ISIS PLANT DESIGN SECTION

AIR COOLED WATER CHILLERS

FOR THE R5.1 MAIN CHILLED WATER CIRCUIT

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ISIS

Document Reference:	
Document Type:	**Technical Specification**
Project - Client	**ISIS Rutherford Appleton Laboratories**
Title:	**AIR COOLED WATER CHILLERS FOR R5.1 MAIN CHIILED WATER CIRCUIT.**

Summary & Reason for Issue:-

final Issue – for inquiry

Revision History:

Version	**B**		
Originator	**Vince Major**		
Date	**03/07/2018**		
Approved			
Date			

1. INTRODUCTION

1.1 The Science and Technology Facilities Council (STFC) is a world leading multi-disciplinary science organisation that seeks to understand the universe on all scales. STFC is part of the UK Research and Innovation (UKRI) which in itself comprises of seven research councils; Innovate UK and Research England.

1.2 This specification defines the general technical requirements and scope for the design, manufacture, testing, delivery and commissioning of up to 3 No air cooled water chillers to replace failing units located on the existing R5.1 platform. The assembly forms part of the ISIS Neutron Science Research facility at Rutherford Appleton Laboratory (RAL), Chilton, Oxfordshire, part of the Science and Technology Facilities Council (STFC).

1.3 STFC are carrying out a phased programme for the replacement of 3 No existing Climaveneta TC/SRAT/LN-1202 chillers. The programme will begin in 2018 and expect to be completed by 2020. The anticipated phasing will be to purchase a single 350 kW chiller in 2018 with two further chillers purchased before the end of the agreement period.

1.4 The chillers will be located in the space vacated by the failing TC/SRAT/LN-1202 chillers. The replacement chillers will fit broadly within the same foot print as the old units. The footprint for each chiller shall not exceed 4.6 m in length and 2.3 m in width. There is no height restriction except as required for safe access for personnel carrying out any maintenance. There is a weight restriction because of the design and condition of the existing R5.1 steel platform. No single chiller will exceed 4.5 tonnes in weight when fully loaded with refrigerant.

1.5 The specification is not intended to constrain the supplier in his material selection or from offering plant that is manufactured to the supplier’s own design provided that it is fit for purpose.

1.6 Each chiller shall be designed for:-

- High Energy Efficiency Performance
- Flexibility of operation
- Low running costs
- Short installation cycle
- High reliability and availability
- Accessibility for maintenance
- Long life cycle
- Low life cycle costs

2. REGULATIONS, CODES AND STANDARDS

All equipment shall be in conformance with all relevant codes, laws and standards, including local codes, laws and standards.

The applicable editions of codes and standards shall be the latest editions, with all amendments, current on the date of tender submission.

Appendix A references a list of applicable Codes and Standards. This list is not exhaustive, and it is the Supplier's responsibility to ensure that the equipment complies with all applicable codes and standards.

3. HEALTH AND SAFTY

3.1 Applicable Regulations

All equipment supplied shall conform in all respects with all relevant statutory provisions, orders, regulations and by-laws made by competent authorities having the force of law in the United Kingdom.

No instructions given in this specification or supporting documentation shall relieve the supplier of responsibility to provide a safe and reliable product.

3.2 Responsibilities

Drawings and specifications shall be submitted to enable STFC to gain an understanding of the basis of the design. A brief description of the plant system design philosophy with regard to safety in design, erection, commissioning, operation, maintenance, decommissioning and demolition shall be submitted, as a "Method Statement"

3.3 HAZOP Study

The Supplier shall conduct a full product risk assessment, in accordance with EN1050, and shall when requested be required to participate in a HAZOP study which may be conducted by STFC.

3.4 Health and Safety Requirements

All contractor personnel are required to conform to the STFC health and safety requirements (SHE Group link https://staff.she.stfc.ac.uk/pages/staff/home.aspx). These include attending a site specific Safety Induction Course, prior to working on Site. All workers will require a permit to work in a restricted area, (hot work permit etc.) and may be required to wear a radiation film badge at all times issued by STFC.

4. OPERATION AND THE ENVIRONMENT

4.1 Operation

All equipment shall be designed for maximum practicable reliability and availability throughout its design life. Industry best practice shall be employed throughout the design and construction, to prevent recurrence of known potential problems.

