Appendix A-80.272.42.2024

Description of the Subject of Public Procurement

Helium Recovery and Compression System in National Synchrotron Radiation Centre SOLARIS

1. General information

The object matter of the procedure (order) is the design, manufacturing, testing, delivery, training and installation of a set of devices forming a system for the recovery and compression of gaseous helium from the devices of the research infrastructure at the National Synchrotron Radiation Centre SOLARIS (hereinafter called: SOLARIS).
Within the scope of the Agreement, the Contractor is required to provide a suitable design of the system (including documentation) in consideration of the required parameters and edge conditions such as the existing infrastructure.
The SOLARIS synchrotron is the 3rd generation source of electromagnetic radiation based on the 1.5 GeV storage ring. It is characterized by a low emittance of 6 nm·rad, and the maximum current of the electron beam of 500 mA.

General description

The Contractor undertakes to deliver to the Purchaser a complete helium recovery and compression system. The recovery and compression system should contains specific components and devices (among others: low pressure recovery pipe lines, valves, flow meters, oxygen sensors, gas bags, compressor, high pressure pipe lines, bottle storages, etc.) allowing connection of the research equipment to the system, keeping recovered helium gas free from contamination and efficiently compress the helium gas into the dedicated high pressure bottle sets.

Abbreviations:
EXPH – Experimental Hall
PDR = preliminary design review
FDR = final design review
FAT = factory acceptance test/tests
SAT = site acceptance test/tests

2. Technical specification for the recovery and compression system

2.1 Low pressure system part

We assume to have total length of low pressure piping (tube 54 mm x 2 mm or bigger depending on the assumed gas flow and other parameters) in the experimental hall: 340 m. The tubes should be made of stainless steal. The wall holdings installed in the experimental hall (EXPH) can be used during installation. They are installed every 3 m. We may assume that already installed holding may support approximately 75% of low pressure pipe length. The rest will require prefabrication of the support points by the Contractor. The final length and holding positions will be defined during the design phase. For each beamline gas meter should be installed and additional gas meters will be installed at the main low pressure piping path. A few oxygen sensors should be installed at different locations of installation.

The following components need to be installed in the low pressure sub-systems:

a) Low pressure piping with holders

Pay attention to installation difficulties - limited access at the line area, access to the space above the roof structure.

b) Connection ports

It is assumed to have at least 20 connection ports at the EXPH area and 10 for Dewar's storage area. Each connection point should contain: manual open/close valve and fitting with self closing quick connector. For part of low pressure line for each beamline part the main cut-off valve need to be installed. Additionally on the main pipe line several cut-off valves need to be installed for the maintenance purpose (not to force the venting the whole system).

c) Gas Meters

- At least 16 pcs. gas meters with measuring range at least 0.06 – 10 m^3/h and accuracy at 25 °C at least 2 % FS, installed for each potential beamline at EXPH;
- At least 3 pcs gas meters with measuring range at least 0.25 – 40 m^3/h and accuracy at 25 °C at least 2 % FS, installed at main path of the low pressure system.

d) Oxygen sensors

At least 5 pcs oxygen sensors with measuring range at least 0-62.85 % -vol and accuracy at 25 °C at least 1 ± 0.05 %-vol: 21 ± 0.2 %-vol; 50 ± 0.5 %-vol. They will trigger the cut-off valves around the avoid oxygen contamination of the low pressure circuit.

e) Flow meters

At least 16 pcs. gas flow meters with measuring range at least 0.1 – 5 m^3/h, installed for each potential beamline at EXPH. Gas flow meters should be analog with a clear scale enabling reading of the total flow of the gas phase of helium from the devices of a given beamline.

f) Low Pressure Gas Storage (Balloon)

At least 2 pcs of 20 m^3 neoprene balloons with tear strength at least approx. 3500 N/5 cm with frame. The balloons will be installed potentially just below the EXPH roof. The number of fittings/components mounted above the roof structure should be reduced to a minimum to reduce maintenance problems. The installation above the roof structure cannot enter the crane runway and limiting crane working area. The installation should keep safe and protect of the balloon against puncture and abrasion - protection of all sharp edges, threaded rods, screws, etc. on the installation performed by the Contractor, but also on the existing roof structure.

