
 <b>EUROPEAN SPALLATION SOURCE</b>	<b>Technical Specification</b>		Document ID ESS-0013683	
	Project/Area/Building <b>Accelerator Building G02</b>		Responsible Discipline and Company <b>PS01 Sweco Industry AB</b>	
	CF Description CWH Membrane Degasser and Demineralizing Units Technical Specification		Work Package Leader <b>Kennet Lindström</b>	
	Document Status Detailed Design		Date <b>2016-10-31</b>	
Code	Text	Amount	Unit	Revision <b>1</b>


**Accelerator Building G02**  
**CWH Membrane Degasser and Demineralizing Units Technical**  
**Specification**  
**Detailed Design**

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## DOCUMENT REVISION HISTORY


Revision	Reason for revision	Date
1	Detailed Design	2016-10-31

List of Authors	List of Reviewers	List of Approvers
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## 1. GENERAL

### 1.1 This Technical specification

This technical specification concerns Membrane Degasser Unit and Demineralizing Unit for treating of Cooling Water (CWH) to be installed within the scope of the ESS project.

### 1.2 ESS project

ESS stands for "European Spallation Source". The European Spallation Source (ESS) is a multi-disciplinary research centre based on the world's most powerful neutron source. This new facility will be around 30 times brighter than today's leading facilities, enabling new opportunities for researchers in the fields of life sciences, energy, environmental technology, cultural heritage and fundamental physics.


The ESS facility is to be built in Lund, Sweden. The pre-construction phase started in 2010 and consists of three major projects: the Design Update (DU), the Preparation to Build (P2B) programme, and the Integration, Acceptance and Support activities (IAS). This phase will result in a schedule for construction, operation, and decommissioning, together with the associated costs. Preliminary studies, including upgrade opportunities, will be performed. The primary objective of the Pre-Construction Phase is to prepare the foundations necessary to initiate construction of ESS by 2014, with the overall goal of achieving first neutrons in 2019.

### 1.3 Redundancy and reliability

For packaged units, like Membrane Degasser Unit and Demineralizing Unit, the reliability requirements are such that water with low O<sub>2</sub>-content and low conductivity can be produced also during regeneration and cleaning cycles.

Critical process units in delivery shall have one separate unit redundant, per vendor's recommendation.

A typical configuration is depicted in figure 1. The vendor is free to suggest any other configuration as long as availability and redundancy is considered in the design.

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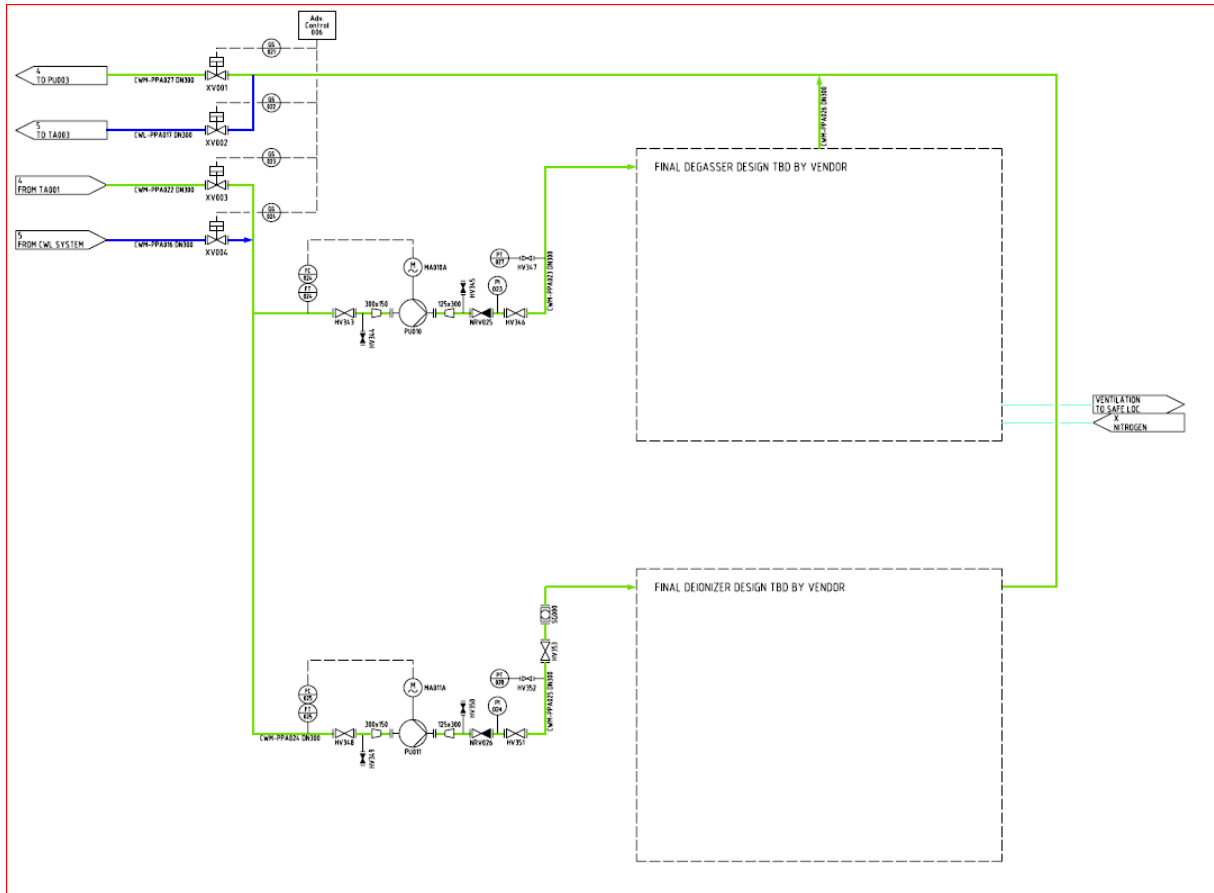



