basis

The complete electric installation has to be designed in a way that there is a spare power margin of 10% with respect to the maximum required power of the supplied system under worst case conditions.

#### Harmonic Distortions

General

It is Supplier’s obligation and part of the scope of supply that the CU electric installation can be connected to the grid in such a way that no existing installation will be negatively influenced. Moreover, the Supplier has to ensure that the electric system itself can be operated failure-free when connected to the electrical grid.

The point of common coupling (PCC) is defined at feeding terminals in LV main switchgear.

Principles for the Evaluation of the Harmonic Distortion

The principles for the evaluation of the harmonic distortions can be found in the standards. Moreover, Supplier has to ensure that the power quality for all consumers connected to the energy supply still complies with the limits required by EN 50160 after connecting the CU electrical installation to the grid.

The reference value for the short-circuit power at PCC shall be provided by Employer.

Measurements

To proof the conformity to the requirements of grid operator and standards, a network analysis must be carried out prior and after commissioning of the drive systems, especially concentrated on harmonics measurement at PCC (0,4 kV level) during VSD run.

The two harmonics measurements should be performed as far as possible at identical conditions:

This means:

* Identical measurement device
* Identical or similar seasonal conditions.

Measurement process and procedure for data storage has to be elaborated by the Supplier and submitted to the Employer for review and approval.

A report, confirming the conformity to the specifications shall be issued.

### Emergency electric shut down

The complete compressor package has to be equipped with an emergency electric shut down system according to the requirements of this specification (EN 60204-1, category 0) as well as HAZOP/SIL requirements

The shutdown philosophy will include the de-energization of the low voltage CU electrical installation.

As isolating switches the main incoming circuit breakers or disconnectors in MCC can be used. Tripping must be ensured by undervoltage coils and normally closed push-buttons (or other safety contacts) connected in series.

### Earthing and equipotential bonding

The Employer provides an equipotential meshed grounding networks on site.

Following groundings are available:

* Power earth (PE)
* Instrument earth (IE)
* Intrinsically safe earth (IS)
* Frame ground (FG).

All exposed conductive parts or elements of the CU systems shall be connected to these networks by Supplier, according to its requirements.

### Motor control centre (MCC) and Switchboards

The LV power distribution and feeding power towards the electrical consumers delivered with the CU package shall be realized by a motor control centre (MCC). The basic construction shall be realized by use of type tested switchboards in withdrawable design and possible exceptions in fixed-mounting design. Manufacturer shall follow the standard regulation according to EN 61439 and EN 60947, the equipment shall be suitable for operation and utilization according to EN 50110.

The MCC shall be an industrial standard system, with interface to UCS as defined in chapter 4.11 “Control and Instrumentation”.

To protect the equipment against lightning strikes, overvoltage arresters Class I+II shall be installed near the main power supply terminals of MCC-cabinet.

The MCC will be equipped with one feeder from existing output of upstream main LV switchgear.

In case of short power failure of the common power supply (time to be defined by Employer) and after its restoration, the UCS shall automatically restore the operation status of the whole equipment as it had before power outage (including TC, valves, coolers, etc). That means that no resets or pushing of buttons shall be required in order to return to normal operation.

#### MCC design basics

The cabinets shall be constructively straight aligned, unique in height and depth. Cabinets shall also be suitable for back to back installation or installation near walls.

The motor control centre parts of the switchboard shall consist of totally enclosed, vertical sections joined together to form a rigid, free-standing assembly. The MCC panels shall contain busbars, motor starters, feeder circuit breakers and control as required to comply with this specification.

The status of the busbar condition, voltages (L1/L2; L2/L3; L1/L3) and the single phase current will be supervised, displayed at incomer cabinet and provided to the UCS / SCS in real values. A multifunctional power measuring device shall be installed.

Each panel shall have a separate vertical cable compartment, minimum width 400 mm. Each cable compartment shall have its own hinged door. Hinged front doors of each cabinet shall be able to swing out more than 90°.

The PE busbar shall be located in the cable compartment.

The form of separation shall be 3b according to EN 61439-2. Vertical busbars shall be isolated in a way that with the compartment door open and the draw out unit removed, personnel is protected against unintentional contact. Live parts shall be protected by flexi glass or equivalent. The busses for the phases shall be arc-proof insulated.

Minimum degree of protection for MCC: IP21 (acc. EN 60529).

Except for the miniature circuit breaker (MCB) feeders, which shall be realized as fixmounted installations, all consumer feeders shall be designed as withdrawable units.

All consumer feeders shall be designed for breaking phases and neutral. For this purpose, neutral mandatorily shall be conducted through the withdrawable units, miniature circuit breakers shall be equipped with a separate contact for neutral. The fusing of neutral is not required.

The units shall be withdrawable without use of special tools or disconnecting works. A withdrawal or an engage of the withdrawable units must only be possible with opened power circuit. The withdrawable units shall be supported from the frame as far as the whole unit can be lifted out.

For all withdrawable units, a defined operating position, test position and outside position shall be provided which shall be discernible from outside, too. In test position the main contacts shall be opened, but the control circuits shall be in function. In the test position, the testing of the withdrawable unit from a local control panel on site must be possible, if installed.

Contactors for motor consumers shall be designed for category AC 3.

Signals indicating the operating and test position of all withdrawable units shall be prepared for the superior control system. In addition, further control and monitoring devices and signals to remote systems shall be provided, depending on the type of the withdrawable units, as below.

The withdrawable units shall be designed for being secured with at least two padlocks per feeder (e.g. electrical and mechanical locking).

Standard feeder units of different size, corresponding to the power and the type of consumer are to be used. The following types are applicable:

Incomers:

As incoming feeders of the MCC, hand-operated molded case circuit breakers (MCCB’s) shall be installed. Adjustable overcurrent and short-circuit tripping releases shall be used.

For protection against overload a current-dependent, delayed releaser shall be used. The setting range shall be from 0,2 to 1,0 times of nominal current and the time delay adjustable from 2 to 30 seconds.

For selective short-circuit protection an independent releaser shall be used. The setting range shall be from 2 to 12 of the setting range of overload releaser. The delay time of the independent releaser shall be adjustable.

On the front of the withdrawable units at least the following indication lights shall be placed:

* ON
* OFF
* TRIP

Each withdrawable unit shall be provided with respective push buttons for ON and OFF.

Each incomer shall be provided with a multifunction measuring device to measure single phase voltages and currents, apparent power, real power and reactive power.

LV-Motor Feeders - Direct start:

The feeders are to be realized without fuses if possible. Each withdrawable unit shall be equipped with the following indications:

* ON
* OFF,
* Operating hours
* Failure

Operation of the feeder shall only be possible from remote (from UCS). In test position a test of the control functions shall be possible.

The following signals shall be available for remote monitoring:

* Motor running
* Motor off
* Motor failure

LV-Motor Feeders with Soft Start

For motor sizes of 50 kW or more, an electronic soft starter has to be provided and integrated in the withdrawable unit. The soft starter is automatically activated as soon as voltage is applied at the input terminals. After start up, a bypass contactor is switched on. The use of an electronic bypass relay is not permitted. Apart from that the above mentioned requirements for “LV-Motor Feeder - direct start” are valid. Additionally, the position of the bypass relay has to be displayed and transmitted.

LV-Motor Feeder with frequency converter

For temperature reasons, the frequency converters shall be installed outside MCC cabinets, mounted on the wall (but installation into MCC cabinets also possible if feasible). In MCC cabinets only their disconnecting switches (breakers) shall be mounted, either in withdrawable units or as fix-mounted.

At least the following signals shall be available for remote monitoring:

* Rotational speed – set point value
* Rotational speed – actual value
* Frequency converter failure

Circuit Breaker Feeder

Withdrawable circuit breaker feeders shall be manually operated MCCBs. Adjustable overcurrent and short-circuit current relays shall be used.

On the front of the withdrawable units the following indication lights shall be placed:

* ON
* OFF
* TRIP

Each withdrawable unit shall be provided with respective push buttons for ON and OFF.

The signals are transmitted for remote monitoring:

* ON
* OFF
* TRIP

Circuit Breaker Feeder with Contactor

The feeder is to be realized without fuses. Each withdrawable unit shall be equipped with the following indications:

* ON
* OFF,
* Operating hours,
* Failure

Operation of the feeder shall only be possible from remote (from UCS). In test position a test of the control functions shall be possible.

RCDs with residual currents max 100 mA (30 mA preferred according to EN 60079-14) shall be installed for explosion proof heaters.

Miniature Circuit Breaker (MCB) Feeder Circuits

MCB feeders shall be realized fixed mounted. A group of MCBs will have to be protected by backup fuses if required due to high the short-circuit currents. If RCDs are required, preferably combined miniature circuit breakers with RCD shall be used (RCBO).

The use of only one RCD for several MCBs is not permitted.

MCBs have to be provided with auxiliary switches to indicate switch position as well as failure to the UCS. The trip of RCDs has to be signalled too.

#### Labelling

Labels must be permanently fixed. Each withdrawable unit must have its own label, also control and signalling devices on the front of MCC must be labelled according to schematic diagram.

The built-in devices must be provided with an adhesive label with equipment identifier on the device and next to the device according to MCC schematic diagram.

### Electromagnetic compatibility (EMC)

The essential requirement of the EMC is to prevent any current flow within the earthing or equipotential system. For this the whole power distribution system of the CU unit must follow the TN-S net characteristic acc. IEC 60364-1.

All electrical equipment supplied under this contract shall comply with the following requirements in regard to EMC:

* the harmonic content of the power supply is in accordance with IEC 61000-2-4, Class 3,
* the harmonic content caused by the equipment may not exceed the requirements of IEC 61000-2-2 for LV Variable Speed Drives.

### Cables and trays

Supplier shall use only cable types in accordance to the list mentioned below. The selection of the cross section is the responsibility of Supplier. Supplier shall consider the cable load, cable operation, environmental conditions, installation conditions and requirements of protective multiple earthing.

The maximum allowed voltage drops under full load conditions are the following:

* At consumer by nominal load 3 %
* At the LV motor terminals during start up 15 %
* Supply cable for lighting and uninterruptable equipment 2 %
* Supply cable for distributions at nominal power 2 %
* At the MCC busbars during start-up of the biggest LV-Motors 10 %.

The cross section of power cables must be calculated on the basis for the following specified maximum conductor temperature:

* PVC – insulated cable 70 °C
* XLPE – insulated cable 90 °C

All cables shall comply with the core colours acc. EN 60445.

Cables have to be designed considering that the cable between the buildings will be routed in conduits.

#### Power cables

Supplier shall use multi conductor cables with copper cores. The cable insulation must be suitable for the given environment and temperature.

The minimum cross section of the low voltage cables and conductors should not be less than 2,5 mm² (1,5 mm² if cable is short and not in ground).

When a required cross section is more than 240 mm² it is necessary to use two or more parallel cables.

The concentric conductor is utilized as protective earthing conductor. Reduced cross section for protective earthing conductors shall be used only if the loop impedance remains below the maximum allowed value. A common conductor for protection and neutral use (PEN) is not allowed for the feeders.

Low voltage cables shall comply with EN 60228 and shall be self-extinguishing and flame resistant according to EN 60332-2-1.

#### Control and signalling cables

Supplier shall use multi conductor copper cables The cable insulation must be suitable for the given environment and temperature.

The cables must be provided with at least 20% reserve conductors. The outer sheath colour of intrinsically safe cables should be blue.

Control and signal cables shall comply with the EN 60502-1 They must be self-extinguishing and flame resistant according to EN 60332-2-1.

#### Instrumentation cables

The instrumentation cables are made of twisted pairs of shielded cupper wires and cupper overall screen. The cables must be suitable for buried outdoor installation. The conductors must be identified by engraved numbers on the conductor insulation. The conductor colours should preferably black and white for each pair.

The cables must be provided with at least 20 % spare conductors. The outer sheath colour on intrinsically safe cables should be light blue.

Instrumentation cables must comply with the EN 60811-2-1 CLAUSE 10. For normal use cables with flame-retardant insulation should be employed.

If no other solution is possible because of technical necessities, other cable types e.g. with sheathing can be employed.

#### Fibre optic cable (FOC)

FO cables and related equipment shall be according to the GCUI-CD-GOT-TEL-SPC-002 Fibre Optic Cable - Specification.

FOC shall be single mode. Connector type will be defined during project execution.

#### Cable laying

Cable ways

Cables can be laid as follows:

* Directly in the ground,
* In protective pipes,
* In concreted cable channels,
* In buildings,
* In open air,
* on the wall or on cable racks,
* on the cable bridges,
* others to be discussed and approved by the Employer / Consultant

The cable laying will be performed based on the cable plot plans prepared and reviewed in close coordination with the Employer.