2.2 High pressure system part, control system elements

We assume to have total length of high pressure piping (tube 17.2 mm x 1.5 mm or bigger depending on the assumed gas flow and other parameters) in the experimental hall: 140 m. The tubes should be made of stainless steal. The wall holdings installed in the experimental hall can be used during installation. They are installed every 2 m. We may assume that already installed holding may support approximately 80% of high pressure pipe length. The rest will require prefabrication of the support points by the Contractor. The final length and holding positions will be defined during the design phase.

The following components need to be installed in the high pressure sub-systems:

a) High pressure piping with holders

b) Compressors

The Compressor should compress recovered helium gas from balloons to 200 bar. The capacity/efficiency of compression should be higher than 30 m^3/h. The service period should be

more than 4000 hours. The compressor will be located at dedicated room with special floor but the Contractor need to apply dumpers to minimize the vibrations.

c) Oil water separation

With separation performance at least 99,99995%, solid and liquid particle ≥ 0,01 μM and content of rest oil aerosol ≤ 0,01 MG/M³. The volume of cumulated water need to be defined. There is a floor drain in the room and a condensate installation above the ceiling.

d) High pressure bundle/reservoir

- At least 6 pcs. of 12x50 litres high pressure bundles with pressure 200 bar and with certificates and marked by signs according to the directives 2010/35/UE, 76/767/EWG, 84/525/EWG, 84/526/EWG, 84/527/EWG,1999/36/WE, 2008/68/WE.
- In first stage (for recovery and compression system) the high pressure bundles will be located outside of the building. It is required to easily disconnect and connect set of bundles from and into the main system. Packages with cylinders need to be connected to the installation with flexible hoses for easy disconnection and removal of the package. Each package should contain individual cut-off valve. For the future second step (liquefier) the bundles will be located in the room of compressor. The high pressure pipeline need to have possibility for extension for that purpose.

e) Control Cabinet, Distribution Panel, diagnostic and SCADA System

The distribution of Helium into the various storage groups should be based on the pressure. The helium should be balanced between storage groups using the Distribution Panel. The quality of the Helium should be measured and fed into a quarantine bundle if the level of contamination is too high. This increases the availability of the system, since contamination of the helium is quickly detected and overloading of the freezing purifier is prevented. The gas in the quarantine bundle should be automatically supplied to the balloon in metered quantities after the degree of contamination no longer affects the system and subcomponents. By using gas meters, the automation of the helium compression process will be controlled for efficient work and prevents leaks and detects them in short time period.

The pipeline for low and high pressure and other sub systems needs to have possibility for extension to allow installation of required components for the future second step, which is liquefier (like pure gas buffer, gas management system, liquefier and others).

2.3 The SOLARIS facility

In this section we provide general information about facility building, assumptions for the pipeline paths and the rooms for the equipment.
Below the facility plan at the experimental hall floor level is presented. In yellow the dedicated room for control unit and equipment, compressor and future liquefier is marked. In red the heavy equipment drop zone is marked.