Figure 1. General configuration of Membrane Degasser Unit and Demineralizing Unit for Cooling Water High (CWH)

## 1.4 Bid evaluation

ESS evaluates bids based on the most economically favourable technical solution. Basis for this evaluation will be calculated as an investment cost compared to annual costs and incomes.

The evaluation is to be based on the following:

- Total investment cost, including:
  - Cost for vendors scope
  - Utilities and consumables. Electrical power will be valued to 0,05 € / kWh.
  - Depreciation time is 10 years
  - Internal rate is 5 %.

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## 2. PROCESS

### 2.1 Description of Cooling Water High (CWH) system


#### 2.1.1 Description of membrane degasser and demineralizing unit to be delivered

Cooling Water High is required at several locations over the ESS site, main cooling water loop shall have a conductivity of  $<0,5 \mu\text{S}/\text{cm}$  and an O<sub>2</sub>-content of  $<15 \text{ ppb}$ . To be able to fulfil main loop requirements, CWH quality after Membrane Degasser Unit and Demineralizing Unit must fulfil specification DS-002, basically a conductivity of  $<0,1 \mu\text{S}/\text{cm}$  and an O<sub>2</sub>-content of  $<5 \text{ ppb}$ .

Design flow is between 10-25 m<sup>3</sup>/h, operational flow is expected to be 15-20 m<sup>3</sup>/h with max flow at 25 m<sup>3</sup>/h at intermittent time periods.

Main installations of Membrane Degasser Unit and Demineralizing Unit in G02 consist of:

- Membrane degasser unit to remove oxygen and CO<sub>2</sub>. To be delivered in one skid containing contactors, valves, control etc.
- Mixed bed demineralizing unit. To be delivered in one skid containing exchangers, valves, control etc.
- Police filter positioned after mixed beds in Demineralizing Unit per vendor's recommendation.
- Each skid shall have one single inlet/outlet per media.

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## 2.2 Performance criteria


- A. The design and construction of Membrane Degassing Unit and Demineralizing Unit shall be the Supplier's proven design.
- B. The packages shall be sized for the design capacity as well as providing sufficient water to meet the requirements of regenerations, sanitizations etc. Filters shall be sized to ensure no greater than four (4) change-outs per annum without impacting product water quality.
- C. Reliability and operational historical data shall be submitted to the Owner. The equipment shall have a guaranteed uptime of 365 days per year, this includes for cleaning, sanitising and maintenance of the system.
- D. The Membrane Degasser Unit and Demineralizing Unit shall operate on a 24 hours per day basis including during regeneration and sanitisation.
- E. The Supplier is responsible for any failure to comply with the above water quality performance criteria during the warranty period of 2 years, provided the Membrane Degasser Unit and Demineralizing Unit is operated and maintained in accordance with the Supplier's recommendations.

