



Document Title:	ISIS Cryogenic Supply Systems – General Requirements		
Used On:	TS1 Cryogenic Systems		
Document No:	ISIS-TS1-UPG-SRV-Sp-0010	Issue No:	1
Author:	R A Dean	Issue Date:	05/09/17
Reviewer:	D Haynes – Target Ops Manager	Date:	04/09/17
Reviewer:	R Burrige – Target Controls	Date:	01/09/17
Reviewer:	S Gallimore – Project Manager	Date:	01/09/17
Reviewer:	D Jenkins – Project Technical Lead	Date:	04/09/17
Approver:	D Jenkins – Project Technical Lead	Date:	04/09/17

Issue	Date	Change Description	Auth	Check	App
1	DD/MM/YY	Initial Issue	-	-	-

1 Summary of Requirements for Tender Submission

This tender is for the supply of two cryogenic, vacuum-insulation-coldbox contained, supply systems:

- One unit supplying liquid methane at 110 K
- One unit supplying liquid hydrogen at 21 K

Supply is for the Coldbox and equipment contained only. Interfacing equipment and systems, including gas supply & vent, refrigeration, and vacuum shall be provided by STFC.

The systems are to be installed into existing infrastructure, and are replacements for existing systems. These existing systems have been functioning successfully for over 30 years and the new systems should be viewed as like-for-like replacements with the inclusion of a number of improvements, rather than as completely new designs. It is of utmost importance that all functionality available in the current systems is retained in the replacement equipment.

The required date for delivery of the completed Cryogenic Supply System assemblies, all associated items and all documentation is **Wednesday 26th June 2019**.

As a minimum, the tender submission is expected to comprise the following documentation:

- System Description
 - o Detail of how requirements of this document will be met
 - o Proposed equipment layout and dimensions
 - o Draft P&ID
 - o Equipment List including details of proposed Type & Manufacturer
 - o Suggested Instrument List
 - o Description of how instrumentation will be connected for Atex compliance
- Costs
 - o Total Fixed Cost
 - o Cost breakdown
- Project Plan
 - o Schedule, including key deliverables, milestone dates
 - o Resource Plan
- Provisional Testing Plan



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2 Introduction

2.1 Purpose

This document provides General Requirements to suppliers for the provision of the Methane and Hydrogen Cryogenic Supply Systems.

Specific Technical Requirements for the Methane Cryogenic Supply System (MCSS) are given in the companion document ISIS-TS1-UPG-SRV-Sp-0011

Specific Technical Requirements for the Hydrogen Cryogenic Supply System (HCSS) are given in the companion document ISIS-TS1-UPG-SRV-Sp-0012

2.2 ISIS Neutron & Muon Source

The ISIS pulsed neutron and muon source at the Rutherford Appleton Laboratory in Oxfordshire is a world-leading centre for research in the physical and life sciences. It is owned and operated by the Science and Technology Facilities Council (STFC).

ISIS produces beams of neutrons and muons that allow scientists to study materials at the atomic level using a suite of instruments, often described as ‘super-microscopes’. It supports a national and international community of more than 2000 scientists who use neutrons and muons for research in physics, chemistry, materials science, geology, engineering and biology. It is the most productive research centre of its type in the world.

From the original vision over 30 years ago, ISIS has become one of the UK’s major scientific achievements. As the world’s leading pulsed neutron and muon source, ISIS has changed the way the world views neutron scattering.



The ISIS Facility, Rutherford Appleton Laboratory, Harwell Oxford, UK

Neutrons are produced when a tungsten target is bombarded with pulses of high energy protons, driving neutrons from the nuclei of the target atoms in a process called spallation. This gives an extremely intense neutron pulse, and the neutrons then need to be slowed to speeds useful for



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condensed matter research. This is achieved using an array of hydrogenous moderators around the target.

As part of a major sustainability project, the systems which supply Cryogenic methane and Cryogenic Hydrogen to these moderators are to be replaced.