4.2 Maintenance

The equipment shall be designed to aid any maintenance required throughout the life of the plant. Any requirements for special tools or equipment, which may be required for handling and erection, commissioning, testing, operation and maintenance, shall be minimized. However, where the requirement for such equipment is unavoidable, the supplier shall include it within his scope of supply. The Supplier shall provide a schedule of all such special tools and equipment. The Supplier shall, when requested, be required to participate in a review of the plant layout, which will be conducted by STFC, to ensure that adequate maintenance access is provided.

5. SCOPE

The scope of supply shall include all equipment items between Terminal Points (refer to section 5.2) including any skid-mounting and containerisation. All necessary items, which are not included in the supplier's scope, shall be clearly identified in the tender.

The supplier shall be responsible for the design, procurement of materials, fabrication, testing, cleaning, painting, delivery and commissioning of all items included in this specification. The Supplier will deliver each chiller using a HIAB vehicle. The subsequent installation and connection of the packaged chillers will be the responsibility of STFC.

5.1 Services to be supplied by the Chiller Supplier

The services will be provided as required for the period 01/09/18 until 31/12/2020. Up to three chillers will be required. At each purchasing stage the following will be required.

a) Delivery to site (note- installation and connection of each chiller will be done by STFC).
b) Supply a single Chiller and supporting equipment.
c) Commissioning of the Chiller.
d) Supply of Material Certificates.
e) Maintain equipment and drawing schedules, plus provide weekly progress reports covering engineering and manufacturing status.
f) Maintenance of all QC records for Client review in particular pressure test certificates.
g) Documentation in accordance with Document Submission Schedule
h) Chiller manufacturer to provide a detailed description of the proposed training program to support a Customer training program.
i) Technical data, information and documentation.

5.2 Terminal Points

PIPEWORK CONNECTIONS

a) Inlet and outlet water connection flanges to be PN16.

6. MATERIAL SPECIFICATION

6.1 Where dissimilar metallic materials are used, e.g. Stainless Steel/ Carbon Steel Headers, the Supplier is to ensure insulated joints are provided at interfaces to ensure that there is no galvanic corrosion.

6.2 The water to be chilled will contain chemical inhibitors and 25% w/w Mono Propylene Glycol (MPG) as a circuit anti-freeze. All refrigeration circuit surfaces in contact with this grade of water will be compatible.

6.3 Each chiller inlet / outlet connecting flanges to be designed to BS EN 1092 PN 16. Backing rings for flanges to be either nylon coated or 'hot dipped' galvanised carbon steel.

7 DESIGN REQUIREMENTS

7.1 General Legal Design Requirements

a) All chillers to be defined as 'Process Chillers' for the purposes of complying with the EcoDesign Directive 2009/125/EC.
b) Each chiller will be classed using the latest Tier chiller under lot 21 of the EcoDesign Directive 2009/125/EC and will have a compliant Seasonal Energy Performance Ratio (SEPR).
c) The refrigerant will comply with BS EN 378-1: 2016 'Refrigerating systems and heat pumps. Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria'.
d) The refrigerant will have no UK / EU planned phase out imposed upon it.
e) The chiller unit will be CE marked as an assembly with a conformity certificate.

7.2 Mechanical Design Requirements

a) The Compressors to be Turbocor type.
b) The Compressors are to be fitted with manual-reset motor thermal protection.
c) The Compressors are to have a delivery check valve fitted
d) The Air cooled condenser must have a suitable corrosion prevention protective coating applied externally to the air coil fins.
e) The external enclosure/paneling is to be either made from aluminum or galvanized and painted with 2 pack epoxy paint system. The paneling/enclosure shall be designed to ensure ease of access to the internal components.
f) Delivery gas temperature control.
g) Drain down valves to be 1" NB Ball Valves complete with Locking Handles.
h) Dryer filter with replaceable cartridge.
i) Refrigerant line sight glass with humidity indicator.

7.3 Electrical, Control and Instrumentation (EC&I) Design Requirements

a) The chillers are to be supplied capable of communication via an RS485 port with a Programmable Logic Controller (PLC) running Modbus (note:- The PLC will be supplied by STFC). The chillers are to be supplied with control protocols to enable it to be controlled by an STFC supplied control system.
b) The chiller units to be supplied with an integral power meter with pulsed output for connection to the STFC BMS system. This is for measurement of electrical power consumption.