## 2.3 Performance guarantees

Vendor should offer performance guarantees for operations as per chapter 2 of this technical specification.

Vendor must also guarantee that variations of flows and temperatures as described in chapter 2.1.1 can be reached.




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### 3. SCOPE OF SUPPLY

#### 3.1 Scope of supply

The scope of supply includes, at least, but not limited to:

- Membrane Degasser Unit and Demineralizing Unit as per this Technical Specification
- All delivered units to be delivered skid mounted, one skid for the Membrane Degasser Unit and one skid for the Demineralizing Unit.
- All engineering required.
- All materials, machines, equipments, instruments, pipes, valves and other components required.
- All manufacturing and installation on each skid required, also including interacting with instruments in external control loops.
- All documentation described in this document
- Testing and inspections
- Spare parts
- Options as per agreement later
- Obtaining approvals required to fulfil standards, laws, rules and regulations as per this document.
- Both delivered skids shall be CE-marked.
- Mechanical guarantees for 2 years continuous operation after approved SAT.
- Performance guarantee as per chapter 2.3
- Packaging
- Transport to ESS site in Lund, Sweden
- Training of operators. Vendor to make a proposal for a typical training programme.
- Commissioning and start-up of Membrane Degasser Unit and Demineralizing Unit in scope of supply
- Each delivered skid must be delivered as a fully functioning unit.

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## 3.2 Options

### 3.2.1 Supervision of installed Membrane Degasser Unit and Demineralizing Unit

This option includes:

- Supervision and inspection of mechanical, electrical and control installation. The actual installation may be done by contractor employed by purchaser.

Supervisor's inspection and approval of mechanical installation should enable validity of vendor's guarantees.

### 3.2.2 Spare parts

Vendor should offer spare part packages, with itemized prices and delivery / lead times for the following scenarios;

- Spare parts for commissioning and start-up
- Spare parts for 2 years continuous operation
- Long lead time spare parts


### 3.2.3 Maintenance of Membrane Degasser Unit and Demineralizing Unit

Vendor should offer a maintenance service contract. Service contract should include, at least, but not limited to:

- Annual maintenance procedures, including materials

### 3.2.4 Consumables

Vendor should list annual consumables like utilities, filters, acid/base etc


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#### 4. BUILDING

Purchaser plans to have Membrane Degasser Unit and Demineralizing Unit installed in Central Utility Building. The room reserved for Demineralizing Unit is 3,5 x 3 meters with a free height of 3 meter. The room reserved for Membrane Degasser Unit is 3,5 x 1 meters with a free height of 3 meter.

Access to skids for maintenance and operation is possible from 3 sides since skids are adjacent to a walls.

Temperature in room is to have a max temperature +35 °C. The atmospheric corrosivity class is C2 according to ISO 12944-2.

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## 5. ELECTRICAL AND AUTOMATION

Supply voltage levels are 6kV for machines larger than 900kW, and 400V for smaller machines.

Cabinets and electric apparatus outside cabinets shall be minimum IP54.

Motors shall be premium efficiency (IE3) or better.

Instruments, electric and control equipment selected for best reliability and performance.

Halogen free cables shall be selected if possible.

Cable trays shall be protected against corrosion.

Electric cabinets for start and control equipment shall be included in delivery.

All wiring on the skid, from control cabinets to components are included.

All programming in local control system and operator panel is included.


Naming of components and signals according ESS naming convention.

Operation shall be possible to perform both locally on operator panel, as well as in parent control system. Communication to parent control system via Profibus. Operation from local control panel shall be password protected in different levels for operation and maintenance.

Signals to deliver to parent control system are start/stop and sum alarm.

The equipment must meet the requirements of EN 61800-3, deviations must be clarified in quotation.

Vendor to mark on P&ID for indicating of main control features.