Cables for power systems and signal systems shall be routed as far as possible separate from each other. Power cables and signal cables must be laid in separate cable trays and protecting tubes. For intrinsically safe cables separate routes are to be planned as well. Intrinsically safe cables can be laid together with other signal cables in the same cable trays on the condition that proper separation is ensured.

Transitions from hazardous areas to non-hazardous areas shall be designed with certified solutions as pressure, water and gas sealing and in case of necessity with mineral oil sealing pass-through. Protective pipes must be interrupted if necessary. After cable laying all cable runs including the spare transitions shall be closed. The sealing shall be performed by a certified company. All protective pipes in outdoor surrounding, also spare tubes, will be water proof sealed after the cable installation.

#### Cable trays

Supplier’s cable tray system shall be made of hot dipped galvanized material.

Cable trays must be connected to the earthing system at every distance of 20 m, also at the route ends.

The Supplier’s scope contains the interconnection of his cable tray system to the plant cable tray system.

For cables with different voltage levels, a separated tray or barrier strip –if applicable has to be provided.

Laying

Cables shall be laid with considering the manufacturer’s instructions. In particular the allowable minimum bending radius, maximum allowable torque strength and minimum laying temperature shall be considered.

Shielded signal cables are generally to be earthed on both sides. Ex-i signal cables are not earthed in the field. All conductors shall be connected.

Supplier shall deliver all necessary auxiliary equipment required for cable installation, i.e. cable train rolls, corner rolls, tools, lifting devices, ladders, frameworks, cable drum unrolling devices, transport means for cable drum transports from storage place to construction side and the working place lighting as a minimum.

After laying, the cable ends must immediately be protected with water-repellent material (heat shrink tubing) in order to avoid moisture.

Cables shall be marked in a long-lasting, UV resistant and acid proof way. Cables shall be marked at both ends and in case of underground cables also at the beginning and at the end of the protective pipes, at the buildings entering, at branch-off from main routes (only the branching cable) and at each sleeve. A system must be employed that guarantees long lasting readability even when placed under ground, e.g. aluminium card corners with engraved cable number.

Delivery and placement of the labels is part of the supply.

The Supplier shall coordinate the delivery of cables with the Consultant and sub-contractor such that the cable installation shall be made during a frost free period of the project. Cable installation at temperatures below 5° C is allowed only after Employer’s approval.

#### Cable Testing

Low Voltage Cabling

For all cables and conductors loop resistance and insulations measurements according to valid EN standards shall be carried out and registered before putting into operation. This procedure includes I&C as well as intrinsically safe cables and conductors.

Traction Force Recording

If lifting gear/winches are employed, a traction force record must be kept and submitted to the Employer.

Only professional auxiliary mounting devices shall be used for the pulling like hoisting grip, slide and deflection roller and a correspondent record over their use is to be compiled.

#### Junction Boxes

All cables in the external system shall be inserted from below. The outdoor junction boxes must have a minimum ingress protection rating IP 65. The junction boxes shall be provided with a grounding terminal.

All Ex – junction boxes and their components shall be delivered with appropriate ATEX certificates and approvals.

The Ex i – junction boxes shall be equipped with blue terminals and cable entries.

Only metric cable glands shall be used. Inside the junction boxes the latest respective terminal plan has to be fixed.

A weather-proof label with the tagging of the box has to be installed.

Sufficient terminals shall be provided to terminate all spare cable cores. Separate junction shall be provided for each of the following cases:

* Intrinsically safe instrumentation circuits
* Non-intrinsically safe instrumentation circuits
* 24V DC control circuits
* 230V AC control circuits
* Other voltage levels.

## Enclosure

### General Information

The CU shall be supplied with an enclosure for the compressor skid to comply with the noise emission limitations specified in chapter 2.4.

Enclosure shall be mounted completely on the base frame and shall comply with the following requirements:

* Designed for installation in a Zone 2 hazardous area CS area,
* Internal confinement shall allow free access to the system components which require maintenance,
* Access doors shall be operable from inside/outside when the CU is running and shall be provided with windows and proximity switches to confirm the “closed” position,
* For major repair or overhaul free access a swing door or an easy-dismountable access panel shall be provided,
* In the area of suction and pressure line connections the panels shall allow dismantling of the piping,
* The auxiliary systems of the acoustic enclosure (ventilation, FFS, GDS, lighting and internal maintenance equipment) shall meet the requirements listed in the chapters 4.13.2, 4.13.3, 4.13.4 and 4.13.5,
* The safety functions for the inspection during operation must be decided by the Supplier and agreed with the Employer and Consultant before construction,
* The Supplier has to arrange a 30-minute-tightness test performed by independent third party during COMMISSIONING.

### Ventilation

The enclosure must be provided with a positive pressure ventilation system which ensures that the temperature within enclosure does not exceed a maximum temperature of 50 °C. Moreover, the compliance of the minimum air exchange to the explosion protection must be ensured. Open or semi-enclosed spaces which are designed to be ventilated by natural means shall achieve a minimum of 12 air changes (AC)/hour for 95% of the time. This natural ventilation may be augmented by mechanical means. The system consists in a suction filter, suction and foul-air ducts with muffler and fans. The following requirements are to be complied with:

* All the ventilation equipment shall be Zone 1 certified and remaining energized in case of gas detection
* Two AC fans (2 x 100% one in operation, second stand-by, alternating in agreed intervals) for normal operation shall be provided,
* The fans and the corresponding E-Motors must be easily accessible for maintenance,
* The start sequence shall only be initiated when a fan is operating and the gas concentration is below the alarm limit. In case of a malfunction in the venting system, the fan shall be shut-down by an adjustable switch after a certain bridging time,
* In case of fire inside the acoustic enclosure, the venting system shall be shut-down, the ventilation flaps closed and the fire extinguishing system triggered,
* Supply air and discharge air channels are to be provided with lifting lugs for easy maintenance and protection against water entrance,

The Supplier shall provide supporting structures and compensators for the ventilation ducting if required.

The suction and outlet duct openings shall be protected with bird protective grids; this shall be protected against icing.

The enclosure including enclosure ventilation shall comply with the noise emission values specified in chapter 2.4.

### Lighting system

The Supplier shall provide a lighting system including emergency lighting system inside the enclosure.

The system shall be designed for Ex-zone 1 and for the temperatures present in the enclosure and shall provide the following lighting level:

* min. 200 lux for normal lighting
* min. 20 lux for emergency lighting

The normal lighting shall be partly supplied from UPS for emergency lighting purpose.

### Internal Maintenance Equipment

The enclosure shall be provided with an internal crane necessary for assembly and disassembly of the main components of the CU. The enclosure shall allow the exchange of the CC bundle, CC rotor and whole GT or rotor. The Supplier shall submit all drawings showing all steps including the necessary space required for maintenance including exchange of CC bundle, CC rotor and whole GT or rotor. This shall include a description of the single phases / movements / weights shall to be submitted.

### Access Platforms

The enclosure shall be provided with the corresponding ladder / platforms for access. Inside the acoustic enclosure the accessibility to all system and parts subject to maintenance and test operations shall be provided by suitable platforms. All platforms must have guardrails in accordance to valid regulations. Guardrails have to be self-locking.

### Fire, CO2 and Gas Detection System (FGDS)

The Supplier shall supply and install a fire, CO2 and gas detection systems for the TURBO-SET scope. The system shall be in line with IEC 61508 and EN 12583, i.e. it has to be certificated for the required SIL class. The FDS/GDS system will be a continuous monitoring device.

The fire detectors shall be provided with 2 out of 3 logic voting (2oo3).

The gas detectors shall be provided with 2 out of 3 logic voting (2oo3) for the ventilation inlet and outlet ducting of the acoustic enclosure

The FDS/GDS shall be the Supplier’s standard, taking into account valid Latvian legislation and Owner’s requirements.

The Supplier shall be responsible for training of Owner´s personnel.

## Further Requirements

### Labeling and Marking

All equipment shall be provided with identification Tag-Number out in conformity with the respective drawings and documents. The tags used for the various labels are subject to Employer´s approval, Supplier shall issue a list of all labels intended to be used for his systems.

### Tagging

Tagging shall comply with the Supplier tagging system.

The concept for tagging by the Supplier shall be approved by the Employer during project execution. Tagging and naming convention must be strictly consistent within the whole system and documentation.

### Pressure Piping, Fittings and Pressure Vessels

The Supplier shall consider the battery limits specified in document No. GCUI-TD-GOT-MEC-DWG-001 for the design and selection of all tie-in points at the skid limits as well as for all piping required in the Scope of Supply.

The CU shall be factory packaged with all required equipment, piping and fittings and shall be delivered to site as packaged skids. All piping required for utilities supply (instrument air, etc.) and all vent piping shall be assembled on skid in the Supplier workshop and shall be routed to the skid edge.

The local vents of the CU shall be included in the Scope of Supply as required in chapter 3.1 and shall be routed to the outside, i.e. roof of the CU enclosure. The Supplier shall perform detail design of the local vents during the project execution and shall submit this to the Employer and Consultant for review and approval. All local vents shall be provided with flame arrestors, if required. The Supplier shall indicate the position, size and construction type of all tie-in point connections at the CU base frame.

All piping, filters and control valves required for the CU shall be included in the Scope of Supply and preferably installed on the CU skid in the Supplier workshop. If certain piping elements require installation tie-in to the station process piping, these shall be supplied loose for installation on Site. The Supplier shall design these and all required process interfaces to the station process piping during the project execution and shall submit the technical solution to the Employer and Consultant for review and approval.

All piping shall be realized and installed in such a way that no improper forces, e.g. resulting from temperature and pressure changes and no improper vibration can occur during the transportation, installation and operation of the CU. The piping shall, especially in regard to employed materials, comply with the requirements of chapter 1.5 and 0. In case of tubing, high-quality stainless steel connection shall be used.

All pressure vessels, supplied either on-skid or off-skid (e. g. filter, finned-tube cooler etc.) shall be designed and tested in accordance with valid Latvian regulations and Pressure Equipment Directive (PED) listed in chapter 1.5 and 0.

When supplying piping, fittings and pressure vessels, the Supplier shall ensure that these are compliant with all relevant standards, norms and technical regulations listed in chapter 1.5 and 0 and all certifications required by the Employer and third parties and/or authorities are included in the Scope of Supply.

### Coating and Corrosion Protection

#### Coating

The CU, and other equipment for delivery shall be provided with coating, whenever meaningful and necessary. This shall apply also for thermally insulated connections. The Supplier shall refer for coating and painting for details on the requirements for coating and painting. The colour to be applied will be communicated during project execution.

The following shall be considered as a minimum:

* Surface preparation shall comply with the requirements of EN ISO 12944 – part 4 “Preparation and testing of surfaces” - degree of derusting Sa 2 1/2,
* Sandblasting shall be applied at an air moisture lower than 85 %,
* The maximum throatiness should not exceed half of the primer coat’s layer thickness,
* The primer coat must be carried out in a closed room within 12 hours after the sandblasting (zinc-abundant and silicone coatings within 5 hours)
* The aluminium percentage should be < 25 %
* The overall film must be at least 150 μm thick,
* Testing of the dried film thickness is to be carried out with a non-destructive device like “Mikrotest” or similar.

#### Corrosion Protection with Zinc Coating

The Supplier shall provide corrosion protection with zinc coating for the following steel constructions as a minimum:

* frameworks
* operating platforms
* pipe - support etc.

The Supplier shall consider all relevant Employer specifications (and technical conditions) and requirements as per applicable international and Latvian Standards and Regulations.

#### Thermal Insulation

The maximum surface temperature of the thermal insulation shall not exceed 60°C, all parts where temperature exceed mentioned, must to be insulated. All thermal insulations and contact protections foreseen for hot components shall be easily removable. All electric connections shall extend beyond the thermal insulation and shall provide for easy access. All cables shall be the laid outside the insulation.

# FACTORY INSPECTION AND TESTING

## General Information

Factory inspection and testing of the CU shall be carried out according to API 617 8th edition and the requirements listed herein.

The Employer has the right to witness all factory inspections and testing. The number of factory inspections and testing to be carried out in the presence of the Employer as well as the extend of Employer’s or his representative participation to testing shall be defined and shall be submitted to the Employer for review and approval.

The Supplier shall notify the Employer at least 10 days before the fixed day for the test.

The Employer or his representative shall have free accessibility to the quality management programmes of the Supplier.

All factory certificates issued according to EN 10204 3.2, sub deliverers’ specifications, heat treatment protocol, QA protocols as well as the final CU tolerances shall be kept for at least 10 years and, if requested, put at Owner’s disposal.