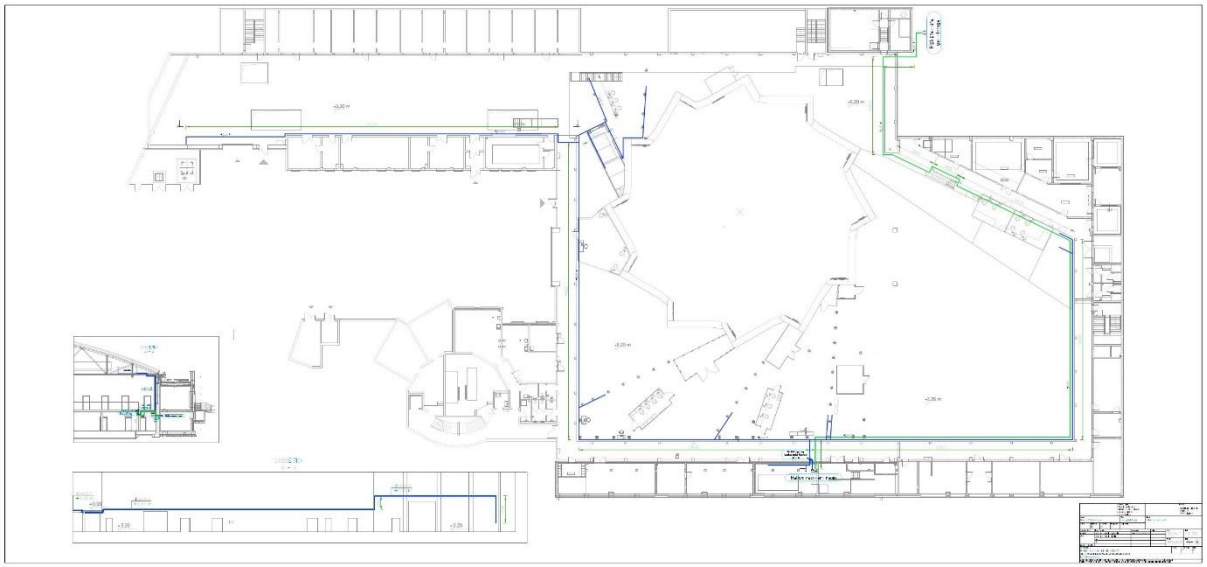

Figure 1. The top view of the floor level of the SOLARIS facility building with marked symbolically pipeline paths.

A plan of the piping is presented (the better resolution is in the pdf file in the attachment, Appendix EXPH-top-view). The blue colour depicts the piping around the beamlines to accumulate the evaporated helium from the experimental stations. The approx. total length of this piping is around 340 meters:

- as a main backbone: approx. 160 m in the experimental hall with prepared handles, and approx. 60 m (to the left side of the building - marked by red arrow) along a reinforced concrete wall, without prepared handles;
- approx. 70 m as the dedicated pipeline prolongations towards beamline end stations with prepared assembly rails;
- approx. 30 m is planned for the connection to the balloon(s), which will be mounted under the roof, (no prepared brackets, scaffolding or a platform is probably needed to assemble the installation);
- approx. 20 running meters towards dedicated rooms for the compressor, control units and other main components.

The green colour depicts the high-pressure piping, which is planned for the connection of high-pressure cylinders/bundle and also the cylinders with He delivered from other institutions. The approx. total length of that piping is 140 m:

- approx. 110 m with prepared mounting rails;
- approx. 30 m without prepared holders (including approx. 10 m outside)

Additionally, the separate file (Appendix INFRASTRUCTURE-01) presents the photographic documentation of the exists Solaris infrastructure for pipeline installation and EXPH roof construction, where the gas storages can be placed.
Appendix EL-switchgear RHELDP.pdf show dedicated existed electrical cabinet.

3. Additional conditions

3.1 Schedule (design, manufacturing, delivery, installation, commissioning)

The Contractor has to present a detailed schedule of all the activities referred to in these terms of reference.

a. The time schedule shall contain milestones (design reviews, tests and delivery) and give a rough overview about the design and manufacturing process that allows for an easy communication of the project progress.
b. The time schedule shall contain delivery dates etc. for all parts to be provided by the Purchaser.
c. The time schedule shall contain dates/periods for meetings, on-site visits etc.
d. The time schedule shall contain delivery dates for documentation prior to milestones.