Existing Methane Coldbox



Existing Hydrogen Coldbox

2.3 Associated Documents

This Technical Specification shall be read in conjunction with the following documents:

<u>Document Title</u>	<u>Document Number</u>
ISIS Cryogenic Supply Systems – General Requirements	<i>ISIS-TS1-UPG-SRV-Sp-0010</i>
ISIS Cryogenic Supply Systems – Methane Specific Requirements	<i>ISIS-TS1-UPG-SRV-Sp-0011</i>
ISIS Cryogenic Supply Systems – Hydrogen Specific Requirements	<i>ISIS-TS1-UPG-SRV-Sp-0012</i>
Cryosystems Drawing Pack	<i>SI-5600-100</i>
Methane Circuit P&ID	<i>SI-5700-100</i>
Hydrogen Circuit P&ID	<i>SI-5700-101</i>
Condenser Suggested Layout	<i>SI-7046-150</i>
Material Selection and the Cleaning of Components for use in the ISIS Synchrotron vacuum systems	<i>ISIS/TS/N5/05</i>
Cryogenerator Head Heat Exchanger Drawing Pack	<i>SI-7047-400</i>
Helium Refrigerator Information Pack	<i>ISIS-TS1-UPG-SRV-Eq-0001</i>

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3 Scope of Supply

Supplier is responsible for the design, manufacture, testing and delivery of two cryogenic, vacuum-insulation-coldbox contained, supply systems.

Scope comprises:

- 1 x Cryogenic Hydrogen supply system housed within a vacuum vessel
- 1 x Cryogenic Methane supply system housed within a vacuum vessel
- 1 x Cryogenerator Head Heat Exchanger and interconnecting Transfer Line
- Any additional equipment as required to meet the requirements of this specification
- Delivery to site, including all supportive, protective and packaging materials
- Additional Samples of material used in manufacture
- Documentation as described in Section 4.5

Excluding, but interfacing with:

- Refrigeration Units
 - Sulzer Helium Refrigerator (Hydrogen System)
 - Stirling Cryogenerator (Methane System)
- Transfer Lines to Moderator Vessels
- Moderator Vessels
- PLC Control System
- Vacuum System

Suggested system arrangement are provided in the attached P&IDs, Ref: *SI-5700-100* (Methane) and *SI-5700-101* (Hydrogen). Supplier shall be free to alter these arrangements, provided that all requirements described in this Technical Specification are met.

The support frames, onto which the equipment will be installed, do not form part of this scope of supply. However the supplier will be required to provide sufficient information (geometry, load distribution, etc.) to allow suitable supports to be designed and constructed.

The Supplier is also responsible for the design, construction and manufacture of all equipment required for the following tasks:

- Production
- Inspections
- Testing (prior to delivery)
- Handling, storage, packing and transport.

Upon completion of The Work, all Design, Documentation and Equipment shall become the property of STFC.

4 General Requirements

4.1 Project Management

The Supplier shall be responsible for the scheduling of all activities in order to meet the agreed delivery date.

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The Supplier shall include the Project Plan Document as part of the tender submission, containing, as a minimum:

- Project Schedule / Gantt Chart, highlighting key milestone dates / deliverable
- Resource Plan

Supplier shall update this document throughout the contract period

4.2 Design Phase

STFC recognises that some design work will be required in order to finalise the design of the Cryogenic Supply Systems.

In particular, supplier’s design input is requested in the following areas:

- Overall system layout and finalised P&ID
- Equipment selection
- Pressure equipment design

A Design Phase shall therefore be included within the Equipment contract.

During the Design Phase it is expected that the supplier will consult with STFC on aspects of the design.

A programme of regular reviews will be agreed; Suppliers shall include an anticipated schedule for the Design Phase within the Project Plan as part of the tender documentation.

As a minimum, the following formal meetings shall be held:

4.2.1 Kick off meeting

A kick-off meeting shall be arranged within the first month of the contract placement date. This will allow teams from the supplier and STFC to meet and discuss the scope and any outstanding technical points.