## Non-Destructive Testing (NDT)

The non-destructive material testing shall include the following parts as a minimum:

* Casting (only steel casting is allowed)
* Shafts
* CC impellers
* Weld seams of pressure vessels and high pressure piping as specified in chapter 4.2.14.

All welds shall be subjected to 100% visual examination and surface crack detection.

Long seam and circumferential welds of pressure piping and pressure vessels shall be tested to the following extent:

* minimum 100% RT or
* minimum 100% UT

Nozzles and nozzle welds shall be subjected to 100% UT.

All Non-Destructive Testing shall be performed as per standard API 617 8th edition.

The Supplier shall consider the following requirements if the CC impellers are forged and welded:

* NDT of welds shall follow the requirements listed herein above,
* The load in one direction or another must not exceed the minimum yield strength with more than 65 % at maximum rotation speed and operations temperature,
* The material must have certificates documenting the composition, hardness test and ultrasonic test,
* Moreover, specimens from the forged piece should undergo the tensile and notch tests,
* After the overspeed test with 115 % of the nominal rotation speed a test of the impeller with dye penetration procedure shall be performed.

## Hydrostatic test

The water pressure test shall be carried out for the following parts:

* All pressure components of the CC with test pressure=1,45 x 105 barg and as required in the standard API 617 8th edition,
* High-pressure piping as required per PED,
* All pressure vessel according to the European Pressure Vessel Directive PED 2014/68/EU,
* All water pressure testing shall be certified by an independent third party expert, as per EN 10204 3.2.
* All process coolers with test pressure=1,45 x 105 barg.

## Testing of CU components

The following tests shall be carried out in Supplier’s or OEM´s factory:

* Mechanical running test (no load) of the CU, bearings cabinet, coupling, instrumentation as per standard API 617; shall be witnessed by the Owner,
* Factory aerodynamic test of the CU according to PTC 10 Type 2. All guarantee operating points listed in Annex 1, Attachment 1.9 and the CU operating map limitation lines including the surge limit for three different rotation speeds shall be tested. The results shall be documented in the test report of the CU performance test. Factory aerodynamic test will be witnessed by the Employer,
* FAT of the UCS; shall include all control cabinets of CU and bearings; shall include testing of all communication interfaces to the SCS and to equipment supplied by others; shall include I/O testing; the FAT will be witnessed by the Employer,
* FAT of GT (full-load test); shall include verification of GT performance /efficiency as per API RP11 PGT92 the FAT will be witnessed by the Employer,[[2]](#footnote-2)
* FAT of MCCs; the FAT will be witnessed by the Employer,
* FAT of all cooling systems,
* FAT overspeed test (115%)

The Supplier shall prepare 1 month before starting of each test FAT procedure and acceptance test criteria complying with Inspection and Testing Plan. In particular, the procedure for the measurements being part of the performance tests shall be described in detail. This FAT procedure is subject to the Employer and Consultant approval.

# PACKING AND TRANSPORTATION

The objective of this chapter is to specify the minimum requirements and procedures related to protection of material and equipment during the air transport, maritime transport, road transport and storage at Site. The material shall be in any case prepared for transport in such a way as to withstand the multiple handling, storage, exposure to rain, salty water impact and external storage for the minimum period of one year.

The Supplier shall be held fully responsible for any damage or loss of goods due to the following reasons:

* inadequate and/or inappropriate packing into containers
* inadequate and/or inappropriate packing
* inadequate and/or inappropriate labelling and/or tagging
* inadequate and/or inappropriate documentation distribution

The packing methods used shall be appropriate also for the extended storage at Site under the environmental conditions specified in chapter 2.2. If it is assumed that the time of storage is at least 1 years.

Each transport container shall contain full lists of packages in English and Latvian language, which shall enable to unpack and sort the received equipment. Each part of the equipment shall be sufficiently labelled so that it can be matched to the transportation documents.

The Supplier shall not pack, load and/or transport the Equipment to the Site prior to the Ready for Delivery Certificate being issued by the Owner with respect to the Equipment (or relevant part thereof). The transport of each piece of equipment shall be notified to the Owner sufficiently in advance.

# INSTALLATION AT SITE

## Site Installation of the complete Scope of Supply (Base Scope)

The Supplier shall supervise the site installation of the complete Scope of Supply including mechanical, electrical and I&C equipment as defined in chapter 3. The installation will be provided by construction company with relevant knowledge. The Employer will choose and be responsible for construction company.

## Supervision for Site Installation (base scope)

The Supplier shall include in the base scope the supervision of site installation of all equipment included in the Scope of Supply as defined in chapter 3.

# COMMISSIONING, PERFORMANCE TESTS

## Mechanical Completion COMMISIONING

The Supplier shall inform the Employer in writing as soon as the assembling, installation and test activities are completed and the complete equipment is set up and tested without gas, inclusive loop and functions test in the system.

At this point the Supplier shall have the following documentation ready for submission to the Consultant and Employer:

* Reports and certificates of all factory tests,
* Reports certificates, and any other documents required by the Authorities and Notified Body,
* Site QA/QC reports (in original),
* Operating and maintenance manuals on English and Latvian language,
* Certificates for all E- and I&C equipment installed in hazardous areas, including a relevant list,
* All other documents, drawings, tables, lists, test protocols etc. which were produced in connection with the inspection and tests performed on site (e.g. loop test certificates, certificates for compressor connection to the station process piping),

After a written notification from the Supplier, the Employer and the Consultant will:

* verify the completeness of the installation work,
* run simulations for the functions of the safety systems,
* verify including cooperation and check at Site for I/O signals from/to station control system (SCS) and to all other systems which communicate with the UCS. The Supplier shall ensure qualified person for this activities at Site,
* verify the completeness of the documentation.

After the conclusion that the assembly, test and installation work is completed and all necessary documentation is available, a Protocol (certificate) on the mechanical completion will be set up. At this point the CS is ready for pressurisation with process gas. After gas filling, the Supplier must to supervise the commissioning activities according to the agreed program with construction company. The Supplier shall prepare the program for the subsequent commissioning activities for approval 3 months prior hot commissioning (first start of CU) announcement at latest and shall submit this to the Consultant and Employer. When all inspections and tests are completed, the Supplier shall inform the Employer in writing that CU is ready for the test runs.

The Supplier shall bring all tools required for unloading, unpacking, storage/ removal of preservations, grouting, chemical cleaning / flushing, field installation and assembly, as well as for Start-up and commissioning.

## Test Runs, Reliability Test, Availability Test

All activities related to the testing will be done by Construction company under supervision and participation of Supplier.

After the receipt of the written notification that the CU is ready for putting into operation, the Employer has the right if required to ask for improvements which in his opinion are indispensable for the safety of the Site.

During the first phase of the Test-Runs, all the controls and fine adjustments to be carried out.

The Test Runs are to be performed as follows:

* At the beginning 10 starts and stops of the CU at maximum pressure ratio have to be performed, out of which at least 9 have to take place without alarms or shut-downs,
* One additional start has to be performed from the condition with equal suction and discharge pressure,
* In the next step the CU shall be started and kept in operation for an entire week. In this period the CU must run completely fault-free automatically controlled. It must be possible to carry out further starts and stops, to adjust load and rotation speed range within the complete operating envelope, test the correct functionality of the safety arrangements, make fine adjustments and control the surge valve,
* the selected tests will be performed locally from UCS and remotely from SCS,
* the Supplier shall prepare 3 month before starting of hot commissioning each test SAT procedure and acceptance test criteria. This SAT procedure is subject of the Employer and Consultant approval.

Further on the CU shall be regularly checked in order to detect malfunctions (vibrations in the piping etc.).

At the end of the above listed tests, the 72 hours test (Reliability Test) shall be started in the presence of the Employer or his representative.

The test begins with five starts and four stops at maximum pressure ratio. At the end of the 72 hours, four starts and five stops shall be performed. During the start and stop procedures possible tests of the safety systems of the CU can be carried out (e.g. shut-down after a simulated gas detection alarm). The following acceptance criteria apply for the successful completion of the 72 hours test:

* 72 hours test shall be performed based on the approved test procedure,
* the 72 hours test shall be completed without equipment malfunctions, failures, alarms or trips.

If – during the 72 hours test – the CU suffers malfunctions, alarms or trips, the cause of the respective failure shall be mitigated and then repeat the test from the beginning. The costs for electrical power and fuel gas required for the 72 hours test shall be as per following:

* the Employer will cover the costs for the electrical power, process gas and fuel gas consumption for the first 72 hours test-run,
* if the first 72 hours test fails because of malfunctions, alarms or trips associated with the equipment included in the Supplier scope and the 72 hours test must be repeated, then the Supplier shall cover the costs for electrical power an fuel gas of the subsequent 72 hours test(s).

The Supplier shall submit the 72 hours test procedure to the Employer and Consultant for review and approval, the program for the 72 hours test shall be issued based on the requirements stated in the this chapter.

After successful completion of the 72 hours test, the 168 hours test shall be commenced in the presence of the Employer. The Supplier shall prepare the program of the 168 hours test and shall submit this to the Employer and Consultant for review and approval. The Employer reserves the right to change the test program for the 168 hours test depending on the transport requirements of the CS or include additional testing scope in the testing program. The Supplier together with construction company (Employer) shall plan the Performance Tests as per chapter 8.3.1 during the 168 hours test.

## Measurement of the Guarantee Parameters and Availability Tests

### Performance Test

The purpose of the Performance Test is to verify – for all CS including itself CU supplied – the guarantee values for the electrical power consumption and fuel gas consumption and to determine the unit operating envelope. The applicable tolerance for increased electric power and fuel gas requirements of the guarantee operating points is 0%.

During the 168 hours test period, the Supplier shall verify that the defined guarantee values are fulfilled for all CU supplied. The performance tests will be carried out by the Construction company and Supplier on the base of approved Performance Test Procedure.

The Performance Test of CS and CU will be organized mainly as per the following principles:

* the Supplier shall prepare the Performance Test procedure and submit this to the Employer and Consultant for review and approval. The Performance Test Procedure shall include all measurement instrumentation, measurement parameters, calculation methodology and formulas required for evaluating the Performance Test results,
* the Employer will provide all instrumentation which is required for the Performance Test as per the approved Performance Test procedure. This will including the flow measurement as well as the pressure and temperature instrumentation to be installed in the CC suction and discharge piping as required by ASME PTC 10,
* The Employer will measure all process data required for evaluating the guarantee values as per approved Performance Test procedure,
* The Employer will submit to the Supplier all process data which is required for evaluating the guarantee parameters,
* The Employer will supply the process gas composition required for the site Performance Test,
* The Supplier shall evaluate the data measured during the Performance Test, elaborate the Performance Test report and submit this to the Employer for review and approval; the report shall include the evaluation results which shall prove the compliance with the guarantee values,
* The on-site Performance Tests shall be carried out as per PTC 10 Type 1,

If, according to the results of the Performance Test, modifications are necessary, these shall be implemented by Supplier immediately. After a positive end of the contractual defined Performance Tests, further operation points shall run in order to determine the "as built” performance maps of CU. It is the responsibility of the Supplier to elaborate the “as-built” performance maps for CU and submit these to the Owner.

### Noise Emission Tests

The verification of the guarantee values for noise shall be performed by an independent third party accepted by the Employer and the Supplier. The third party shall prepare the noise measurement report. Third part will be ordered by the construction company which will be chosen by Employer. The Supplier shall assist and operate the equipment in the Scope of Supply during the whole test.

The measurement of the noise emissions shall take place in accordance to valid EN standards and Latvian regulations.

The measurement and report is not in Scope of Supply. If the guarantee values are not met, the Supplier shall apply measures to comply with the guarantee values and compensate addition costs related to extra tests required.

### Guarantee Parameters for Availability

The Availability of each CU incl. all auxiliary equipment shall be min. 97% @ 364 days per year. The Supplier is required to provide in the Offer the Guaranteed Availability value of the CU and detailed conditions for its fulfilment. The Availability of the CU shall be evaluated after 10,000 operating hours or a period of two years starting from unit release for operation whichever occurs first.