Milestone	**Points to fulfil before the milestone is considered completed**	**Deadline**
Start up meeting at SOLARIS	Time schedule	Up to 4 weeks from the date of contract signing
PDR (Preliminary Design Review)	The Contractor should have identified all technical issues and proposed technical solutions	Up to 3 months from the date of contract signing
FDR (Final Design Review)	Detailed design completed. Acceptance of FDR by SOLARIS gives approval prior to manufacturing.	Up to 5 months from the date of contract signing
FAT (Factory Acceptance Tests)	Agreed tests should have been completed by the Contractor and approved by Purchaser.	Up to 10 months from the date of contract signing

Delivery of the components	The goods should have been delivered to the agreed address and inspected for possible damage.	Up to 10 months from the date of contract signing
Installation on-site, SAT (Site Acceptance Tests), commissioning and Staff training.	Installation, agreed tests should have been completed, and commissioning of the whole system should be performed by Contractor. During running and commissioning process the training of the SOLARIS Staff will be done by Contractor.	Up to 13 months from the date of contract signing

Table 1. The time table of the project with main milestones.

All communication shall be in English. The Contractor shall appoint a project manager who throughout the whole undertaking acts as key contact for Purchaser. Meetings can take place at the Purchaser or at the Contractor's site or via video conference. All parties shall cover for their own travel and hotel expenses and will not be reimbursed by the other party.

3.2 Preliminary and final design review

A preliminary design review (PDR) and a final design review (FDR) shall be foreseen. The approval is to be granted within 3 weeks from obtaining all necessary documents related with certain review/milestone. The SOLARIS approval will be limited to examination of the design with respect to the requirements stated in the technical specification of the Object of the order and the Contractor's offer. Any approval does not influence the Contractor responsibility for the overall performance and achieving the required operating characteristics.

<u>Preliminary design shall contain:</u>

a. Technical description of the system and its components,
b. Preliminary scheme of the piping system (low and high pressure),
c. Preliminary scheme of the electrical system for all delivered components requiring power,
d. Preliminary scheme of the required compressed air system (if any),
e. Number and type of end points, flow meters and others.

<u>Final design shall contain:</u>

a. Detailed technical description of the components,
b. The 2D model and drawings of the components including all elements with defined position of all required connectors (water, compressed air, power plugs, cable connectors, patch panels, etc),
c. Detailed scheme of the piping system (low and high pressure) with all subcomponents of these system (end points, valves, gas flow meters, sensors, etc.),

d. Detailed scheme of the electrical wiring and supply, data related with required power for components for normal operation,
e. Detailed scheme of the compressed air system for all delivered components requiring compressed air (if any),
f. All the necessary information about internal control system,
g. The list of the scope of installation work for both Parties.

The acceptance of the FDR for particular components of a complete helium recovery and compression system by Purchaser gives approval prior to their manufacturing.

3.3 Factory acceptance tests

The FAT shall be foreseen. The scope of the FAT shall be agreed at the FDR meeting. The Contractor shall submit an agenda for the FAT.
During Factory Acceptance Tests all standard tests shall be performed. The Contractor has to provide hardware and software needed to perform all tests. All electrical components shall be tested at the FAT. The helium recovery and compression system components should be prepared for installation.

3.4 Installation and commissioning

The Contractor shall conduct the installation, SAT (Site acceptance Tests), commissioning and SOLARIS' staff training after accepted assembled delivery. All necessary consumables as necessary for the helium recovery and compression system components assembly (screws, washers, caps, seals, connectors, required cooling water and compressed air circuits prefabricated components, etc.) and all other nonstandard tools will be delivered by Contractor. The agenda for installation should be agreed between both Parties depending on installation obligations.

The components covered by the Scope of supply should be installed and connected in the dedicated locations according to the final design documentation by the Contractor. This includes the labour, set of brackets and piping material. Components will be placed in two rooms – total dimension: 25 m x 5 m and at the experimental hall. For electrical installation: The SOLARIS will prepare main electrical switch board with fusses/brakers. The Customer may provide pumping stations for pipeline commissioning but at the preliminary stage of contract (latest at PDR meeting) the Contractor need to specify the number of pumping units and required pumping speed.

The installation process for the helium recovery and compression system will be scheduled at FDR meeting. The installation of the system will be performed no later than three months after accepted assembled delivery.

The documentation describing safety procedures during the assembly and disassembly process of each subassembly and the whole system should be provided to SOLARIS centre not later than with the delivery step of a particular sub-assembly.

The commissioning should include a 24-hour test run to verify the performance and functionality of the system. The training will cover the instruction of SOLARIS's Staff as well as the briefing of the safety-relevant system components. The training should last at least 2 x 8 hours and should be performed for a maximum of 8 Solaris people during the launch of the entire system.

3.5 Design and drawings of the helium recovery and compression system

a). General requirements

The detailed design shall contain a geometrical scheme of the helium recovery and compression system components. The drawings must be updated as a result of any modification. On completion of the contract (latest together with the delivery of the system) the Contractor shall supply hard copy and one soft copy of the assembly drawings and the manual (including technical data, procedures for system assembly, disassembly, maintenance and service).

The Contractor will provide detailed information (described below) which will be the base for design and possible construction of the whole infrastructure. All design guidelines for compressed air, water cooling, electricity, signal cables and IT infrastructure shall be delivered together with the FDR meeting report.

b). Mechanical requirements

The design will be provided in 2D (DWG or DXF) and 3D (STEP or IGES), if possible, formats and will include the location of the components. The drawings will be the base for the project of the infrastructure (power electrical installation, low–current cable installation, cooling water and compressed air installations, IT infrastructure).

c). Electrical requirements

The Contractor will present an ideographic diagram of electrical and signal installation for all components of the helium recovery and compression system.

The MCB, RCD, RCDO circuit breakers shall be type DX3 Legrand with a rated short-circuit capacity of 10 kA are required in automation cabinets. In cable trays, separation must be maintained between power cables and low-voltage cables. Cables trays should be as KDSH60 with hot dip galvanized steel PN-EN ISO 1461:2023-02. All scheme of the electrical system shall be DWG ver.10.

d). Cooling water and compressed air requirements

The Contractor will provide guidelines for the cooling water installation and compressed air (location of the connection points at the devices, their types and required flows, pressure drops, 2D models). All details can be found in Appendix WAT-CW1 and WAT-CA1.

e). IT infrastructure requirements
The Contractor will provide guidelines for the IT infrastructure - the helium recovery and compression system component location, 2D models, number of Ethernet interfaces needed to control the equipment foreseen in the project.

f). Building Management System (BMS)
The Contractor will provide complete and safe control system based on PLC device. To keep Solaris standards, Allen-Bradley or Siemens platform are preferred. Control system should consist HMI panel with all signal necessary to serve the machine in the local mode.
The recovery and compression system must be available in Scada of Solaris Building Management System (BMS). To do this PLC must work as Modbus TCP server, and share all and the same data which is available in the local HMI. Contractor will provide manual which allow properly configure Modbus TCP Client in BMS. The manual should include among others the table with all available signals and their addresses in the Modbus TCP register.

4. Attachments

The terms of reference document is appended with the following attachments. The Attachments include technological descriptions used in SOLARIS, which the Contractor shall observe and comply with. Attachments constitute an integral part of the Terms of Reference.

Appendix A1 to ToR, included:
a) Appendix WAT-CW1 – Cooling water basic standards
b) Appendix WAT-CA1 – Compressed air basic standards
c) Appendix EXPH-top-view.pdf
d) Appendix EXPH-top-view.dwg
e) Appendix INFRASTRUCTURE-01.pdf
f) Appendix EL-switchgear RHELDP.pdf