7.4 Mandatory Safety Design Requirements

a) The following are mandatory;
   (ii) Liquid line solenoid valve & shut-off valve,
   (iii) Externally equalized thermostatic valve or electronic thermostatic valve,
   (vi) High pressure safety valve and redundant equivalent valve,
   (vii) High and low pressure switches,
   (viii) High and low pressure gauges.
b) Fault Warning Protection system to Local Control Panel (supplied by STFC) and capability for fault signal to be retransmitted to RAL monitoring system.
c) Factory Run Test. The unit is to have a pressure test on each individual component (before assembly) and on the refrigerant circuit (when fully assembled). The unit is to be run tested prior to shipment. The function of the chiller and all controls are to be thoroughly checked.

7.5 Bid information

See Appendix C for a list of documentation to be submitted by the Supplier prior and after any contract award.

The following is a list of Mandatory information to be supplied with the bid as supporting evidence for compliance with the requirements of this specification;

a) Completed chiller data sheet (see Appendix C) – STFC needs this information to check conformance against length; width; weight and noise restrictions stated in Appendix A.
b) Overall and constituent part dimensions for each Chiller. This would be shown on a General Arrangement (GA) drawing
c) Quality Plan.

The following is a list of initial bid information required to facilitate STFC in understanding a bid proposal;

d) Design and manufacturing Programme – This will provide assurance that the Supplier can deliver a chiller within meet their claimed delivery period.
e) Technical description describing salient design and operational features of the Chiller.
f) Chiller Performance data – How the power consumption varies with cooling load etc.
g) Chiller Acoustic data – Sound pressure levels at range of frequencies etc.
h) Proposed schematic and wiring diagrams
i) Proposed customer connection drawing.
j) Details of any safety devices required to be installed by STFC for safe and optimal functioning of each chiller (e.g. low flow protection devices etc).

7.6 Access Facilities

ALL equipment, valves, instruments, tubes, motors, etc. that require Operation and Maintenance intervention, SHALL be accessible by operators and maintenance staff (without the need of cranes, scaffolding, etc.).

7.7 Additional requirements

a) The use of materials containing any form of asbestos is not permitted.
b) Cadmium plating is not permitted.
c) Drains shall be located at the lowest points in the system.

7.8 Acoustic Requirements

Each chiller will have a Sound Pressure Level to be 60 dBA or less measured at 10m as measured in conformance to ISO 9614.

8 QUALITY

The scope of supply covered by this specification shall be conducted to the intent of BS EN ISO 9001.

9 INSPECTION AND TEST

A full inspection and test plan for all equipment covered by this specification shall be submitted for approval. This shall include inspection and tests in accordance with the standards, codes and recognised industry practice in order to determine whether the materials and equipment comply with the specification.

10 DOCUMENTS AND DRAWINGS

All Suppliers drawings are to be produced using CAD in DWG or DXF format. A 3D model (compatible with either AutoCad 2018 or Plant 3D 2018) of the chiller is desirable with the tender document.

Drawings and documents will also be required in hard copy format A1/A3/A4 (A0 size is not acceptable), numbers of copies as detailed in the specification..

11 SUBMISSION OF DOCUMENTATION

Drawings and documentation shall be submitted to STFC in accordance with the requirements of the Document Submission Programme.

All documentation, including manuals, are required in electronic format (with permissions for use), in addition to the hard copies.

All documentation is to be in English.

The following procedures shall be submitted for approval prior to their implementation on the contract.

- NDT Procedures
- Hydraulic/Pressure Test Procedure

12 WARRANTY

Refer to UKSBS Commercial Conditions. Details of service contract cost and details of service provided to be included as an optional extra. Supplier is to advise if an extension to warranty is given with a service contract.

APPENDIX A - CODES, STANDARDS AND REGULATIONS

A1.0 Standards

The equipment shall be designed, constructed and tested in accordance with the current IEC and ISO and international recognized standards listed below. Alternative internationally recognized standards may be nominated by the subcontractor, subject to approval by STFC.

BS EN ISO 1461:1999	Hot Dip Galvanized Coatings
BS 7430:2011 2015	Code of Practice for Protective Earthing of Electrical Installations.
BS EN 1092-1	Flanges and their joints.
BS EN ISO 12944 parts 1 to 8	Paints and varnishes. Corrosion protection of steel structures by protective paint systems.
BS EN ISO 14713	Protection against corrosion of Iron and steel in structures: Zinc and aluminium coatings
ANSI B31.3	Piping Design Code (or appropriate British Standard)
BS EN 593	Industrial Valves, Metallic Butterfly Valves

Standards equivalent to those referred to may be substituted upon written agreement from STFC. Approval of equivalent standards will not absolve the subcontractor from compliance with the specific codes and standards applicable to materials offered.