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## 6. STANDARDS, LAWS, RULES AND REGULATIONS TO BE FOLLOWED

Delivered machines, in scope of supply, shall

- fulfil requirements stated in Swedish laws, rules and regulations. Regarding occupational safety and health issues. Information can be obtained from the Swedish Work Environment Authority's internet site (English version): <http://av.se/inenglish/>
- fulfil requirements stated in applicable EU directives, such as PED directive (EU 97/23/EG)
- design, manufacturing, testing and inspections are to be based on ISO and EU standards


Vendor must, in quotation, state standards and norms applied for equipment, piping, instrumentation, automation and electrical functions in scope of supply.

Piping connections between purchasers and vendors systems are to be flange connections according to SS-EN1092-1, raised face Type B

BS 4994	Vessels & Tanks in reinforced plastics
EN 60204	Safeguarding of Machinery
TEMA	Tubular Exchanger Manufacturers Association
ASTM A270	Sanitary, Pipework and Fittings
BS 4675	Mechanical Vibration in Rotating Machinery
EN 10204	Metallic Products – Types of inspection Documents
EN 61800-3	EMC Compliant Installations

EU European Union: Applicable directives not limited to the following:

2006/42/EC	Machinery Directive
97/23/EC	Pressure Directive
2006/95/EC	Low Voltage Directive
2004/108/EC	Electromagnetic Compatibility Directive
ASTM A380	Standard Practice for cleaning, descaling and passivation of stainless steel parts, equipment and systems


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ASTM A967

Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

- A. Additional code or specification references may be found in the individual specifications.
- B. The issues and revisions of all referenced codes and standards that apply shall be effective from the date of proposal.
- C. European Directives are applicable to the full extent, independent of effective date and/or transition period. All equipment shall be CE labelled. All equipment classified as machinery shall be CE marked and issued with a Declaration of Conformity as per Directive 2006/42/EC Annex II Part 1.A. One common IIA certificate shall be provided for equipment supplied together as part of one system. The Supplier shall provide a sample Declaration of Conformity for the skid with the quotation.

In the event of conflict between the referenced codes, standards, specifications, P&IDs and Data Sheet(s), the Supplier shall contact the Owner/ Buyer for written resolution.

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## 7. TESTING AND INSPECTION

Scope of supply includes testing and inspections required for:

- obtaining approvals required by Swedish laws, rules and regulations.
- obtaining necessary approvals for CE marking

Vendor must in quotations present;


- standard
- available optional (with separate optional and itemized per test / inspection prices)

Test and inspections for delivery of Membrane Degasser Unit and Demineralizing Unit as per this technical specification.

- A. The Owner/Buyer may visit the skid manufacturers shop to ensure that established schedules are being met and to ensure that quality control procedures are being maintained at an acceptable level. Forty-eight (48) hours notice for these visits shall be given.
- B. The Supplier shall be responsible for the arrangement, co-ordination and payment of a third party insurance inspection agency(s) for CE Marking to review and approve the design of the equipment, materials calculations, welding procedures and qualifications, and to witness and approve vessel inspections and tests (stage and final), as required by the PED.
- C. The Supplier shall notify the Owner/Buyer or their representative at least ten (10) working days prior to anticipated final shop inspection or to the witness test dates, following completion of Membrane Degasser Unit and Demineralizing Unit.
  1. Hydrostatic Test
    - a. Skid hydrostatic pressure test procedure shall be submitted to the Owner/ Buyer for approval.
    - b. Hydrostatic testing shall take place prior to installation of thermal insulation and sheathing.

### 7.1 Factory Acceptance Test

- A. The Supplier shall submit a FAT protocol for review and approval at least six (6) weeks before scheduled FAT date. This protocol is required to address the functional tests as detailed below.
- B. The minimum required functional tests to be executed during the FAT for the Membrane Degasser Unit and Demineralizing Unit are as follows:


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1. P&ID verification
2. GA Drawing Dimensional and Assembly Verification.
3. Surface Finish testing, where applicable.
4. Water quality checks including conductivity and O2-content. Feed water quality to be pre-approved by Owner/ Buyer.
5. Verification of I/O signals
6. Vessel and skid drainability test.
7. Sprayball coverage testing
8. Control Device Test

An independent national accredited laboratory shall perform the analysis of the feedwater and produced water samples.