4.2.2 Intermediate Progress Review

A progress review shall be arranged at an appropriate midpoint during the Design Phase.

This shall be an opportunity for STFC and Supplier to assess progress against the project plan, confirm the design is on track to achieve specification requirements and discuss any outstanding technical points.

4.2.3 Safety Assessments

A HAZOP Study shall be undertaken during Design Phase in collaboration with STFC after P&ID is prepared.

HAZOP shall be carried out in accordance with BS EN 61882:2016

If the HAZOP finds that further assessments (for example SIL / LOPA) are appropriate, then these shall be organised as required.

All HAZOP Actions must be closed before Final Design Review, except with agreement by STFC.

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4.2.4 Final Design Review

The final design shall be subject to formal review and acceptance by STFC. Before manufacturing phase can be commenced, the Supplier must demonstrate, by means of detailed evidence and calculation, that the Final Design meets all requirements of this specification document.

4.3 Communication and Reporting

All communication shall be conducted in English.

4.3.1 Communication Plan

Good communication between STFC and the supplier will be an important part of ensuring the contract runs as smoothly as possible. As part of the tender submission, the supplier shall provide a document entitled the Communications Plan that shall contain, as a minimum:

- The name and contact details for:
 - Project Manager – responsible for the schedule
 - Lead Engineer – responsible for technical decisions and day to day technical contact
 - Procurement Supervisor – responsible for legal and financial decisions
- NOTE – one person may hold one or more of these roles. If this is the case, this shall be clearly stated.*
- The preferred/expected methods of communication i.e. email, video-conference, etc.
 - Expected response period to any questions asked by the supplier to STFC or vice versa, asked by STFC to the supplier
 - Any specific language considerations
 - The frequency of contact regarding various aspects of the project, for example, monthly video-conference meetings to discuss progress to date, weekly technical review emails or site visits by STFC staff every six months.
 - Information expected to be supplied by STFC and the expected frequency

Previous experience has shown that having a clear, defined and agreed chain of communication with defined single contacts for specific aspects is the most efficient and lowest risk approach.

4.3.2 Progress Reporting

The supplier shall provide regular project progress update reports to STFC throughout the contract period. Reports shall be sent via email. As a minimum, this shall include:

Monthly Report, briefly covering:

- Activities carried out during preceding month
- Activities planned to commence in the coming month
- Commentary on progress compared to schedule, highlighting any changes to timescales, milestone dates and durations
- Issues encountered and risks identified during preceding month*
- Changes to scope agreed in preceding month
- Additionally, where appropriate, supplier should provide visual evidence (e.g. photographs) manufacture

Report every 3 Month, detailing:

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- updated Project Plan showing schedule and key deliverable

*NOTE: In addition to the regular monthly update, in the event that an issue is identified or realised that which will result in:

- The final product not meeting the technical specification
- More than a two week delay on agreed delivery date
- A significant cost increase

Supplier shall immediately contact STFC to notify of the issue. This will allow a dialogue to be opened on how to best manage the issue.

4.3.3 Meetings

All meetings shall be held at STFC, Rutherford Appleton Laboratory, during normal RAL working hours (09:00 – 16:00 GMT) unless agreed otherwise.

4.3.4 Telephone / Video Conference

Communication by telephone or video conference shall be conducted during normal RAL working hours (09:00 – 16:00 GMT) unless otherwise agreed.

4.3.5 Facility Visits

Supplier Manufacturing Facility Tour

Members of the STFC engineering team shall conduct a visit, during the Design Phase, to view the supplier’s production facilities.

ISIS facility tour

STFC will extend an invitation to the supplier to visit the ISIS facility during the period covered by the contract. At least two weeks’ notice is required to organise such a visit.

4.4 Intellectual Property

STFC has no commercial interest in designing or producing components for cryogenic equipment outside of those required for the operation and maintenance of its own facilities.