The S.I. system for units of measurement shall be used with the exception of Pressure and Temperature, which shall be expressed in Bars and Degrees Celsius respectively.

A2.0 Regulations

The site is governed by all current EU and UK regulations. The subcontractor must take into account and comply with all local statutory regulations, health and safety regulations and any other standards and Codes of Practice relevant to the type of plant offered and the location of the site. These regulations include but are not limited to the following

The Ecodesign for Energy-Related Products Regulations.
Environmental Protection Act 1990.
Construction (Design and Management) Regulations 2015.
Electricity at Work Regulations 1989.
COSHH Regulations 2002.
The Control of Noise at Work Regulations 2005.
Supply of Machinery (Safety) Regulations 2008.
Electromagnetic Compatibility Regulations 2006.

APPENDIX B –

DATA SHEETS

Data Sheets are to be filled in and returned with the Supplier's tender

DS1 - Water Chiller Data Sheet
DS2 - Electrical Load Schedule

Site Environmental Condition

Site Location Chilton, Oxford

The site conditions to be applied to the design are defined below.

Altitude above sea level	120 m	
Relative humidity	Min	20 %
	Max	100%
	Design	65%
Ambient Temperature	Min	- 4^{o}C
	Max	35^{o}C
Seismic	Not applicable	
Snow Loading	Not Applicable	
Rainfall	100 mm/month	
Wind Loading	Refer to BS6399 Part 2	
Site Designation	Industrial Polluted	

UTILITY REQUIREMENTS

ELECTRICITY SUPPLY

AC Supply (3 Phase)		
Volts	V AC	400 ± 10%
Phase	ph	3 + E
Frequency	Hz	50
AC Supply (1 Phase)		
Volts	V AC	230 ± 10%
Phase	ph	1
Frequency	Hz	50

CONTROL & INSTRUMENTATION

Digital Signals (Wetting voltage by receiving device)	V DC	24
Analogue (2 wire loop powered @ 24 V by the receiving device)	mA	4 - 20

DESIGN DATA CHILLER

EVAPORATOR WATER FLOW RATE

25% Mono Propylene Glycol in water	(maximum)	74 m^3/h

CHILLED WATER CIRCUIT

Design	7°C
Supply	7°C
Return	12°C
Operating	7 ±0.5°C
Guaranteed maximum	7.5°C

TOTAL COOLING LOAD

350-400 kW

CHILLER ENCLOSURE RATING

Protection Requirement	IP55

CHILLER DESIGN CONSTRAINTS

The following Chiller Design constraints apply to this specification**;**

a) NOISE

Noise Level – not to exceed in any chiller orientation	60 dB(A) @ 10 m

b) CHILLER FOOT PRINT AND WEIGHT

Chiller length	4.6 m or less
Chiller width	2.3 m or less

The weight of the chiller shall not exceed 4.5 tonnes fully loaded with refrigerant.
The load for each chiller foot shall not exceed 0.30 kN/mm^2

STFC	RAL LABORATORIES	Data Sheet Nº DS1
CHILLER DATA SHEET	Contract / Project	
	Supplier	
	Date of Issue	

		Units	Design	Normal	Minimum
Performance					
Unit Model					
Quantity		Number	1		
Type /No of Compressor					
Cooling Capacity		kW			
Refrigerant Type					
Refrigerant Charge		kg			
Flow rate		kg/s			
Inlet Temp		^{O}C	12		
Discharge Temp		^{O}C	7		
Electrical					
Unit Voltage		V/Hz/Ph	380/50/3		
Total Compressor Power		kW			
Total Fan power		kW			
Full Load Amps		A			
General Data					
Weight (with refrigerant)		kg			
Length		m			
Width		m			
Height		m			
Noise		dBA			

STFC	RAL LABORATORIES	Data Sheet Nº DS2
LOAD SCHEDULE	Contract / Project	
	Supplier	
	Date of Issue	