# DOCUMENTATION

## Required documentation in Supplier’s Offer

The Supplier shall furnish in Offer the following data:

* Sub supplier list
* References list
* Detailed supply
* Utility Consumption List including utility specification,
* Filled in data sheets document No. GCUI-TD-GOT-MEC-DAT-001 Mechanical datasheet of the Centrifugal Compressor and document No. GCUI-TD-GOT-MEC-DAT-002 Mechanical datasheet of the Gas Turbine
* CC performance maps, operating point conditions. Performance maps shall include:
	+ Isentropic head [kJ/kg] in relation to the inlet volume flow rate [m³/s] with a surge limit.
	+ Clutch power TNGC [MW] in relation to the inlet volume flow rate [m³/s]
	+ Isentropic efficiency in relation to the volume flow rate [m³/s]
* GT Shaft Power Output vs. Ambient Temperature
* GT Efficiency/Heat Rate vs. Ambient Temperature
* GT Shaft Power Output vs. low pressure turbine speed, curves of high pressure turbine speed and efficiency for different ambient temperature
* GT Exhaust Gas Temperature vs. Ambient Temperature
* GT Exhaust Gas Mass Flow vs. Ambient Temperature
* GT Inlet-/Exhaust Pressure Drop vs. Power resp. Efficiency/Heat Rate
* CU Start-up Sequence
* CU Shut-down Sequence
* GT Degradation Curve
* Residual heat load list,
* List of Comments, Exceptions and Deviations,
* UCS control architecture as specified in chapter 4.11.3,
* Communications Block Diagram as specified in chapter 4.5.13,
* Electric Load List,
* TC P&ID’s,
* Manufacturing, factory testing, delivery and installation plan,
* Equipment maintenance drawings,
* Preliminary Inspection and Test Plan (ITP)
* Maintenance and regular overhaul schedules.
* Proposed surface preparation and coating
* Spare parts lists
* List of special tools

The minimum requirements for the form and scope for all documentation including documentation for project execution are specified in chapter 9.

## Documentation elaboration

### General requirements

Supplier shall prepare a project document list, which shall list all document required during the project execution including the number of copies and submission dates.

Each document shall be identified based on the following minimum information:

* Purchase Order number
* Project name
* Document number and title as per Supplier document numbering system,
* Document status,
* Revision history table,
* The As-Built revision of documents shall include also the denomination “As-Built” beside the alphanumeric revision number,
* Number of copies (to be defined later),
* Planned and actual document submission date.

All documents shall be issued by the Supplier with considering the Employer’s requirements listed in this specification.

Changes made in subsequent revisions of drawings shall be clearly marked up with “revision clouds”.

Changes made in subsequent revisions of text documents shall be clearly marked with revision bars located on the left side of the text block.

Changes made in subsequent revisions of excel tables shall be clearly marked with colors.

The documents shall be transmitted in electronic form by e-mail prior being sent by post (hardcopy). During the project execution, the Supplier shall submit all documents by using the document exchange platform provided by the Supplier or Employer.

Supplier may suggest the usage of Supplier’s document management system and shall provide a respective documentation with the offer. A decision on which document management system shall be considered shall be made during the clarifications meetings,

The Supplier’s project documentation shall be generated using:

* AutoCADTM (drawings),
* Microsoft WordTM,
* Adobe Acrobat WriterTM (documents),
* Microsoft ExcelTM
* Microsoft AccessTM and
* Microsoft ProjectTM (time schedules)

Upon request, the Supplier shall provide all documents in digital form as DXF-files for drawings and Microsoft Office for Text and lists.

Electronic native files submitted to Employer and Consultant shall be always accompanied by ‘pdf’ or other agreed format copies to assure integrity and traceability of the original native files.

The documents in the pdf format shall enable text searching (OCR).

The Employer and Consultant will put all reasonable effort in checking documents submitted by the Supplier without any delay. The Employer and Consultant will review the documents submitted by the Supplier within 2 weeks (10 working days) starting from the date of receive.

The documentation rejected by the Employer and sent back to the Supplier shall be updated with considering all comments submitted and shall be re-submitted to the Employer within 2 weeks (10 working days).

The documentation may only be approved by the Employer if no obvious errors are discernible and if documentation is complete. The Supplier shall not submit during the project execution documentation marked as "Preliminary" or “Typical” to the Employer. On inquiring about approval, the Supplier shall assure the Employer that the documentation has been compiled in compliance with the terms and conditions specified herein and in the CONTRACT, including the subsequently incorporated amendment requirements. Approval shall not release the Supplier from any subsequent updating or correction obligation at no extra cost for the Employer.

The Supplier can include preliminary or typical documents, drawings and schematics only in the Offer provided these are marked as such clearly.

All documents required from the Supplier shall contain the counter-reference of all signals or cables, even if the counter-terminals are not included in the Scope of Supply (supplied and installed by others). The Supplier shall incorporate the cable number, core identifier, counter terminal identifier (including switchgear identifier, terminal strip identifier and terminal number) in their documents. The Supplier shall include in his documents all required cross-references to all relevant documents including documents of the Employer. The Supplier documentation shall include as well all counter-references to station process piping including piping of the CU anti-surge loop. The Supplier is responsible for obtaining all necessary information.

With regard to the applicable legislation, within the project phases it is required to elaborate and supply all and any required documentation for project:

* Design documentation for issue of the Building Permit or Building Notification (DSP),
* Detailed Engineering Documentation,
* Documentation required for Site acceptance by the responsible authorities,
* As-built documentation.

The documents required shall include – where possible – all battery limits for the Scope of Supply as defined in chapter 3 and document No. GCUI-TD-GOT-MEC-DWG-002, Document No. GCUI-TD-GOT-GEN-DWG-003, Document No. GCUI-CD-GOT-IAC-SPC-003 and Document No. GCUI-CD-GOT-IAC-DWG-001. The battery limits shall be shown in the following documentation as a minimum:

* Mechanical interface list / tie-in schedule,
* General arrangement drawings,
* General layout drawings,
* Piping and instrumentation diagrams (P&IDs),
* Instrumentation loop diagrams,
* Electrical wiring diagrams,
* Electrical single line diagrams,
* Cable block diagrams / interconnection schedule,
* Cable lists,
* Hook-up drawings,
* CU control architectures.

### Detailed Documentation Requirements

#### General Arrangement Drawings and General Layout Drawings

The general arrangement drawings are required for all equipment included in the Scope of Supply (GT and CC skid, inlet duct, exhaust duct, anti-icing system, UCP cabinets, outdoor heat exchangers package, oil cooler, and field instrumentation, package and field valves, interconnecting piping, all supporting steel structures etc.) which shall be installed or connected to the Employer’s pipework / foundations or cabling.

The general layout drawings are required to indicate the overall location of equipment. The general layout drawings shall include all requirements for maintenance space as well as the clearance space for the doors of cabinets and junction boxes.

The general arrangement drawings and the layout drawings shall show all equipment included in the Scope of Supply with considering the equipment corresponding to CU.

The general arrangement drawings shall indicate the following as a minimum:

* Envelope dimensions,
* Access, withdrawal and lay-down maintenance space requirements,
* Mechanical, electrical, I&C and civil termination and interface points (numbered as per PROJET tagging system according to Annex 1, Attachment 1.18),
* List – in tabular form – with all mechanical, electrical, I&C and civil termination and interface points with including the PROJECT TAG numbers, location with reference to a common axis reference system, scope, dimension, number, size, materials, rating, type, operating medium; the termination and interface points shall include the following as a minimum: CU process flange connections suction and discharge, EM cooling gas return line tie-in, instrument air flange connections at CU skid edge, drain flange connections at CU skid edge, earthing bosses, junction boxes (LV, MV, I&C), etc.,
* Overall weights, maintenance weights and transportation weights for major components,
* Lifting points and centre of gravity of skid and components and overall centre of gravity with skid and components assembled to be shown,
* Lifting drawings,
* Assembly drawings including list of components,
* Acceptance flange loads based on relevant design standard,
* Acceptance alignment tolerances for all flanged interfaces,
* Cross reference with detail drawings for Document Number, Title and Views,
* Static and dynamic forces acting on the foundation during all operating and test conditions,
* For control valves and similar, envelope drawings and/or tables showing flange sizes and ratings, face to face dimensions and maximum envelope sizes shall be provided,
* Earthing lugs, electrical trace heating and cathodic protection anodes, if any.

In the case the Scope of Supply includes packages / skids with several different types of equipment, the above information shall be supplied for each individual package or skid as appropriate; each package or skid shall be separately identified and an overall general layout drawing showing the mechanical, electrical and I&C interconnections between each individual package / skid. In this case the Supplier shall group and submit all drawings as a set.

The following data shall be furnished additionally for all packages and skids included in the Scope of Supply:

* General arrangement and overall dimensions of package / skid,
* On-skid mechanical equipment including PROJECT TAG numbers,
* On-skid electrical equipment and electrical junction boxes including PROJECT TAG numbers,
* On-skid instrumentation and instrumentation junction boxes including PROJECT TAG numbers,
* All on-skid cable routes including cable trays,
* Identification of all major on-skid components with PROJECT TAG numbers,
* Foundation bolt location / orientation,
* Foundation bolt diameter,
* Base plate thickness,
* Special Supplier anchor bolt requirements e.g. shape, material, pre-tensioning, etc.,
* Minimum grout thickness,
* Special grout requirements of the Supplier, e.g. epoxy, precision non-shrinking, fully-filled base plate etc.,
* Limiting dimensions for plinths and other structural elements where critical for clearances around piping, nozzles and the like,
* Special maintenance requirements,
* Requirements for cable trenches at package / skid limits for all interconnecting cabling,
* Requirements for drain systems at package / skid limits,
* All on-skid access platforms including hand rails.

The Supplier shall refer to the following tabulations for further specific information required:

* Total operating weight of the CU skid (including CC, GT, oil system, auxiliary equipment, baseplate…),
* Inlet duct weight,
* Exhaust duct weight,
* Weight of all auxiliary equipment including outdoor heat exchangers, anti-surge valves, etc.,
* Centre of gravity of the CU compressor skid (dry and wet) in x, y, z directions (in table form),
* Centre of gravity of all auxiliary equipment in x, y, z directions (in table form),/
* Centre of gravity of the base frame in x, y, z directions (in table form),
* CC rotor weight and centre of gravity,
* GT weight, rotor weight and centre of gravity,
* Centre of gravity of CC rotor in x, y, z directions (in table form),
* Centre of gravity of GT in x, y, z directions (in table form),
* CC speed (rpm) or range of speeds,
* GT speed (rpm) or range of speeds,
* Magnitude, location and direction of specific static loads such as thermal, normal torque, short circuit torque and other CU operating loads
* Magnitude, location and direction of all dynamic unbalanced forces (transverse and vertical)
* Limits of differential deflection between two points on the frame, or allowable differential deflection of the bearings,
* Special alignment tolerances for supporting foundations / structures,
* Specific limits of dynamic amplitudes that could damage the CU at normal operating speed, or could shut-down the CU,
* Specific recommendations for the design and construction of TC foundation, if any,
* Maximum lifting weight and clearances for maintenance,
* Leveling screw plate requirements.

#### Equipment Foundation Interface Details

The design of all foundations required for the equipment included in the Scope of Supply is not in Supplier’s responsibility; however the Supplier shall submit foundations templates as well as foundation interface details including load lists which shall include the following information as a minimum:

* Number and location of all base frame anchor bolts including size, materials, load handling requirements, grouting requirements and detail drawings, etc.,
* Number and location of all base frame levelling bolts including size and materials,
* Requirements for levelling pads including location, size, materials, etc.,
* Table with static and dynamic loads for all anchoring points; these shall consider the following type of loads: dead loads, wind loads (equipment installed outdoors), live loads, dynamic loads during operation, short-circuit loads, etc.,
* Foundation template drawings including construction requirements for all equipment included in the Scope of Supply,
* Special requirements for foundation design.

#### 3D model of CU, all auxiliary systems, bulky spare parts

The 3D model (native file) of the CU including auxiliary equipment, (bulky) Capital Spares shall include the following as a minimum:

* All major on-skid components,
* All mechanical, electrical, I&C and civil interfaces,
* Physical outer boundaries including lifting supports, transportation and storage dollies,
* Dimensioning and positioning of all utility connections at skid / equipment limits,
* Detailed representation with dimensioning and positioning of all foundation anchoring,
* Obstruction volumes due to requirements for maintenance space.

Shell 3D model of equipment / skids / packages without internal components is acceptable.

#### Equipment Data Sheets

The Supplier shall furnish ISA Data Sheets for valves and instrumentation for all instruments included in the Scope of Supply. These shall include project Tag-numbers, instrument OEM, instrument description, model number, measurement domain and precision, IP class, electrical and process connections, explosion protection. The Data Sheets shall meet the ISA Standard S20 format. Where the same instrument data applies to several Tag-numbers, then these Tag-numbers may be listed on one sheet.

Material Safety Data Sheets (MSDS) shall be provided for all chemicals (preservatives, sealants, coolant, lubricants and chemicals for water wash) or any materials requiring careful handling. An MSDS for each substance shall be prepared in accordance with the ASCC document “National Code of Practice for the Preparation of Material Safety Data Sheets” 2nd Edition [NOHSC: 2011 (2003)].