4.4.1 Background IP

STFC shall not place any claim on the background IP of the supplier. STFC expects, however, that the supplier shall make use of its own background IP and incorporate all appropriate knowledge and experience to ensure the successful completion of the project.

It is expected that if a certain method, technique or approach is employed based on the suppliers background IP that it would still openly discuss these with the STFC engineering team, as part of technical discussions.

4.4.2 Foreground IP

All drawings and documentation which constitute the design, and all physical parts which constitute the supplied systems, shall become the property of STFC upon completion of the contract.

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STFC expects that the engineering team should be able to openly discuss and develop detailed understanding of any methods, techniques or approaches developed directly for the production of the items covered by the contract. This knowledge is only to allow the better understanding for possible modifications (to the items covered by the contract) and as an input to planned post-irradiation examination (PIE) on components at the end of the operational life. Results from these investigations are general published in scientific journals and therefore provide STFC with no commercial gain.

4.5 Documentation

4.5.1 Documentation Ownership

The Design and all relevant design documentation shall become the property of STFC upon completion of the contract

4.5.2 Documentation Requirements

Supplier to provide:

At Tender Stage

- System Description
 - o Detail of how requirements of this document will be met
 - o Proposed equipment layout and dimensions
 - o Draft P&ID
 - o Equipment List including details of proposed Type & Manufacturer
 - o Suggested Instrument List
 - o Description of how instrumentation will be connected for Atex compliance
- Costs
 - o Total Fixed Cost
 - o Cost breakdown
- Project Plan
 - o Schedule, including key deliverables, milestone dates
 - o Resource Plan
- Provisional Testing Plan

At Design Phase Completion

- System Description
 - o Details and evidence of how the requirements of this specification are met
- Finalised P&ID
- Complete Mechanical Drawings package
- Bill of Materials
- Installation Plan
- Quality Plan
- Instrumentation List
- Design Calculations, including (but not limited to):
 - o Pressure system stress determination
 - o Heat leak
 - o Safety Case / Relief Valve Sizing

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- Pressure Drop
- Heat exchanger sizing
- HAZOP Study Report (no outstanding actions)

Minimum 3 Months before Factory Acceptance Testing

- Agreed Testing Plan

At Equipment Delivery Stage

- User Manual / Maintenance Manual for all equipment items
- Quality Assurance Documentation, including (but not limited to):
 - Material Certification
 - Welder Specifications/qualifications
- Spares List
- Warranty

4.5.3 Documentation Format

All documentation shall be supplied in English.

All documentation shall be supplied in PDF format, except where described below or otherwise agreed with STFC:

Project Plan

STFC currently uses Microsoft Project as its planning and scheduling tool, and this is the preferred format for the Supplier Project Plan documentation.

If the supplier uses an alternative software package, or does not have a specialised planning software tool, then documents submitted in PDF file format shall be acceptable.

Drawings and CAD Data Handling

Drawing numbers shall be in STFC format, details shall be supplied at the start of the contract.

STFC currently uses Solid Edge computer-aided design (CAD) software, and this is the preferred software for supplier use, as this will allow drawings/CAD models to be provided using STFC templates.

Suppliers utilizing alternative CAD software shall provide drawings/CAD models in an acceptable alternative format (for example .dwg / .stp) to be agreed

Where possible, Supplier shall provide drawings using STFC templates.

NOTE: All drawings to be in ‘warm state’ unless otherwise specified

4.6 Change Control

Any change to scope which results in a change to cost, schedule or equipment functionality shall be subject to formal written approval by STFC

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4.7 Quality Control and Assurance

The quality of the final product is of paramount importance. Supplier shall ensure that a quality management system is in place to ensure that the quality expectations of STFC are met.

The Details of this management system, quality controls and quality assurance procedures shall be documented in a Quality Assurance Plan submitted as part of the tender submission.

The Supplier must plan, establish, implement and adhere to a documented quality assurance program that fulfils all the requirements described in the Requirement Specification. The list of relevant topics to be covered by the quality assurance plan is given below:

Policy:	Quality Assurance Policy Health and Safety policy
Project Management:	Project organisation and structure Outline of project governance
Planning:	Planning, monitoring, control and reporting
Design:	Quality Assurance Categories
Materials:	Traceability, certificate of supply, composition data, mechanical property data
Manufacturing and Inspection:	Manufacturing and Inspection of Equipment

5 General Technical Requirements

5.1 Overall System Design Requirements

Supplier shall design the system to provide functionality as described in the System Specific Requirements documents (ISIS-TS1-UPG-SVS-Sp-0011 and ISIS-TS1-UPG-SVS-Sp-0012).

The equipment shall not have a defined maximum lifetime but shall be, as a minimum, designed for continuous operation, 24 hours per day for 200 days per annum for 20 years

Wherever possible standard commercially available items are preferred to bespoke designs to aid sourcing of spares. However, system functionality shall not be compromised for this requirement.

Wherever possible equipment should be standardised between the hydrogen and methane systems in order to reduce spares holding. However, system functionality shall not be compromised for this requirement.

5.2 System Control

STFC shall be responsible for provision of the PLC hardware and control software.

Equipment must be compatible with the existing ISIS control PLC hardware

Where system equipment differs from the existing system, STFC shall be responsible for modifications to control software

Cabling distance between equipment location and control hardware is 60 meters. STFC to install cabling, supplier to provide suitable equipment and connection for use in the ATEX zone.



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5.3 Applicable Standards

The system is subject to CE Marking and shall comply with all applicable standards. This list includes, but is not limited to:

- Pressure Equipment Directive
- Electrical Equipment Directive
- DSEAR / ATEX (BS EN 60079)*
- Machinery Directive
- PD5500 / alternative Design Code (to be agreed with STFC)

However, Nuclear Industry Regulations are not applicable.

* Certification by Notified Body required.

5.4 Equipment Location

The systems shall be installed in place of existing moderator supply coldbox systems at the front of the ISIS Services Trolley (Fig.1), located within the Target Station 1 Target Services Area (TSA).

The TSA is located within a building and within a radiation shielded area.

The Services Trolley is mounted on rails and can be moved forward and backward to allow access to different sections. All connections between the services trolley and external supplies are routed along drag chains.

The equipment is to be installed on the Services Trolley within a specially built structure in order to provide separation for ATEX Zoning requirements (see Section 5.7)

An area layout is provided in Drawing Ref: *SI-5600-100 Sheets 4 & 5*.

Note that the fixed points are the transfer line connection, location of Cryogenerator, Helium Refrigerator Unit and ATEX room boundaries.