- C. It is intended that the Supplier execute a Pre-FAT test by using the approved FAT Protocol. The successful results will be submitted to the Owner/ Buyer for review prior to the Owner/ Buyer witnessed FAT. In addition the following items will be confirmed during the pre-FAT.
  1. Supply and quality of once through feed softened water is sufficient for Run and quality tests.
  2. Ensure calibration of test instruments.
  3. Supply of utilities is sufficient for tests as required.
- D. All testing and documentation shall be completed and the equipment ready for delivery prior to FAT.
- E. The Owner/ Buyer's representative shall confirm documentation is ready for FAT fifteen (15) days prior to the scheduled FAT start date. All documentation must be labelled and assembled into turnover books according to Owner/ Buyer supplied table of contents. The Owner/ Buyer will generally review and approve the pre FAT test documents and the turnover books for completeness prior to the witnessed FAT. After confirming complete system documentation the Owner/ Buyer will confirm the FAT dates.
- F. Temporary variable speed drives and motor starters used for testing will be provided by the Supplier where required for the FAT.
- G. The Supplier shall supply all necessary utilities to test the Water Treatment Package functions.
- H. The Supplier shall provide a test PLC and variable speed drives for FAT testing.
- I. The Supplier shall perform temporary wiring between the skid(s) termination panel and the temporary PLC supplied by the Supplier.
- J. The Supplier shall provide at a minimum manpower, equipment, tools, materials, temporary walkways, personnel hand railings, temporary power hookups and



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wiring, temporary raceways, temporary piping hook-ups, trays, fittings and supports, scaffolding, ladders, genie lifts and utilities as required for the FAT.


- K. The Supplier shall confirm that all equipment FAT's shall take place at the same location.

## 7.2 Delivery Installation


- A. The Water Treatment Package shall not be released for shipment until inspection and Owner/ Buyer witnessed FAT have been completed or the inspection (and/or factory acceptance test) is waived through written notification by the Owner/ Buyer.
- B. In addition, the Supplier is responsible to ensure that the system shall not be shipped until any defects, physical or documentation, that have been identified are remedied to the Owner/ Buyer's satisfaction or have each specifically been waived by the Owner/ Buyer in written communication.
- C. After the Owner/ Buyer witness FAT has been completed and approved, the Supplier is responsible for disassembling, packing and labelling all components that shall not be shipped mounted on the equipment. Original manufacturer's packaging must be used for shipping instrumentation with the completed packaged system.
- D. The Supplier is responsible for determining which parts to disconnect and ship loose to ensure that no parts of the Water Treatment Package get damaged during shipment. In general this shall include, but not be limited to instrumentation, filters, etc. All components must be covered for shipment to prevent introduction of foreign material. The Supplier shall remove RO membranes after FAT and transport in preservative to ensure membranes arrive on site in perfect condition.
- E. The control panels (low voltage and solenoid) are expected to be wired and tubed, as specified, and shipped without disassembly, fully wired, supported to prevent damage and sealed to prevent environmental damage.
- F. The Supplier must provide detailed disassembly drawings. All components removed or piping disassembled must be labeled on these drawings and on the items themselves. Approval of this information by the Owner/ Buyer is required prior to shipment.

## 7.3 Site Acceptance Test

- A. The Water Treatment Package will be site acceptance tested (SAT) to confirm that the installed system performs in accordance with the process and control requirements given in this Specification and on the attached Data Sheet(s).
- B. Supplier shall prepare and provide SAT protocols for approval.

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C. Supplier shall participate in the execution of SAT.

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## 8. DOCUMENTATION

### 8.1 Document delivery format

All documents are to be delivered in both paper and electronic format. Electronic format to be agreed later. Engineering documents can be delivered in English. However Final documents for operators are to be delivered in Swedish and English.


### 8.2 Documents to be delivered with quotation

These documents are required for the following purposes:


- Bid evaluation and comparison
- Ensure sufficient technical data is available for continuing owner/buyers engineering.