#### Calculation Reports

The Supplier shall submit the train (CU) lateral rotor-dynamic analysis report. Lateral critical analysis calculations shall determine the natural frequency of the shaft assembly and identify all excitation frequencies and harmonic components relative to operating speed range of the CU. The analysis and results shall be presented in graphical and narrative form, and shall include the following as a minimum:

* Critical Speed Analysis
* Undamped Critical Speed Map
* Damped Unbalance Response Analysis
* API Stability Analysis including LOG DEC
* Method used
* Graphic display of bearing and support stiffness and its effect on critical speeds
* Graphic display of rotor response to unbalance
* Stiffness and damping coefficients
* Journal bearing static loads
* Tilt pad bearing pad geometry and configuration

The Supplier shall submit train torsional analysis report for the entire GT and CC including couplings (train) as per API 617 8th edition. Calculations shall clearly indicate number and details of finite elements that the system has been divided into for the calculation, and a table of stiffness and inertia for each element shall be included. The results shall be presented in graphical and narrative form, and shall include the following as a minimum:

* Method used,
* Graphic display of mass elastic system,
* Tabulation identifying the mass moment torsional stiffness for each component in the mass elastic system,
* Graphic display of exciting sources (revolutions per minute),
* Graphic display of torsional critical speeds and deflections (mode shaped diagrams).

The Supplier shall submit the CU performance curves and data as required in chapter 4.2.13.

The Supplier shall submit the GT performance curves (power and torque vs. speed).

The Supplier shall submit start-up curves.

The Supplier shall perform stress analysis calculations for all interconnecting piping in scope and shall submit these to the Employer and Consultant for review and approval.

#### Utility Consumption List

The utility consumption list shall list all utility consumptions required to start, operate (under all reasonable conditions/operating scenarios), and maintain the equipment included in the Scope of Supply. The list shall indicate the following as a minimum:

* Type of utility,
* Quantities,
* Duty consumption rates during start-up, continuous operation, stand-by, run-down, ESD, etc.,
* Pressures,
* Temperature,
* Flows.

The list shall include, instrument air, gas, nitrogen (if applicable), demineralised water, oil, etc..

#### Documentation for electrical equipment

The Supplier shall submit general layout drawings for all electrical equipment included in the Scope of Supply (Low Voltage Switchgear Panel (MCC), all electrical and I&C cabinets …).

The Supplier shall submit disposition drawings for all electrical equipment included in the Scope of Supply. The electrical disposition drawings shall show the location of equipment in the compressor station buildings.

The Supplier shall provide cable block diagrams for all electrical and I&C equipment included in the Scope of Supply. The cable block diagrams (electrical and I&C equipment, LV cabling, I&C cabling) shall show equipment arrangements and identification of termination points as well as all interconnecting cables (in single line format) between individual instruments, junction boxes, cabinets and panels including cable types (number of cores/pairs, and core size). The cable block diagrams shall list of all junction boxes with location. The junction boxes, cabinets, panels and cables shall be tagged as per the tagging procedure. The cable block diagrams shall include all electrical, instrument and telecom interconnecting cables included in the Scope of Supply and shall consider the cables specific to CU supplied.

The Supplier shall submit electrical wiring diagrams and device outline drawings for all electrical equipment included in the Scope of Supply. The wiring diagrams shall include the battery limits, termination panels, PROJECT TAG-numbers, cable number, core identifier, reference drawings and shall cover all areas (field, junction boxes, cabinets, equipment rooms etc.). The wiring diagrams shall include all interconnections between equipment / packages included in Supplier’s scope as well as all wiring connections between Supplier’s scope and external systems (SCS, , LV main switchgear, etc.). The electrical wiring diagrams shall show the location of electrical equipment and cabling, i.e. location indoors and outdoors.

The wiring diagrams shall include the layout drawings of panel interiors and panel doors. The layout diagrams shall show the scaled location of such devices including:

* Front of panel layout clearly showing overall size and layout, with a table of instruments showing duty/label engraving/model number,
* Back of panel arrangement showing same data as front of panel,
* Construction drawing showing main dimensions hinging/opening of doors, door restraints, method of locking, plinths, stiffeners, hold down details (fully dimensioned) anti-vibration methods, materials, panel finish procedure and colours,
* Mimic/ annunciator drawing (where applicable),
* Terminal/ connection blocks,
* Wire ways,
* Power supplies,
* Bill of material,
* External cable entry locations and hubs.

The panel internal layout drawings shall show all lighting, cable entries and terminal strip locations, wiring trays, segregation of voltage level, IS and non-IS equipment, hydraulic, pneumatic layouts (where applicable), grounding points and power isolation.

The Supplier shall submit Single Line Diagrams for all electrical equipment included in the Scope of Supply. The Single Line Diagrams shall illustrate electrical circuits including representations of electrical power, and/or control circuits, electrical major components including functions and instrument control circuits, defining the relationships as following (as appropriate):

* Control systems,
* Consumer ratings,
* Switchgear/control gear ratings,
* Busbar ratings,
* Equipment descriptions and Tag-numbers,
* Protection devices.

The Single Line Diagrams shall show all earthing requirements along with required conductor sizes.

The Supplier shall submit cable schedules / cable lists, for all electrical equipment included in the Scope of Supply. The cable schedules / cable lists shall include all electrical, instrument and telecom cables in Supplier’s scope and shall consider the cables specific to CU supplied. The cable schedules / lists shall include the cables for CU. The cable lists shall include packaged / on-skid cabling as well as Site (off-package, field) cabling. The cable schedules / cable lists shall provide the following information for each cable as a minimum:

* Cable Project TAG number,
* Number of cores,
* Cable size, type and cross-section,
* Gland size and type,
* To and from location including the project specific TAG numbers for cabinets and junction boxes,
* Cable laying details , i.e. skid / off-skid, indoor / outdoor including scope for installation (factory packaged, site installation),
* Inter-connection diagram cross reference,
* Cable length, in meters (inter-connecting cables only),
* Voltage grade,
* Reference wiring diagram document number.

The Supplier shall submit data sheets for all electrical equipment included in the Scope of Supply.

The Supplier shall issue the cable numbering / tagging for the electrical wiring diagrams, cables lists and cable block diagrams.

The electrical load lists shall contain the following as a minimum:

* Type of electrical load,
* Service,
* Duty (continuous, emergency, standby, etc.),
* Power (normal, nameplate),
* Voltage, phase, frequency.

The Supplier shall submit all protection configuration/settings for all relays, circuit breaker releases, control units and all other electrical equipment in scope at the latest 8 weeks prior to delivery.

The Supplier shall submit the Hazardous Area Classification Documentation. This shall include the Hazardous Area Classification Report issued in accordance with EN 60079-10-1. The Report shall include the following, as a minimum:

* Summary Narrative of the Hazardous Area Classification Report,
* Definitions,
* Industry Standards Reference List used to develop the Report,
* Design Criteria including the following:
* Sources of Release with Estimated Release Rates (Refer to IEC 60079.10.1, Annex A),
* Ventilation Calculations to determine the Type of Zone Classification (Refer to IEC 60079.10.1, Annex B),
* Flammable Materials List and Characteristics per IEC 60079.10.1, Table C.1,
* List of Sources of Release per IEC 60079.10.1, Table C.2,
* Hazardous Area Classification Drawing showing location of classified Zones 1 or 2 using the Preferred Symbols for Hazardous Area Zones per IEC 60079.10.1, Figure C.1.

#### Control and Instrumentation Documents

The Supplier shall submit instrumentation lists. Instrument Lists/ Index shall detail all tagged instrument items for both packaged and field instruments and include the following as a minimum:

* Tag-number as per project requirements,
* Instrument description (pressure switch, control valve, level gauge, etc.),
* Manufacturer’s name,
* Model number,
* Service description (e.g., vessel low level, etc.),
* Instrument location or line (size/number/spec). Location Drawings shall show all tagged instrument items, local panels, and JBs in plan and elevation views,
* P&ID reference number,
* Data sheet number,
* Hook-up drawing reference,
* Wiring diagram number,
* Schematic drawing number,
* Set point and range (including alarms and shut-down),
* Gland sizes.

The Supplier shall provide instrumentation data sheets. Instrument data sheets shall include packaged instruments as well as field instrumentation. The instrument data-sheets shall include the following information as a minimum:

* project tag-numbers,
* Manufacturer (OEM),
* Model number and description,
* Size,
* Measurement range and precision,
* IP class,
* Electrical and process connections,
* Materials of construction,
* Certification details and explosion protection,
* Process data.

Specifications shall be provided for major instrument items, control and safety systems as well as the FFS.

The Supplier shall specify all installation materials (typically cable, glands, JBs, cable tray, tubing and fittings, and instrument valves).

Hook-up drawings (process, pneumatic and hydraulic, as applicable) shall be provided for each instrument installation type, with a list of all materials required for operation, installation and maintenance.

The Supplier shall provide instrumentation loop diagrams. The instrumentation loop diagrams shall be issued for each electronic instrument showing interconnecting cables between instruments and associated junction box and/or cabinet, panel, with cable, core and terminal numbers identified. The instrumentation loop diagrams shall show the scope for instrumentation and cabling and shall include the location of equipment, i.e. indoor, outdoor. The core identifiers shall be those as ferruled on to the conductors. The equipment and cable numbering shall follow the Supplier numbering system. Each loop shall be shown on a separate sheet. The Supplier shall submit instrument the loop diagrams for the package instrumentation as well as for the Site instrumentation.

The Supplier shall submit instrumentation loop diagrams also for the ESD system FGDS and CU protection system oil system incl. bearing vibration and temperature monitoring system,.

Drawings shall show segregation between IS and Non-IS signals together with cable and/or core screen terminations. Inputs and outputs shall be identified using the project Tag-numbers. For ease of identification cable destinations shall be shown with any cross-reference drawing numbers.

The Supplier shall provide cable block diagrams for instrumentation loops. The Supplier shall include the instrumentation cable block diagrams in the electrical cable block diagrams (chapter 9.2.2.7).

Functional Schematic Diagrams shall include Control System Topology Diagrams, Shutdown System Diagrams and Logic Diagrams as a minimum. The description of the Control System shall address:

* Modes of operation,
* Basis for selection of the mode of operation,
* Operator dependent actions,
* Health and safety responsibilities,
* Start-up, shut-down abnormal operating condition and special maintenance operations,
* Input, output, permissive signals, including internal logic signals to accomplish start-up, shutdown, etc.,
* Information displayed and operator interface,
* Listing of pre-alarm and shut-down alarm trip requirements and the failure mode of all valves and equipment must be clearly indicated,
* Shall clearly indicate switch room equipment, control room equipment and types of signal to and from, with interface information clearly stated,

Functional Schematic Diagrams shall include the list of all alarms and shut-downs with set values for CU and all auxiliary equipment.

The cause and effect charts shall show, in matrix form, all shutdown (including fire and gas) requirements associated with Supplier equipment.

The Supplier shall submit control system I/O List/ Signal List. The I/O List shall include all signals provided or required by the Supplier for the system to effectively work as specified in P&ID’s, logic diagrams and cause and effect drawings. The I/O List is not supposed to be a software list of signals (The Modbus List should contain this information).

The System I/O Schedule shall identify all I/O signals within packages in Supplier’s scope, between systems/ packages in Supplier’s scope and between systems in Supplier scope and project systems (ex. SCS). The schedule shall identify signal type and voltage level as a minimum and serial link interface data if applicable. The I/O List shall include the following as a minimum:

* Instrument or signal Tag-number,
* Descriptions,
* P&ID or related document,
* Range (general and calibrated),
* Set point(s) for alarm and shut-down (if available),
* Signal origin/destination (from/to),
* Type of signal (Analog Input / Analog output, discrete input, discrete output, etc.),
* Other data relevant to the configuration of the signal (receiving device, I/O card, etc. if required).

The Supplier shall submit instrumentation and control interface lists. These shall provide details of PLC type, device address, all jumper settings, cable and connector types with port pin definitions, interface type, protocol, baud rate and parity bit and data bit. All alarms, analogue variables, diagnostic and status registers, permitted remote commands and timer accumulators shall be stored in contiguous registers and be available for transmission to SCS. For this data the following details shall be supplied as a minimum for each signal:

* Tag-numbers,
* Engineering units for analogue signals,
* Engineering high scale for analogue signals,
* Engineering low scale for analogue signals,
* For binary signals, 0 and 1 descriptors and operator alarm requirements,
* PLC registers.

The Supplier shall provide visualization displays of UCS incl. summary of all warnings and alarms.

The Supplier shall submit layout drawings of all instrumentation in scope, both packaged and field instrumentation including local gauge board layouts. Layout drawings of instrument panels shall identify panel dimensions, connection points, all faceplate-mounted instrumentation and gland plates. Major “back of panel” items and trunking, terminals, and isolators shall be also shown.

Instrument Power and Air Distribution Diagrams shall identify the distribution of instrument electrical (AC /DC) and pneumatic power to individual users within the Supplier system or package from a single supply point provided by the project.

Instrument Calculations shall include control valve sizing and noise, relief valve sizing, flow meter sizing, control system reliability and availability as a minimum. The calculations shall cover all the identified design cases and shall identify the calculation methods and standards used.

The Supplier shall submit P&IDs for the following equipment as a minimum:

* CU including, DGS, CU monitoring system, NGC recirculation loops with anti-surge valve and hot-bypass valve (if required),
* Oil system,
* FFS,
* All control and shut-off valves including pneumatic and hydraulic actuators.

P&IDs shall indicate the following as a minimum:

* Battery limits,
* Equipment names and Tag-numbers,
* Major items of equipment shall have duties and design conditions stated,
* Interface numbers,
* Insulation and trace heating requirements,
* Venting and draining requirements,
* Relief valve location, project Tag-numbers, sizes and set pressure,
* PSV interlock valves and interlocking sequence and set pressure,
* Positive isolation requirements,
* Block and check valves, with type identified,
* Valves and actuators and solenoids; failure mode to be stated,
* Nozzles of vessels, sizes, man ways, and other inspection provisions,
* Slope of vessels,
* Levels in vessels, NLL, LSL, LSH, LSLL, LSHH, etc.,
* Instrumentation warning and alarm levels (LL, L, H, HH),
* Elevations of major equipment,
* Process and utility flow lines with directional arrows,
* In/Out continuation boxes with references to other Supplier P&ID drawing numbers as applicable,
* Line sizes, numbers, pipe specifications, specification breaks and goods designation,
* Piping special items,
* Piping notes,
* Switches and instruments with Tag-numbers, and alarm trip set points,
* Instrument signals and interactions with SCS,
* ESD valves,
* Interfaces with other P&IDs including Owner P&IDs,
* All interface equipment, instruments, valves, etc., shall be tagged, with Owner Tag-numbering system requirements.

#### Materials Engineering Technology

The Supplier shall submit Welding Procedure (WPS/PQR) Documents. The Supplier shall provide all welding procedures (WPS and PQR), including welding procedures used for base material repairs, together with cross-referenced Weld Maps in accordance with the Employer requirements. Weld Maps shall specify and show the following as a minimum:

* WPS(s) to be used for each weld joint (WPS shall be made available to Employer / Notified Body for review upon request),
* The type of weld joint (full penetration, partial penetration, fillet, socket, etc.),
* Actual materials thickness at each weld joint,
* Specific base materials by Type and Grade for each weld joint,
* Whether back gouging and back welding will be applied for each joint,
* Preheat temperature for each weld joint,
* Whether Post Weld Heat Treatment (PWHT) will be applied,
* Weld Filler Material(s) Classification to be used for each weld joint.

The Supplier shall submit Non-Destructive Testing (NDT) Procedures. All proposed NDT procedures (radiography, ultrasonic, dye penetrant, magnetic particle, PMI, or similar) shall be utilized in accordance with the Employer requirements specified herein (see chapter 5.2 and shall be defined and cross-referenced with the Weld Map to determine procedures to be used.

The Supplier shall submit Heat Treatment and PWHT Procedures. The Supplier shall provide detailed Heat Treatment and PWHT procedures in compliance with the Employer’s requirements specified herein.

The Supplier shall provide Painting Specifications for the CU and all auxiliary equipment included in Scope of Supply. Painting Specifications and Procedures shall include the following information for each equipment item:

* Surface cleaning,
* Preparation,
* Shop or field painting,
* Paint/coating manufacturer,
* Paint/coating composition,
* Linings (where applicable),
* Anti-rodent/insect treatment,
* Repairs to damaged finishes,
* Quality system in place.

The Supplier shall submit Material Traceability Procedures.

The Supplier shall submit Positive Material Identification (PMI) Procedures.

#### Installation, Operation and Maintenance Manuals (IO&M)

Installation, Operation and Maintenance Manuals shall be provided in English and Latvian language and include description of equipment, operating procedures for start-up, steady state, shutdown, emergency and fault conditions, operating parameters, function of protective devices and controls, copies of fault finding guidelines. Manuals shall include the following as a minimum:

* Cause and effect charts,
* Data sheet for equipment,
* Data sheet for the EMD,
* Data sheet for auxiliaries and components,
* Performance curves,
* General arrangement drawings,
* Outline and cross section drawings including base plate,
* Drawings of ancillary equipment such as fans, gearboxes, filters etc.,
* Complete Parts lists,
* Block diagrams,
* Schedule of packing,
* Purchasing specifications,
* Piping and instrumentation diagrams,
* Instructions for installation, preservation, operation, maintenance, disassembly, repair, overhaul and assembly,
* Recommended spare parts listing,
* System of trouble detection and remedy,
* Electrical drawing and details,
* Control schematics,
* Details on sub-contractor equipment with information on the specific model utilised,
* Owner approved drawings as specified in the Supplier Document Requirements List,
* Special Tools List shall include all tools necessary for removing equipment from transport at Site, all tools necessary for installation and maintenance. For each list item, a brief description shall be given and where necessary for clarity, a drawing shall be provided.

Unloading, Unpacking and Installation procedures shall include the following information, as a minimum:

* Construction method statement,
* Assembly instructions,
* Erection drawings,
* Lifting points,
* Lifting weights,
* Shipping break points for panels and switchboard assemblies,
* Erection match markings,
* Fixing points,
* Leveling procedures,
* Alignment procedures,
* Erection fasteners summary list,
* Details of any special unpacking/handling requirements shall be stated,
* Procedures for removing transportation and storage preservations applied prior to installation.

The installation instructions shall cross reference with documents such as Packing List, Erection Drawings, General Arrangement Drawings, Panel/ Junction Box Termination Details etc. that will facilitate the assembly of the package.

Commissioning and Start-up procedures shall detail all pre-commissioning, commissioning and start up steps, including loop-checks, commissioning of all individual equipment and start-up of the whole ES package, see also chapter 8.1and 8.2.

The Supplier shall submit all installation procedures for all equipment included in the Scope of Supply which shall be installed by others (see chapter 3). This shall include, welding and testing procedures as well as cleaning, flushing and bursting procedures with minimum level of cleanliness required to be achieved prior to package commissioning.

## Documentation for Building Permit

The Supplier shall submit all documentation required for the Building Permit as specified in Annex 1.

A Building Permit is required for the PROJECT according to the building permitting legislation listed in chapter 1.5.

The Supplier shall provide at least the following documents, which will be used in the Application for documentation preparation:

* Summary technical report on CU and their equipment;
* Drawing documentation of CU and their equipment.

The Consultant will prepare the Project documentation for building permit and the Application for the issue of the building permit based on the submitted documents from the Supplier and in cooperation with the Employer. The Supplier shall support Employer and Consultant in aspect related to permitting process with relevant technical information and descriptions as required.

## Marked Red and As-built Documentation

The Supplier shall submit the Change Documentation Marked Red as well as the As-built Documentation to the Employer.

The Change Documentation Marked Red shall contain the following as minimum:

* + 1. The Project As-built Documentation,
		2. Accompanying Technical Documentation.

The Change Documentation Marked Red shall be submitted by the Supplier for a commission check by the Employer in two Project execution stages:

1. The 1st stage of Change Documentation Marked Red submission: no later than within 10 days prior hot commissioning commencement. Supplier is responsible for completeness and formal aspect of the submitted documentation.
2. The 2nd stage of Change Documentation Marked Red submission: no later than within 5 days after finishing of the 72-hour test. The Supplier is responsible for completeness and formal aspect of the submitted documentation. They shall add and incorporate any changes occurred since the 1st stage of Change Documentation Marked Red submission.

The Supplier shall incorporate in red colour all changes and additions arising in connection with the installation and commissioning to all documents. Prior to handing over the documentation to the Owner, the Supplier shall check and mark each page with the changes and supplements by the current date and signature as the confirmation of the correctness.

Complete Documentation Marked Red shall be always available to the Employer’s operation personnel at the place of the works until the final Change Documentation Marked Red is handed over to the Employer by the Supplier (see the 2nd Stage).

The As-built Documentation shall contain the following as minimum:

* + 1. The Project As-built Documentation,
		2. Accompanying Technical Documentation.

The Supplier shall submit the As-built Documentation for a commission check by the Employer within 7 days after the 72-hour test.

Having incorporated all corrections to the As-built Documentation, the entire As-built Documentation shall be handed over to the Employer in form of structured files (including the contents).

The final version of the As-built Documentation shall be handed over to the Owner in 3 hardcopies and 3 electronic versions (in an editable format on a CD-ROM – e.g. drawings in CAD format and text in MS Word) within 20 days after a successful 72-hour reliability test.

The Accompanying Technical Documentation in the Latvian language shall form an integral part of the As-built Documentation

The Accompanying Technical Documentation of the classified technical equipment shall form a part of the Change Documentation Marked Red as well as of the As-built Documentation and shall contain in particular:

* + 1. the data related to the identification of the manufacturer (OEM) or Supplier, basic data of the equipment minimally in the Scope of Supply, the characteristics of the environment where the equipment can operate,
		2. the operating instructions or references to the regulations containing:
1. permissible ways of use,
2. instructions for operation, maintenance, inspections and tests,
3. summary of the requirements for administration of the operating documentation and papers,
4. the requirements for professional qualification of persons performing the operation, maintenance, inspection and tests,
5. the instructions for assembly, testing and conditions for commissioning of the technical equipment,
6. the list of spare parts and auxiliaries,
	* 1. takeover documents containing:
7. a passport, inspection book or other document of the technical equipment to the extent determined by the safety-technical requirements,
8. a certificate of the documentation, if issued,
9. declaration of the manufacturer on conformity of the technical equipment with the safety-technical requirements,
10. a certificate on the type-approval test of the technical equipment,
11. a certificate on the first authorized test and repeated authorized test or on the test performed by a testing technician or qualified expert,
12. test certificates, certificates, descriptions of exceptions, and other.

## Documentation Language

Documentation commenting and approval process between the Employer and the Supplier shall be in the English language.

All requirements related to the language of the documentation (which of the documents shall be submitted in the Latvian and/or English language) are summarized in Annex 1 to this document

## Certifications

According to current European regulation every single item included in the Scope of Supply shall be CE marked and will be proved by the Declaration of Conformity. The Declaration of Conformity for the whole CU shall be supplied by the Supplier after completion and assessment of the 72-hour reliability test. The Declaration of Conformity of the CU systems will be supplied by the Supplier. The Supplier will be responsible for obtaining all necessary certifications to operate the CU according to European and Latvian applicable laws.

## Preparation of Reports

### Monthly Progress Reports

During the project execution the Supplier shall prepare monthly reports (reports on progress of works). The reports shall minimally contain the following items necessary to be checked during the execution of the project:

* Status of delivery of particular levels of the documentation,
* Status of delivery of particular components,
* Manufacturing process,
* Updated project schedule,
* Works progress of Supplier and his sub-suppliers,
* Commercial data (date of order, contractual affirmation, delivery deadlines),
* Status of assembly works execution (execution of works/time schedule of a subcontractor where appropriate),
* Reasons for failure to meet the deadlines (if any),
* Critical points/items,
* Forecast (execution of works/time schedule of a subcontractor where appropriate).

The Employer reserves the right to request additional information.

The Supplier is obliged to send to the Employer the Works Progress Report for the current month not later than by the 5th day of the subsequent month.

### Construction Log-Book

The Construction Log-Book is a document which forms a part of the documentation stored at the Site. All and any significant events which occur at Site shall be recorded in the Log-Book. The Log-Book shall be kept by the Construction Manager. The Owner shall authorize the CS constructor by keeping the Log-Book starting as of the first day of the preparatory works until the completion of the construction works. The Supplier represented by their authorized Construction Manager shall record all and any significant events occurring at Site starting as of the first day of the works at the Site until the completion of the works at the Site.

# SPECIAL TOOLS AND SPARE PARTS

The Supplier shall include in the Scope of Supply all tools, lifting gears and eyelets necessary for installation, routine maintenance and overhaul for all equipment included in the Scope of Supply. The Supplier shall include in the Offer all special tools and shall provide for each item a short description, article number, manufacturer and price. The Supplier shall include in the Scope of Supply all tools required for the 1st inspection.

All consumables, materials, spare parts and/or technological media required for commissioning and acceptance tests under chapter 8 of TECHNICAL SPECIFICATION, including the primary filling of media for the CU, List of Spare Parts for warranty period of the Contract, etc., with the exception of process gas and electricity supplied by the Employer, are included in the CONTRACT price.

The Supplier shall submit to the Employer within 60 days after completion of FAT of the CU an offer for spare parts that they recommend as basic (typical) for 3 year operation of CU, including spare parts needed to carry out scheduled maintenance according to the maintenance schedule. Offered spare parts shall be indicated by numbers and codes of spare parts catalogue (P/N) of the Supplier (resp. OEM of appropriate spare part). The Supplier is obliged to offer the prices of their spare parts with a discount of at least 10% compared to the prices mentioned in publicly available catalogue or price list of spare parts of the Supplier. The validity of the offers of the Supplier shall be at least six months.

The Supplier shall recommend spare parts additionally to those listed in the tender documentation, if deems necessary according to experience.

All spare parts shall be delivered in lockable steel boxes suitable for transportation.

The Supplier shall guarantee that all spare parts are available on the market for at least twenty five (25) years.

# MAINTENANCE

The Supplier shall design the equipment in order to minimize maintenance. Critical items shall be spared to increase reliability. When designing the layout of the equipment package, due considerations shall be given for easy accessibility to all items for maintenance as well as operational requirements. The equipment shall be designed so that all maintenance can be carried out with the minimum special facilities or tools.

The Supplier shall offer his standard maintenance plan for the equipment supplied. The Supplier shall issue the maintenance plan and maintenance costs with considering the following requirements:

* Design life of equipment as specified in chapter 2.6,
* Number of operating hours / machine / year specified in chapter 2.6,
* Environmental conditions as specified in chapter 2.2,
* The operating conditions as specified in chapter 4.2.1,
* Technical requirements as specified in chapter 4.

## Preventive maintenance plan

The Supplier shall include in the Scope of Supply the preventive maintenance plan in accordance with the RCM method. The preventive maintenance plan shall address the following items as a minimum:

* Define a three level breakdown structure of technical points of the Scope of Supply,
* Functionality of equipment included in the Scope of Supply,
* Failure modes based on HAZOP and HAZID studies,
* Causes of all functional failures (failure modes),
* Consequences of failures of equipment (failure effects, what will happen if the given component loses its functionality),
* Risk limits of the respective components based on the risk matrix,
* Preventive maintenance on the respective components, allocate professions, intervals or periodicity of the activities.

The Supplier shall elaborate the evaluation of the equipment and its components according to SAE JA1011.

The Supplier shall provide in the offer all maintenance lifting requirements for the equipment and advise on suitable lifting methods, e. g runway beam, overhead travelling crane etc. The Supplier shall submit the Maintenance Schedule and Maintenance Drawings.

# TRAINING

The Supplier shall include in the Price Breakdown on-site training for the Employer’s personnel. The Supplier’s training shall include:

* Maintenance personnel,
* Operating personnel,
* Technical managers- specialist,

Furthermore, the Supplier shall provide training for:

* Mechanical personnel,
* Electrical personnel,
* Instrumentation, control and telecommunication personnel.

The Supplier shall include in the Offer both classroom training as well as “hand-on” training.

The Supplier shall include in the Scope of Supply for training all equipment included in the Scope of Supply. The Supplier shall foresee separate sessions for the FFS as well as for the TC safety systems.

The Scope of Supply of maintenance training shall be to ensure that the Employer maintenance personal shall be able to carry out regular inspections and / or maintenance independently, without the need to request support of foreign suppliers.

The Scope of Supply of training for CU operation shall include CU start-up, normal operation, monitoring and control, trouble-shooting and optimisation, shut-down as well as remote operation from SCS.

The SCOPE Of SUPPLY of training for the system management, shall ensure that the Employer system management team shall be able to administrate all required consumables and spare and ware parts (operating media like cooling medium, guarantee period spares, capital spares etc.).

The Supplier shall include the price for each type of training, including program. The Supplier shall consider a number of 3 persons O&M training in producer facility and up to 15 persons operational training during commissioning at site. The Supplier shall consider all necessary training manuals and documentation; the training documentation shall be submitted in English and Latvian language. The training sessions will be held in English with translation to Latvian. The Supplier shall submit all training documentation as required in Annex 1, 1.3. The Supplier shall prepare the schedule for all training sessions included and shall submit this to Owner for review and approval.

All training in the Scope of Supply which is required for the operating and maintenance personnel shall be completed before commissioning of the CU.