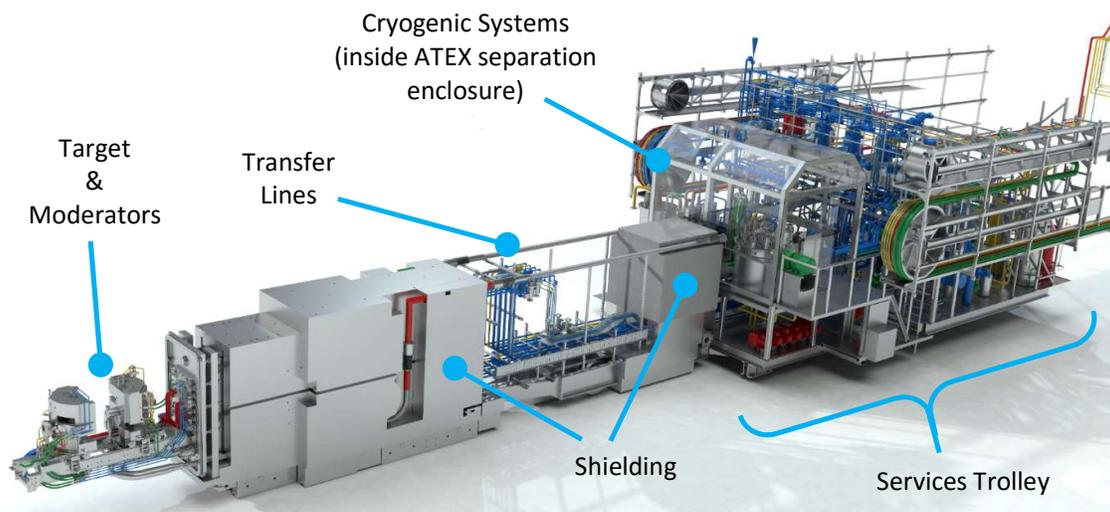


Fig. 1 – Target Equipment Layout (NOTE building/walls not shown)

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5.5 Equipment Layout

Supplier shall be responsible for equipment layout design. An area layout showing the space available for the equipment is provided in Drawing Ref: *SI-5600-100 Sheets 1 & 2*.

A conceptual layout is also provided in Drawing Ref: *SI-5600-100 Sheet 3*.

Dimensions shown shall be used for quotation purposes, Supplier shall be responsible for confirming dimensions during design phase (site visit is strongly recommended).

Equipment should be made as compact as possible and the Coldbox Vacuum Vessel diameter / width must not exceed:

Methane System : 1200 mm

Hydrogen System : 1000 mm

The top surface of the Coldbox Vacuum Vessels shall each be at a height such that it is easily accessible for maintenance activities, as indicated on the drawing. The space above each vacuum vessel is available for equipment external to the vacuum vessel (e.g. circulator pump motors, valve actuators etc.) and pipework.

NOTE: Limited protrusion of items outside of the designated equipment space into space designated for access (for example a drain valve below the vacuum vessel) may be required. Any such instance shall require approval by STFC.

Support frames, onto which the equipment will be installed, do not form part of this scope of supply, however the supplier will be required to provide sufficient information (geometry, load distribution, etc.) to allow suitable support to be designed and constructed.

5.6 Cryogenic Fluid

All equipment and materials used must be suitable for use at cryogenic temperatures.

The systems will operate at approx. 110 K (Methane) / 21 K (Hydrogen)

Design must take into account thermal expansion / contraction as a result of temperature change between ambient and operating temperatures.

All drawings to be in 'warm state' unless otherwise specified.

5.7 Flammable Fluid

Both systems contain a flammable fluid and therefore all relevant equipment will require ATEX certification to meet zoning and product classification requirements.

The area in which the systems are to be installed has been designated as ATEX Zone 2. The following minimum equipment selection requirements therefore apply:

Equipment Group : II

Equipment Category : 3

Environment : G

Hydrogen is identified as the highest hazard gas in the area. The following product classification requirements therefore apply:

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Gas Group : IIC
 Temperature Class : T1

NOTE: Coldbox internals are not considered to be a Zoned area.

5.8 Radiation Environment

Radiation levels in the TSA will be in the region of 100 mGy/hr during system operation.

Any parts which cannot be changed as part of a preventative maintenance plan are expected to have a radiation life of at least 20 years at this level, based on continuous operation 24 hours per day, 200 days per year, representing an anticipated cumulative radiation dose of approximately 10,000 Gy.

STFC has significant experience of equipment operating in this environment and Supplier shall be expected to consult with STFC during the design phase as to the suitability of different materials

The following information is based on the construction materials of the existing equipment, which has successfully operated for more than 30 years in this environment

- Metals for major components (stainless steel for vessels and pipework, copper/aluminium in heat exchangers) can generally be used with no issues.
- Soft sealing materials, such as synthetic rubbers and elastomers, may be used but STFC must be consulted before selection of specific material – see Section 5.11.2.
- Temperature sensors:
 - Existing methane equipment utilizes platinum resistance thermometer type and STFC have significant confidence of the reliability of this equipment in radiation conditions.
 - Existing hydrogen equipment utilizes silicon diode type and STFC have good experience of the reliability of this equipment in radiation conditions. Additionally, Carbon Ceramic Cryogenic sensors and Cernox are used successfully at similar facilities.
- Electronic equipment cannot be used within the TSA due to the effect of radiation. Any electronics must therefore have the capability to be cabled through the shield wall to the outside of the TSA - minimum 60m cable (suitable for routing along drag chains) required.

5.9 Magnetic Fields

Magnetic fields in the MCSS area will be negligible.

5.10 Utilities

5.10.1 Methane

Methane is supplied to the area from a cylinder pack located outside the Target Station Building

Current supply pressure is 4 bar

5.10.2 Hydrogen

Hydrogen is supplied to the area from a cylinder pack located outside the Target Station Building.



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Current supply pressure is 8.5 bar

5.10.3 Nitrogen

Nitrogen, for purging purposes, is supplied to the area from a cylinder pack (230 barG) located outside the Target Station Building

Current supply pressure is 3 bar

5.10.4 Helium

Helium, for purging purposes, is supplied to the area from a cylinder pack (300 barG) located outside the Target Station Building

Current supply pressure is 7 bar

5.10.5 Instrument Air

Instrument air is available from a compressor supply.

Supply pressure is 70 PSI (\approx 5 Bar)

5.10.6 Electricity

- 415V, 3 Phase and 240 V AC Single Phase
- Uninterruptable Power Supply provided for PLC and instrumentation where necessary
- Earth connections

5.11 Materials

5.11.1 All Materials

All materials must be agreed with STFC.

Supplier shall provide full certification, at equipment delivery stage, for all materials used.

Supplier shall provide additional small samples of materials used in production as directed by STFC.

Materials must be suitable for use in cryogenic temperatures as described in Section 5.6

Materials must be suitable for use in a radiation environment as described in Section 5.8

Wetted surface materials must be compatible with process fluids as follows:

System	Process Fluids
Methane	: Methane, Ethane, Propane, Hydrogen, Helium, Nitrogen and Air.
Hydrogen	: Hydrogen, Helium, Nitrogen and Air

The potential for Hydrogen embrittlement must be considered when selecting materials.

5.11.2 Sealing Materials

STFC has significant experience of the performance of materials used for sealing purposes, for example O-rings and gaskets, in the TSA environment. Supplier shall be expected to consult with STFC during the design phase as to the suitability of different materials.

Generally:

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- Metal seals are preferred wherever possible
- Use of other materials, such as synthetic rubbers and elastomers, is acceptable but Supplier shall consult with STFC as to their radiation resistance.
- Silicon seals must not be used

5.11.3 Material Samples

Supplier is requested to supply small samples of materials used in construction.

These will be used for future investigation on the effect of radiation exposure within the TSA

5.12 Cleaning

All equipment must be cleaned according to STFC Specification: *ISIS/TS/N5/05*

5.13 Maintenance and Spares

Supplier shall provide a list of maintainable items at end of Design Phase

Parts requiring regular maintenance must be accessible without breaking vacuum.

Access ergonomics (headroom / reach / etc.) must be taken into account.

Access to parts requiring irregular/breakdown maintenance (e.g. condenser assembly) must also be considered and access procedures provided.

Supplier to include, as a minimum 1 off full spare / maintenance kit for all maintainable items.

Supplier to provide full maintenance schedule and procedures for all maintainable items.

6 Testing

6.1 Testing Plan

6.1.1 Tender Stage

Supplier shall advise STFC of their testing capabilities as part of tender documentation. This document shall additionally outline the envisioned testing procedures and estimated timescales for the tests to be carried out as part of the FATs (factory acceptance tests).

6.1.2 Testing plan – 3 months prior to FATs

The testing plan shall be submitted to STFC a minimum of 3 months prior to the scheduled date of the FATs. This document shall contain detail of the testing procedures and how these will demonstrate compliance of the product with all requirements of the technical specification laid out in the contract.