The technical data required is to have sufficient accuracy for these purposes. The documents are:

- Process description. Description to include limitations of proposed Water Treatment System
- Process flow diagrams, with battery limits indicated.
- List of chemicals used for operation and cleaning.
- Suggestions on handling leaks of chemicals, in case of loss of containment, will be appreciated.
- List and descriptions of interfaces to technical systems in owner/buyers scope of supply. Typical are:
  - Piping
  - Electrical power supply
  - Automation; interface to owner/buyers overall automation system
  - Civil (foundations)
  - Acoustic (noise levels)
- Description of scope of supply (including machines, equipment, engineering services, spare parts, documents etc) provided by vendor and included in quotation.

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- Information on performance of each individual process unit in Water Treatment Skid. Information includes:
  - Pressure drops
  - Water flows (m<sup>3</sup>/h), pressures and temperatures
  - Electrical power consumption
- Process and instrument diagrams, preliminary
- Main equipment specifications / data sheet
- Main dimension drawings of equipment / equipment skids to be installed. Including piping connections.
- Proposed layout drawings of equipment / equipment skids
- Civil works guide drawings. Including data required for civil engineers, such as:
  - Plinth/foundation data
  - Static and dynamic loads
- Electrical and Automation data.
  - Power requirements. (nominal and start)
  - Max connectable cable area.
  - Layout drawing with connection position for power, control and bus cables.
  - List of components.
  - Connection diagrams
  - Bus signal list.
  - Wired signal list
- Noise levels of machines
- Spare part lists with itemized prices
- Description of required maintenance and indication of annual costs.
- Description of vendor's:
  - Quality assurance system
  - Testing and inspection programme for typical deliveries, including options.
- Installation, operation and maintenance manual (typical)

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	CF Description CWH Membrane Degasser and Demineralizing Units Technical Specification		Work Package Leader Kennet Lindström		
	Document Status Detailed Design		Date 2016-10-31		Revision 1
Code	Text	Amount	Unit	Rev	

- Programme for Water Treatment Project covering:
  - Vendor engineering
  - Required approvals from purchaser
  - Vendor procurement of components and material
  - Vendor manufacturing
  - Testing and inspections
  - Packaging
  - Transport
  - Installation (typical installation time)
  - Commissioning and start-up activities


### 8.3 Documents to be delivered with order confirmation

These documents are required for the following purpose:

- Ensure sufficient technical data is available for continuing owner/buyers detailed engineering.

The technical data required is to have sufficient accuracy for this purpose. The documents are:

- Process description, final.
- Process flow diagrams, with battery limits indicated.
- Description of scope of supply (including machines, equipment, engineering services, spare parts, documents etc) provided by vendor and included in quotation.
- Process and instrument diagrams, *final*
- Equipment list
- Pipe line list
- Valve list

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- Instrument list
- Equipment specifications / data sheet
- Main dimension drawings of equipment / equipment skids to be installed.
- Proposed layout drawings of equipment / equipment skids
- Civil works guide drawings. Including final data required for civil engineers, such as:
  - Plinth/foundation data
  - Static and dynamic loads
- Automation description
- Electrical data.
- Final noise levels of machines
- Testing and inspection schedule with indicate dates for specific tests
- Installation, operation and maintenance manual (in Swedish and English)
- Installation instructions
- Proposed date for FAT


#### **8.4 Documents to be delivered for commissioning and start-up**

These documents are required for the following purpose:

- Ensure efficient technical data is available for pre-commissioning, commissioning and start-up of heat pump system

The technical data required is to have sufficient accuracy for this purpose. The documents are:

- Necessary updated versions of documents delivered earlier
- Reports from all functional tests done at vendor's workshop / premises
- Commissioning plan, final
- All manuals and instructions required

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## 8.5 Documents to be delivered after start-up

These documents are required for the following purpose:

- Enable ESS's operation and maintenance organisation to take-over and handle operation heat pump system.

This document delivery includes:

- All documents required for CE marking
- All test and inspection results and reports
- All required descriptions and manuals
- Updated (final) versions of any documents delivered earlier.

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## LIST OF ABBREVIATIONS

Abbreviation	Definition
ESS	ESS stands for "European Spallation Source". The European Spallation Source (ESS)
CUB	Central Utility Building
G02	Accelerator Building
PED	Pressure Equipment directive