# Annex 1

| No. | Document Title | Explanation and Remarks | Submission with offer | Design documentation for issue of Building Permit  | Detail Engineering Documentation | Documentation required for SITE acceptance by responsible authorities | In Latvian Language |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | **GENERAL PROJECT MANAGEMENT** |  |  |  |  |  |  |
| 2 | Monthly Progress Reports |  |  |  |  |  |  |
| 3 | Supplier Document Requirements List (SDRL) |  | **x** | **x** | **x** | **x** |  |
| 4 | Detailed supply list | Scope of supply (equipment, components and documentation) shall be ONE functional complete package - gas turbine driven compressor unit. CU package including all necessary auxiliaries shall be standard configuration. | **X** | **X** | **X** |  |  |
|  | Spare parts lists |  | **X** | **X** | **X** |  |  |
|  | List of special tools |  | **X** | **X** | **X** |  |  |
| 5 | List of Sub-suppliers | List of Sub-suppliers of equipment and services | **x** | **x** |  |  |  |
| 6 | Quality Assurance and Quality Control Plan (QA/QC) | Quality Assurance and Quality Control Plan (QA/QC) shall be issued per ISO 9001Shall be reviewed during Monthly progress report | **x** | **x** |  |  |  |
| 7 | HSSE Plan | Health, safety, security and environment plan |  |  |  |  | **x** |
| 8 | Manufacturer Procedures | Internal technical specification for product manufacturing, inspection, testing, packaging and handling |  |  | **x** |  |  |
| 9 | Maintenance Schedule |  | **x** |  |  |  |  |
| 10 | List of Comments, Exceptions and Deviations to Tender Documentation |  | **x** |  |  |  |  |
| 11 | List of References | provide detailed references for the similar GCU package specified in the offer (place of installation, time, power, hours worked, efficiency, CC flowrate, pressure, number of impellers etc.)  | **x** |  |  |  |  |
| 12 | **PROJECT SCHEDULES** |  | **x** |  |  |  |  |
| 13 | Time schedule for manufacturing, factory testing and delivery to SITE | to be included in the development of technical documentation for the manufacturing the GCU package (including Process Cooler) and Monthly Progress Reports | **x** |  |  |  |  |
| 14 | Time schedule for installation, commissioning, start-up and SITE testing |  | **x** |  |  |  |  |
| 15 | **GENERAL ARRANGEMENT AND GENERAL LAYOUT DRAWINGS** |  |  |  |  |  |  |
| 16 | 3D Model of the TC skids including all system boundaries and maintenance space requirements, obstruction volumes, etc. | Native, e.g. stp format (or other upon agreement)All discipline Owner interfaces to be indicated. |  | **x** |  |  |  |
| 17 | General arrangement drawings of TC compressor skid including location and detail drawings of all civil, mechanical and electrical interfaces; shall include, weight of main equipment, all data required for foundation design, details of all cable and piping connections at skid edge including requirements for cable trenches / cable channels, maintenance space |  | **x** | **x** | **x** |  | **x** |
| 18 | General arrangement drawings of all auxiliary equipment including location and detail drawings of all civil, mechanical and electrical interfaces; shall include, weight of main equipment, data required for foundation design, details on cable and pipe connections including requirements for cable trenches / cable channels, maintenance space requirements. |  | **x** | **x** | **x** |  | **x** |
| 19 | General arrangement drawings of all electrical and I&C cabinets including location and detail drawings of all mechanical and electrical interfaces, disposition plans, weight of cabinets, maintenance and access space requirements etc. |  | **x** | **x** | **x** |  | **x** |
| 20 | Detail drawings with foundation templates for all equipment included in the SCOPE OF SUPPLY including anchor details, grouting requirements, requirements for cable and piping trenches, static and dynamic loads and moments etc. |  |  | **x** | **x** |  | **x** |
| 21 | Detail drawings for all field piping included in the SCOPE OF SUPPLY, shall include all tie-in points with size and pressure ratings, pipe supports, slope requirements, coating and insulation requirements, pipe elevation, requirements for maintenance space, Owner line numbering, etc. |  |  | **x** | **x** |  | **x** |
| 22 | Detail drawings for all local vent piping included in the SCOPE OF SUPPLY, shall include all tie-in points with size and pressure ratings, pipe supports, slope requirements, insulation requirements, pipe elevation, requirements for maintenance space, Owner line numbering, etc. |  |  |  | **x** |  |  |
| 23 | General arrangement drawings of the anti-surge valves, hot bypass valves, pressurization valves including detail drawings of all mechanical, electrical, I&C and civil interfaces, weight data, maintenance space requirements etc. |  |  | **x** | **x** |  |  |
| 24 | General arrangement drawings of all instrumentation included in the SCOPE OF SUPPLY including detail drawings of all mechanical and electrical interfaces. |  |  |  | **x** |  |  |
| 25 | Assembly (sectional) drawings of the GT and CU |  |  |  | **x** |  |  |
| 26 | Layout and general arrangement drawings of all junction boxes including details for all cable connection points |  |  | **x** | **x** |  | **x** |
| 27 | Maintenance Drawings for all equipment included in the SCOPE OF SUPPLY, shall include representations of all maintenance sequences, requirements for equipment dismantling, layout drawings of all maintenance tools |  | **x** |  | **x** |  |  |
| 28 | Heat dissipation data sheets for all mechanical, electrical and I&C cabinets, TC piping (Residual heat load list) |  |  | **x** | **x** |  | **x** |
| 29 | Hazardous Area drawings |  |  | **x** | **x** |  |  |
| 30 | **MECHANICAL DESIGN** |  |  |  |  |  |  |
| 31 | Tie-in schedule | This document “Tie-in schedule” shall contain the list of all process connection points including specification (NPS, pressure rating, material, etc.) for all media (instrument air, process gas, etc.) along with requested terms of their availability for meeting the time-schedule for TC mechanical completion and commissioning in accordance with the milestones  | **x** | **x** | **x** |  | **x** |
| 32 | Utility Consumption List, list of all operating media including required quality and quantities | shall include instrument air, all waste substances including the following information for each operating medium as a minimum: chemical grade, consumption / injection rates, losses, average monthly / annual consumption, chemical supplier, requirements for chemical storage, method of disposal. | **x** | **x** | **x** |  | **x** |
| 33 | CU Data Sheet (API 617 Data Sheet) |  | **x** |  | **x** |  |  |
| 34 | GT Data Sheet (API 616 Data Sheet) |  | **x** |  | **x** |  |  |
| 35 | Dry gas seals Data Sheet |  | **x** |  | **x** |  |  |
| 36 | Data Sheets of all auxiliary equipment |  |  |  | **x** |  |  |
| 37 | TC Performance Data, Performance Curves, Characteristics Curves, Starting Curves (speed vs. torque curves) |  | **x** |  | **x** |  |  |
| 38 | Data on allowable Nozzle Loads (Forces and Moments) for the following flange connections as a minimum:-CU suction flange-CU discharge flange-Fuel gas tie-in interface-Instrument Air tie-in interface | Shall include:- Maximum allowable external forces (Fx, Fy, Fz) and moments (Mx, My, Mz)- Maximal allowable tolerances for installation |  | **x** | **x** |  |  |
| 39 | Pipe isometrics for all interconnecting and vent piping included in the SCOPE OF SUPPLY | SUPPLIER piping classes are applicable for the SCOPE OF SUPPLY. Battery limits shall be in accordance with the Employer requirements.Shall include all pipe fittings, pipe supports including type (glide, fixed), location, etc. |  | **x** | **x** |  | **x** |
| 40 | Piping Book, Breakdown Piping Schedule for all interconnecting and vent piping included in the SCOPE OF SUPPLY |  |  |  | **x** |  |  |
| 41 | Noise Emissions Data Sheet |  | **x** | **x** | **x** |  | **x** |
| 42 | Complete TC Train Torsional Analysis Report; shall include GT, CU and couplings (if applicable) |  |  |  | **x** |  |  |
| 43 | Complete TC Train Lateral Analysis Report; shall include GT, CU and couplings (if applicable) |  |  |  | **x** |  |  |
| 44 | Detailed technical description of all main mechanical equipment | Technical description of e.g. anti-surge valve, hot bypass valve, pumps, coolers, heat exchangers, compressor, etc. | **x** |  | **x** |  | **x** |
| 45 | **ELECTRICAL DESIGN** |  |  |  |  |  |  |
| 47 | Detailed technical description for all electrical equipment | Technical description of e.g. switches, EM, etc. | **x** |  | **x** |  | **x** |
| 48 | General description of operating pointmeters for all electrical equipment |  | **x** | **x** | **x** |  | **x** |
| 49 | Protection setting scheme for all electrical equipment included in the SCOPE OF SUPPLY  |  |  | **x** | **x** |  | **x** |
| 50 | Electric Load List |  | **x** | **x** | **x** |  |  |
|  | One Line Diagrams for the TC and auxiliaries, shall include the MV and LV distribution (MCC) |  | **x** | **x** | **x** |  |  |
| 51 | Wiring Diagrams for the TC and auxiliaries, MV, LV distribution (MCC), I&C, interconnecting cabling. | shall include all junction boxes, equipment cabinets, termination panels, battery limits, location of equipment and cabling, list of components. |  |  | **x** |  |  |
| 52 | Cable Block Diagrams for the TC and auxiliaries, MV, LV distribution (MCC), I&C, interconnecting cabling |  |  | **x** | **x** |  |  |
| 53 | Cable Lists for all MV, LV, I&C and telecommunication cabling included in the SCOPE OF SUPPLY | shall include all cabling in the SCOPE OF SUPPLY with considering the cabling related to TC, cable lengths, cable voltage levels, details on type of cable (I&C, power, telecommunication, etc.), cable cross sections, number of cores, etc. |  |  | **x** |  |  |
| 54 | Cable Data Sheets for all MV, LV, I&C and telecommunication cabling included in the SCOPE OF SUPPLY |  |  |  | **x** |  |  |
| 55 | Calculation reports for all power cabling included in the SCOPE OF SUPPLY (MV and LV power cabling) |  |  |  | **x** |  |  |
| 56 | Interlocking System Specification |  | **x** |  | **x** |  |  |
| 57 | Typical Data Sheets | Typical datasheets for e.g. relays, switches, MCC, etc. |  |  | **x** |  |  |
| 58 | LV e-motor Data-Sheets |  |  |  | **x** |  |  |
| 59 | Battery System Data Sheet | Battery datasheet for common UPS - if applicable |  |  | **x** |  |  |
| 60 | UPS System Data Sheet | AC and DC system for common UPS. |  |  | **x** |  |  |
| 61 | Earthing Plan for all electrical equipment included in the SCOPE OF SUPPLY |  |  | **x** | **x** |  | **x** |
| 62 | List with hazardous area classification including Excertificates of all equipment included in the SCOPE OF SUPPLY |  |  |  | **x** |  |  |
| 63 | Relay protection settings schedule |  |  |  | **x** |  |  |
| 64 | Declaration of Conformity according to EC Directive of Machinery 2006/42/EG for the complete Scope of Supply[[3]](#footnote-3) |  |  |  |  | **x** |  |
| 65 | Declaration of Conformity according to the Low Voltage Directive (LVD) 2014/35/EU for the complete Scope of Supply1 |  |  |  |  | **x** |  |
| 66 | Declaration of Conformity according to IEC/ EN 61800-3 Electromagnetic compatibility (EMC) for the complete SCOPE OF SUPPLY1 |  |  |  |  | **x** |  |
| 67 | **PROCESS, INSTRUMENTATION AND CONTROLS** |  |  |  |  |  |  |
| 68 | Piping and Instrumentation Diagrams (P&IDs) for the TC and all auxiliary equipment including ESD and CU recirculation loops, etc. | shall include the legend sheet, reference drawings, piping and valves sizes, piping classes, all control loops, safety functions, push buttons, switches, slope lines, minimum straight pipe lengths required, equipment elevations, battery limits, instrumentation settings, table of fluids, etc. | **x** | **x** | **x** |  | **x** |
| 69 | Piping and Instrumentation Diagrams (P&IDs) for all pneumatic actuators included in the SCOPE OF SUPPLY | see requirements from item no. 71 above |  |  | **x** |  |  |
| 70 | Unit Control System drawing / architecture | shall include design specification of all hardware required by UCS, functional descriptions, test procedures, Cyber Security concept and disaster recovery description. | **x** |  | **x** |  |  |
| 71 | Communications Block Diagram |  | **x** |  | **x** |  |  |
| 72 | TC Unit Control System wiring diagrams including ESD | shall include detail drawings of all terminal panels, cable number, core identifier, references drawings, shall cover all areas, list of components / part list. |  |  | **x** |  |  |
| 73 | Instrumentation loop diagrams |  |  |  | **x** |  |  |
| 74 | I/O Signal List including interface schedule and detail requirements for all interfaces to SCS, station ESD and Electrical systems |  |  |  | **x** |  |  |
| 75 | Modbus Signal List including interface schedule to SCS and Electrical systems | shall include project specific alarm and trip setting values, descriptions of communication protocol and configurations such as IP Address, Port, Data Format, Data Type etc.; shall include the register for each signal (the address where the data associated). |  |  | **x** |  |  |
| 76 | Communication Gateway List |  |  |  | **x** |  |  |
| 77 | Cause and Effect Diagram |  |  |  | **x** |  |  |
| 78 | Functional Logic Diagrams including Control Loop Narratives (as per DIN EN 60848) with all warnings, alarms and trip set values | Logic diagrams with textual descriptions.The TC Supplier shall provide all relevant documents (even separate docs if needed). |  |  | **x** |  |  |
| 79 | Hook-up drawings for process instrumentation |  |  |  | **x** |  |  |
| 80 | Risk analysis for full SCOPE OF SUPPLY (Standards EN 12583, EN 61508 and EN 61511) |  |  |  | **x** |  |  |
| 81 | UCS HMI Visualization Displays | For the successful progress of the PROJECT, the TC Supplier shall submit necessary and required information for each particular phase. Including all marking labels related to standard operation and maintenance shall be provided bilingual EN/LV | **x** |  | **x** |  | **x** |
| 82 | Instrumentation list / index for all instrumentation included in the SCOPE OF SUPPLY; shall include TC compressor skid, field instrumentation, auxiliaries, etc. | The instrumentation index / list shall include:-design and operating parameters for process pressure and temperature, environmental conditions,-measuring domain,-alarm and trip settings,-Ex-zone classification and Ex type certification |  |  | **x** |  |  |
| 83 | Instrumentation Data-Sheets incl. inspection and calibration certificates |  |  |  | **x** |  |  |
| 84 | Instrumentation calculations |  |  |  | **x** |  |  |
| 85 | Data Sheets of anti-surge valves and hot bypass valves shall include valve sizing calculations, valve characteristic curves (CV vs. Stroke), wall thickness calculations. |  |  |  | **x** |  |  |
| 86 | Data Sheets of pressurization valves; shall include valve sizing calculations, valve characteristic curves (CV vs. Stroke), wall thickness calculations. |  |  |  | **x** |  |  |
| 87 | Data Sheets of depressurization valves; shall include valve sizing calculations, valve characteristic curves (CV vs. Stroke), wall thickness calculations. |  |  |  | **x** |  |  |
| 88 | Material Safety Data Sheets | List of hazardous media, solid, liquid gases, waste (e.g.. oil, cooling media) estimated values, specification, volumes. During construction and during operation. |  | **x** | **x** |  | **x** |
| 89 | HAZOP and HAZID Study Reports for TC including HAZOP Sheets |  |  |  | **x** |  |  |
| 90 | SIL Assessment for the TC compressor skid |  |  |  | **x** |  |  |
| 91 | SIL Calculations for Safety Loops | SIL calculation report shall be performed by qualified third party. |  |  | **x** |  |  |
| 92 | License Handling |  |  |  | **x** |  |  |
| 93 | **TESTS, MANUFACTURER, INSPECTION PROCEDURES AND REPORTS** |  |  |  |  |  |  |
| 94 | Inspection and Test Plan (ITP) | In the offer, the Supplier shall submit an preliminary inspection and test plan. | **x** | **x** |  |  | **x** |
| 95 | Test procedures for all factory acceptance tests[[4]](#footnote-4) |  |  |  | **X** |  |  |
| 96 | Weld Procedures[[5]](#footnote-5) |  |  |  | **X** |  |  |
| 97 | NDT Procedures2 |  |  |  | **X** |  |  |
| 98 | Heat Treatment and PWHT Procedures2 |  |  |  | **X** |  |  |
| 99 | Material Traceability Procedures2 |  |  |  |  |  |  |
| 100 | Positive Material Identification (PMI) Procedures2 |  |  |  |  |  |  |
| 101 | Factory Acceptance Test Reports[[6]](#footnote-6) |  |  |  | **X** |  |  |
| 102 | Coating and Painting Specifications[[7]](#footnote-7) |  | **x** |  | **X** |  |  |
| 103 | Insulation, Lagging and Cladding Specifications4 |  |  |  | **X** |  |  |
| 104 | Manufacturers Data Book including test protocols, material certifications, pressure tests, leak tests, material certificates, welders procedures and certificates, pipe/vessel book etc.[[8]](#footnote-8) |  |  |  |  | **x** |  |
| 105 | Hazardous Area Documentation (ATEX Documentation) for all equipment in SCOPE OF SUPPLY, including declaration of conformity with 2014/34/EU and all ATEX and Eex equipment certificates1 |  |  |  |  | **x** |  |
| 106 | Pressure Equipment Documentation including declaration of conformity with PED 97/23/EG and pressure equipment certifications1 |  |  |  |  | **x** |  |
| 107 | Unloading, Unpacking and Installation procedures[[9]](#footnote-9) |  |  |  |  |  |  |
| 108 | Package Commissioning and Start-up Procedures[[10]](#footnote-10) |  |  |  |  |  | **x** |
| 109 | SITE Acceptance Test Procedures3 | This item applies to the 72 hours and the 168 hours tests  |  |  |  |  | **X** |
| 110 | On-Site Performance Test Procedure[[11]](#footnote-11) | This item applies to the Performance Test  |  |  |  |  | **X** |
| 111 | Availability Test Procedure[[12]](#footnote-12) | This item applies to the Availability Tests  |  |  |  |  |  |
| 112 | Installation Certificates, SITE Test Certificates and Reports from Notified Body as per technical specification[[13]](#footnote-13) |  |  |  |  |  | **x** |
| 113 | Commissioning and acceptance test Spares List[[14]](#footnote-14) |  |  |  | **X** |  |  |
| 114 | Spare Parts Basic (typical) for 3 years – Scheduled maintenance[[15]](#footnote-15) |  |  |  | **X** |  |  |
| 115 | **MANUALS** |  |  |  |  |  |  |
| 116 | Training Manuals[[16]](#footnote-16) | In the offer, the Supplier shall submit an description of training programme for Employer staff. | **X** |  |  |  | **x** |
| 117 | Installation, Operation and Maintenance Manuals[[17]](#footnote-17) |  |  |  |  | **x** | **x** |
| 118 | Controls System Operations and Instruction Manuals1 |  |  |  |  | **x** | **x** |
| 119 | **DOCUMENT PACKAGES** |  |  |  |  |  |  |
| 120 | Documentation required for SITE acceptance by responsible authorities[[18]](#footnote-18) |  |  |  |  | **x** | **x** |
| 121 | Documentation marked red 2st stage[[19]](#footnote-19) |  |  |  |  |  |  |
| 122 | As-built documentation[[20]](#footnote-20) |  |  |  |  | **X** | **X** |

1. During detail design after signing the contract [↑](#footnote-ref-1)
2. Testing of the turbine at site shall be according API 616 (MRT) and as per ASME PTC 22 (performance/efficiency). [↑](#footnote-ref-2)
3. 1 week prior TC installation on site [↑](#footnote-ref-3)
4. 4 weeks before FAT [↑](#footnote-ref-4)
5. To be agreed in the contract [↑](#footnote-ref-5)
6. 2 week after FAT [↑](#footnote-ref-6)
7. 4 weeks before start of the manufacturing [↑](#footnote-ref-7)
8. To be agreed in the contract [↑](#footnote-ref-8)
9. 4 weeks before DELIVERY [↑](#footnote-ref-9)
10. 4 months prior to commissioning [↑](#footnote-ref-10)
11. 6 months prior to commissioning [↑](#footnote-ref-11)
12. 6 weeks prior to test [↑](#footnote-ref-12)
13. 2 week after completion and assessment of 72 hour test [↑](#footnote-ref-13)
14. 4 weeks before delivery to SITE [↑](#footnote-ref-14)
15. 12 weeks after FAT [↑](#footnote-ref-15)
16. 6 weeks prior totraining [↑](#footnote-ref-16)
17. 6 weeks prior commissioning [↑](#footnote-ref-17)
18. To be agreed during Pre Commissioning Meeting (PCM) [↑](#footnote-ref-18)
19. 2 week after successful 72 hour test [↑](#footnote-ref-19)
20. 4 weeks after successful 72 hour test [↑](#footnote-ref-20)