STFC reserves the right to reject the testing plan at this point and request that it be rewritten. If this is the case, STFC will provide clear guidance on the expected changes.

6.2 Testing During Manufacture

Supplier shall perform all necessary testing in order to comply with all applicable legal requirements, Standards and agreed Design Codes

Supplier shall provide evidence of all testing carried out.

 Science & Technology Facilities Council ISIS	Document Title:	ISIS Cryogenic Supply Systems – General Requirements		
	Document No:	ISIS-TS1-UPG-SRV-Sp-0010	Issue:	1
	Author:	R A Dean	Date:	05/09/17
<small>ISIS Design Division Science and Technology Facilities Council Rutherford Appleton Laboratory Harwell Campus Didcot OX11 0QX</small>				

Additionally, Supplier shall carry out the following testing during manufacture:

- Vacuum leak check to ISIS Vacuum Spec ISIS/TS/N5/05 of the following individual components and sub-assemblies:

MCSS:

- Cryogenerator Head Heat Exchanger
- Condenser
- Dump Tank
- Separator Vessel

HCSS:

- Heat Exchanger
- Catalyst vessel

Acceptable Leak Rate shall be **<1x10⁻⁸mbar/litre/sec**

- Radiographic testing on 100% of welds

6.3 Factory Acceptance Test

The facility to perform a functional test of the equipment using the process fluid at operating conditions as part of the FAT would be advantageous. However, due to the nature of the process fluids involved, this is not expected.

As a minimum, the FAT shall comprise the following items, undertaken at the Suppliers premises (or suitable alternative) before delivery to STFC:

- High Pressure Strength test to PED (or other agreed design code) on all components
- Vacuum test on all complete to ISIS Vacuum Spec ISIS/TS/N5/05
Acceptable Leak Rate shall be **<1x10⁻⁶mbar/litre/sec**
- Helium leak check
- Heat leak check to BS EN 12213:1999
- Equipment to be operated using Liquid N2 to demonstrate operation of circulators*, all valves, temperature sensors, level transmitters
- Load test on lifting points

*Circulator manufacturer to be consulted regarding testing methods.

FAT shall be witnessed by members of the STFC Engineering team.

6.4 Site Acceptance Test (external to ATEX room)

The equipment shall be subject to the following testing upon receipt by STFC, prior to installation into the TSA

- High Pressure Strength test to PED (or other agreed design code) on all components
- Vacuum test on all complete to ISIS Vacuum Spec ISIS/TS/N5/05
Acceptable Leak Rate shall be **<1x10⁻⁶mbar/litre/sec**
- Helium leak check
- Heat leak check to BS EN 12213:1999
- Equipment to be operated using Liquid N2 to demonstrate operation of circulators, all valves, temperature sensors, level transmitters

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6.5 SAT (after installation into ATEX room)

The equipment shall be subject to the following testing after installation into the TSA.

- He/vacuum leak check
- Full functionality commissioning checks using process fluid, including:
 - o Valve operation
 - o Circulator operation
 - o System cool down
 - o Methane Liquid Transfer operation (MCSS only)
 - o Alarm/safety system checks

7 Delivery

The delivery of the Cryogenic Supply Systems to STFC is the responsibility of the supplier. The supplier shall take every practicable step to ensure safe delivery, using appropriate packaging. Any customs and delivery charges are the responsibility of the supplier.

7.1 Delivery date

The required date for delivery of the completed Cryogenic Supply System assemblies, all associated items and all documentation is **Wednesday 26th June 2019**.

7.2 Packaging

The purpose of the packaging is to protect the components from damage during transportation.

The supplier should present to STFC their proposal for how to achieve these aims a minimum of 2 months prior to the scheduled date for delivery.

7.3 Delivery location

ISIS Facility
Science and Technology Facilities Council
Rutherford Appleton Laboratory
Harwell Oxford
OX11 0QX
UK

8 Warranty

A full manufacturer's warranty shall be provided by the supplier to cover replacement or repair of any item supplied as part of the contract.