DESCRIPTION	SUPPLIERS REFERENCE	RAL REFERENCE	RATING (kW)	VOLTS	PHASING	DUTY

APPENDIX C - DOCUMENTATION SUBMISSION PROGRAMME

Equipment: **Chilled Water System**
Project: **Air cooled Water Chillers for the R5.1 main chilled water circuit.**

Supplier:

Enquiry/Order No:

Order Date:

Delivery Period (wks):

Delivery Date(s):

The following General documents are to be supplied to STFC with the tender;

Item No	Description	Number Electronic	Number Prints
1.01	Statement of Compliance	-	2
1.02	Order Acceptance	-	1
1.03	Document Submission Schedule (referencing item numbers and supplier document titles and numbers)	-	1
1.04	Reference lists	-	1
1.05	Proposed General Arrangement Drawing	1	1
1.06	Technical Description	1	2
1.08	Chiller Performance Data (load variations)	1	2
1.09	Chiller Acoustic Data	1	4
1.07	Chiller Data sheet (see Appendix B)		
1.10	Load schedule (see Appendix B)	1	4
1.11	Quality Plan with Inspection and Test Notifications (I&TP)	1	2
1.12	Design and Manufacturing Programme	1	2
1.13	Proposed Wiring Diagrams and Schematics	1	1
1.14	Proposed Customer Connection Drawing	1	1

The following documentation is to be sent to STFC after each chiller manufacture but before despatch;

Item No	Description	Number Electronic	Number Prints
3.01	QA Release Certificate (for RAL signature to release shipment)	-	2
3.02	Quality Certification Data Pack, including Certificate of Conformance and Certificate of Incorporation for CE Mark	1	2
3.03	RAM (Reliability, Availability, Maintainability) report including supporting reliability data for constituent parts	1	2
3.04	Mechanical Terminal Point Schedule	1	4
3.05	Electrical Point Schedule	1	4
3.06	Electrical Load Schedule	1	4
3.07	Electrical Terminal Point Schedule	1	4
3.08	Modbus address list	1	2
3.09	Packing , Storage and Preservation Specification(s) and Procedure(s)	1	1
3.10	Special Tools Schedule	1	2
3.11	Recommended Operating Spares Schedule	1	2
3.12	Maintenance Schedule	1	2
3.13	Operations & Maintenance Manuals (See Note 'C')	1	4
3.14	COSHH Data	1	2
3.15	Commissioning procedures	1	1

The following documents are to be available upon request to STFC at the times specified;

Item No	Description	Number Electronic	Number Prints	When
4.01	Update & Progress Reports against the programme (showing progress every fortnight)	1	1	Project Duration
4.02	Functional/Test Procedure	1	1	Before Commissioing
4.03	Functional Test Report	1	1	After Test
4.04	Flushing Procedure	1	1	Before Flush
4.05	Hydraulic / Pressure Test Procedure	1	1	Before Test
4.06	Hydraulic / Pressure Test Report	1	1	After Test
4.07	Commissioning Records	1	1	After Commissioning
4.08	Revised General Arrangement Drawings	1	1	After Commissioning
4.09	Revised Wiring Diagrams and Schematics	1	1	After Commissioning
4.10	Revised Customer Connection Drawing	1	1	After Commissioning
4.11	Any other 'As Built' drawings	1	1	After Commissioning

Notes

(a) All documents are subject to formal review by STFC.

(b) All drawings shall have the customer's title block, duly completed, in the far bottom right corner of the drawing, and the STFC project title block directly above it. Supplier drawing numbers and other information shall be placed above these blocks.

(c) Initial (Draft) Issues of O&M (for comment) to be issued in English - 2 paper copies
An electronic copy of draft O&M is not required
Draft Copy Order + 4 weeks

Final Issue of O&M manuals to be in English 2 paper copies
2 N^{o} electronic copies of the final manual are required; in a format to be agreed with STFC
Final Copy Despatch +2 weeks

(d) Documents for information only

The Supplier shall submit a Document Submission Schedule (item 1.03 above), which shall list the item numbers on this form and the supplier's document titles and numbers corresponding to each item. Each item may represent one supplier document or a group of documents, and one supplier document may satisfy the requirements of several items listed above. The schedule shall also list the STFC Project Document Number for each supplier document; (These will be advised by STFC).

The Supplier hereby certifies that this information is correct and accepts that it will be used as a supply programme for any Purchase Order or Contract resulting from this enquiry.

Signed: **Date:**

For and on behalf of: