UK Research and Innovation

Communications and Power Industries LLC
150 Sohier Rd,

Beverly, MA 01915,

United States

Attn: [redacted]

By email to: [redacted]

Date: Tuesday, 20 February 2024

Your ref: QUO-03588-D3Q5X4

Our ref: UKRI-3669

Dear [redacted]

Award of contract for the supply of PIP-II High Power Couplers

Following your tender/ proposal for the supply of PIP-II High Power Couplers to UKRI, we are pleased to award this contract to you.

This letter ("**Award Letter**") and its Schedule(s) set out the terms of the Contract between:

(1) **United Kingdom Research and Innovation**, a statutory corporation whose registered office is at Polaris House, North Star Avenue, Swindon, England, SN2 1FL ("**UKRI**"); and

(2) **Communications and Power Industries LLC**, a company incorporated and registered in the United States of America whose registered office is at 150 Sohier Rd, Beverly, MA 01915, United States (the "**Supplier**").

Unless the context otherwise requires, capitalised expressions used in this Award Letter have the same meanings as in the terms and conditions of contract set out in Schedule 1 to this Award Letter (the "**Conditions**"). Please do not attach any Supplier terms and conditions to this Award Letter as they will not be accepted by UKRI and may delay conclusion of the Contract.

For the purposes of the Contract, UKRI and the Supplier agree as follows:

Term

1 Commencement Date: Wednesday 17th January 2024

2 Expiry Date: 01st January 2025

Description of Goods and/or Services

3 The Specification of the Goods and/or Services to be delivered is as set out in Schedule 2.

Charges & Payment

4 The Charges for the Goods and/or Services shall be as set out in Schedule 3.

5 All invoices should be sent, quoting a valid purchase order number (PO Number) provided by UKRI, to: finance@uksbs.co.uk

6 To avoid delay in payment it is important that the invoice is compliant and that it includes a valid PO Number, PO Number item number (if applicable) and the details (name and telephone number) of your UKRI contact (i.e. Contract Manager). Non-compliant invoices

will be sent back to you, which may lead to a delay in payment. If you have a query regarding an outstanding payment please contact our Accounts Payable section either by email to finance@uksbs.co.uk or by telephone 01793 867000 between 09:00-17:00 Monday to Friday.

Supplier's Liability

7 Pursuant to clause 20.4, the Supplier's Limit of Liability under this Contract shall be: 125% of the total Charges paid and payable to the Supplier under this Contract.

Insurances

8 The Supplier is required to maintain the insurance policies referred to in clause 19.1 of the Conditions

Notices

9 The address for notices of the Parties are:

UKRI	**Communication & Power Industries LLC** **Beverly Microwave Division**
Polaris House, North Star Avenue, Swindon, England, SN2 1FL Attention: Commercial Business Partner Email: commercial@ukri.org	150 Sohier Road, Bevely, MA 01915 FOIA Section 40 Personal Information

Liaison & Disputes

10 FOIA Section 40 Personal Information

11 Pursuant to Clause 32.3, Disputes shall be escalated to the following individuals:

FOIA Section 40 Personal Information

We thank you for your co-operation to date, and look forward to forging a successful working relationship resulting in a smooth and successful supply of the Goods and/or Services. Please confirm your acceptance of the award of this contract by signing and returning the enclosed copy of this letter to FOIA Section 40 Personal Informa at the above address. No other form of acknowledgement will be accepted. Please remember to quote the reference number above in any future communications relating to this contract.

Yours faithfully,

Signed for and on behalf of **United Kingdom Research and Innovation**

FOIA Section 40 Personal Information

Date:

21st February 2024

We accept the terms set out in this Award Letter and the Schedule(s).

Signed for and on behalf of **Communication & Power Industries LLC**

FOIA Section 40 Personal Information

Date:

February 20, 2024

Schedule 1 - The Conditions

1 INTERPRETATION

1.1 **Definitions.** In the Contract (as defined below), the following definitions apply:

Award Letter: means the letter from UKRI to the Supplier printed above these terms and conditions;

Change in Law: any change in Law which impacts on the performance of the Goods and/or Services which comes into force after the Commencement Date;

Charges: the charges payable by UKRI for the supply of the Goods and/or Services as specified in Schedule 3;

Commencement Date: means the date for the start of the Contract as set out in the Award Letter;

Confidential Information: means:

(a) all confidential information and data which is acquired from or made available (directly or indirectly) by the Disclosing Party or the Disclosing Party's representatives however conveyed or presented, including but not limited to any information or document relating to the Disclosing Party's business, affairs, operations, budgets, policies, processes, initiatives, plans, product information, pricing information, technical or commercial know-how, trade secrets, specifications, strategies, inventions, designs, software, market opportunities, personnel, customers or suppliers (whether relating to this Contract or otherwise) either orally, in writing, or in whatever form obtained or maintained;

(b) any information or analysis derived from the Confidential Information;

(c) anything marked as confidential and any other information notified by or on behalf of the Disclosing Party to the Receiving Party as being confidential;

(d) the existence and terms of this Contract and of any subsequent agreement entered into in relation to this Contract;

(e) the fact that discussions and negotiations are taking place concerning this Contract and the status of those discussions and negotiations; and

(f) any copy of any of the information described in (a), (b), (c), (d), or (e) above, which shall be deemed to become Confidential Information when it is made. For the

purposes of this definition, a copy shall include, without limitation, any notes or recordings of the information described in (a), (b), (c), (d), or (e) above (howsoever made);

but not including any information which:

(i) was in the possession of the Receiving Party without a breach of an obligation of confidentiality prior to its disclosure by the Disclosing Party;

(ii) the Receiving Party obtained on a non-confidential basis from a third party who is not, to the Receiving Party's knowledge or belief, bound by a confidentiality agreement with the Disclosing Party or otherwise prohibited from disclosing the information to the Receiving Party;

(iii) was already generally available and in the public domain at the time of disclosure otherwise than by a breach of this Contract or breach of a duty of confidentiality;

(iv) was independently developed without access to the Confidential Information; or

(v) relates to the Supplier's performance under this Contract or failure to pay any sub-contractor as required pursuant to clause 10.9;

Contract: means the contract between UKRI and the Supplier constituted by the Supplier's countersignature of the Award Letter and includes the Award Letter and Schedules;

Data Protection Impact Assessment: an assessment by UKRI of the impact of the envisaged Processing on the protection of Personal Data;

Data Protection Legislation: means, for the periods in which they are in force, all laws giving effect or purporting to give effect to the GDPR, the Data Protection Act 2018, or otherwise relating to Data Protection, including the Regulation of Investigatory Powers Act 2000, the Telecommunications (Lawful Business Practice) (Interception of Communications) Regulations 2000 (SI 2000/2699), the Electronic Communications Data Protection Directive (2002/58/EC), the Privacy and Electronic Communications (EC Directive) Regulations 2003 (SI 2426/2003), the GDPR and all applicable laws and regulations relating to the processing of personal data and privacy, including where applicable the guidance and codes of practice issued by the Information Commissioner, in each case as amended or substituted from time to time;

Data Subject Access Request: a request made by, or on behalf of, a Data Subject in accordance with rights granted pursuant to the Data Protection Legislation to access their Personal Data;

Declaration of Ineffectiveness: a declaration made by a Court under regulation 98 which has any of the consequences described in regulation 101 of the Public Contracts Regulations 2015 (as amended) or which is made under an equivalent provision implementing Directive 2014/23/EU in England, Wales & Northern Ireland and which has consequences which are similar to any of the consequences described in regulation 101 of the Public Contracts Regulations 2015 (as amended);

Deliver: means hand over of the Goods to UKRI at the address(es) specified in the Specification (or otherwise agreed in writing by the Parties) and on the Delivery Date, which shall include unloading and any other specific arrangement agreed in accordance with clause 6. “Delivered”, “Delivery” and “Deliveries” shall be construed accordingly;

Deliverables: all Documents, products and materials developed by the Supplier or its agents, contractors and employees as part of, or in relation to, the Services in any form, including computer programs, data, reports and specifications (including drafts);

Delivery Date: the date for delivery of the Goods specified by UKRI in writing and if no such date is specified, within 28 days of the date of UKRI’s written request;

Delivery Note: means a note produced by the Supplier accompanying each delivery of the Goods which shows the date of the order, the order number (if any), the type and quantity of the Goods (including the code number of the Goods, where applicable), special storage instructions (if any) and, if the Goods are being delivered by instalments, the outstanding balance of Goods remaining to be delivered;

Disclosing Party: means a Party that makes a disclosure of Confidential Information to another Party;

Dispute: means any dispute, conflict or disagreement arising out of or in connection with this Contract;

Document: includes, in addition to any document in writing, any drawing, map, plan, diagram, design, picture or other image, tape, disk or other device or record embodying information in any form.

EIR: the Environmental Information Regulations 2004 (or if applicable the Environmental Information Regulations (Scotland) 2004) together with any guidance and/or codes of practice issued by the Information Commissioner or relevant government department in relation to such regulations;

EU GDPR: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) as it has effect in EU law;

Expiry Date: means the date for expiry of the Contract as set out in the Award Letter;

FOIA: the Freedom of Information Act 2000 (or if applicable the Freedom of Information (Scotland) Act 2002) and any subordinate legislation made under the Act from time to time, together with any guidance and/or codes of practice issued by the Information Commissioner or relevant government department in relation to such legislation;

Force Majeure Event: shall be limited to one or more of the following events: hurricanes, tempest, acts of state or public enemy, wars, revolutions, uprisings, hostilities, civil disturbances, riots, civil war, insurrection and invasion. For the avoidance of doubt, strikes, lockouts and shutdowns of a Party (or of any person engaged by any of them) shall not be a force majeure event for that Party;

Good Industry Practice: standards, practices, methods and procedures conforming to the Law and the exercise of the degree of skill and care, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced person or body engaged within the relevant industry or business sector;

General Change in Law: a Change in Law where the change is of a general legislative nature (including taxation or duties of any sort affecting the Supplier) or which affects or relates to the supply of goods and/or services to another customer of the Supplier that are the same or similar to any of the Goods and/or Services;

Goods: means the goods to be supplied by the Supplier to UKRI, under the Contract as set out in the Specification;

Information: has the meaning given under section 84 of FOIA;

Intellectual Property Rights: all patents, rights to inventions, utility models, copyright and related rights (including moral rights), trademarks, service marks, trade, business and domain names, rights in trade dress or get-up, rights in goodwill or to sue for passing off,

unfair competition rights, rights in designs, rights in computer software, database right, topography rights, rights in confidential information (including know-how and trade secrets) and any other intellectual property rights, in each case whether registered or unregistered and including all applications for and renewals or extensions of such rights, and all similar or equivalent rights or forms of protection in any part of the world;

Key Personnel: means any persons specified as such in Schedule 4 or otherwise notified as such by UKRI to the Supplier in writing;

Law: means any law, statute, subordinate legislation within the meaning of section 21(1) of the Interpretation Act 1978, bye-law, enforceable right within the meaning of section 2 of the European Communities Act 1972 and section 4 of the European Union (Withdrawal Act 2018, regulation, order, mandatory guidance or code of practice, judgment of a relevant court of law, or directives or requirements of any regulatory body, with which UKRI and the Supplier (as the context requires) is bound to comply. With respect to Environmental and Employment Law, the relevant Federal, State and/or Local Law where the Goods are produced shall prevail;

Limit of Liability: means the Supplier's limit of liability identified in the Award Letter;

Notifiable Breach: has the meaning set out at clause 8.3;

Party: the Supplier or UKRI (as appropriate) and "Parties" shall mean both of them;

Personal Data: has the meaning given to this term by the Data Protection Legislation;

Personal Data Breach: shall have the same meaning as in the Data Protection Legislation;

PO Number: means UKRI's unique number relating to the supply of the Goods and/or Services;

Protective Measures: technical and organisational measures which must take account of:

(a) the nature of the data to be protected

(b) harm that might result from Data Loss Event;

(c) state of technological development

(d) the cost of implementing any measures

including pseudonymising and encrypting Personal Data, ensuring confidentiality, integrity, availability and resilience of systems and services, ensuring that availability of and access

to Personal Data can be restored in a timely manner after an incident, and regularly assessing and evaluating the effectiveness of the such measures adopted by it;

Public Body: any part of the government of the United Kingdom including but not limited to the Northern Ireland Assembly and Executive Committee, the Scottish Executive and the National Assembly for Wales, local authorities, government ministers and government departments and government agencies;

Public Procurement Termination Event: UKRI exercises its right to terminate the Contract in one or more of the circumstances described in either regulation 73(1) of the Public Contracts Regulations 2015 (as amended from time to time), or equivalent provisions implementing Directive 2014/23/EU in England, Wales & Northern Ireland (as amended from time to time);

Receiving Party: means a Party to which a disclosure of Confidential Information is made by another Party;

Remediation Plan: means a report identifying:

(a) the nature of the Notifiable Breach described at clause 8.3, its cause and its anticipated duration and impact on the Contract; and

(b) the procedures and resources the Supplier proposes to apply to overcome and rectify the Notifiable Breach and to ensure the impact of the Notifiable Breach is minimised and future performance of the Contract is not adversely affected;

Request for Information: a request for Information or an apparent request under FOIA or EIR;

Services: the services, including without limitation any Deliverables, to be provided by the Supplier to UKRI under the Contract as set out in the Specification;

SME: as defined by EU recommendation 2003/361/EC;

Specification: the description of the Goods and / or Services to be provided under this Contract as set out in Schedule 2;

Subcontractor/Sub-contractor: means any vendor or subcontractor to the Supplier that is integral to the performance of the Contract and provides a significant level of effort in producing the Goods to be delivered under this Contract.

Specific Change in Law: a Change in Law that relates specifically to the business of UKRI and which would not affect the supply of goods and/or services to another customer of the Supplier that are the same or similar to any of the Goods and/or Services;

Supplier's Associate: any individual or entity associated with the Supplier including, without limitation, the Supplier's subsidiary, affiliated or holding companies and any employees, agents or contractors of the Supplier and / or its subsidiary, affiliated or holding companies or any entity that provides Goods and or Services for or on behalf of the Supplier;

Supplier Dispute: means any disputes, claims, litigation, mediation or arbitration whether threatened or pending in relation to any incident involving the Supplier's, or another party's, provision of the Goods and/or Services;

Staff: means all directors, officers, employees, agents, consultants and contractors of the Supplier and/or of any sub-contractor of the Supplier engaged in the performance of the Supplier's obligations under the Contract;

Staff Vetting Procedures: means vetting procedures that accord with good industry practice or, where requested by UKRI, UKRI's procedures for the vetting of personnel as provided to the Supplier from time to time;

Term: means the period from the Commencement Date to the Expiry Date as such period may be extended or terminated in accordance with the terms and conditions of the Contract;

TUPE: the Transfer of Undertakings (Protection of Employment) Regulations 2006 as amended or replaced from time to time;

UK GDPR: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (United Kingdom General Data Protection Regulation), as it forms part of the law of England and Wales, Scotland and Northern Ireland by virtue of section 3 of the European Union (Withdrawal) Act 2018, together with the Data Protection, Privacy and Electronic Communications (Amendments etc.) (EU Exit) Regulations 2019

Working Day: a day (other than a Saturday, Sunday, public holiday or 27, 28, 29, 30 and 31 December) when banks in London are open for business.

1.2 In this Contract, unless the context requires otherwise, the following rules apply:

(a) A person includes a natural person, corporate or unincorporated body (whether or not having separate legal personality).

(b) A reference to a party includes its personal representatives, successors or permitted assigns.

(c) A reference to any Law is a reference to Law as amended or re-enacted. A reference to a Law includes any subordinate legislation made under that Law, as amended or re-enacted.

(d) Any phrase introduced by the terms including, include, in particular or any similar expression shall be construed as illustrative and shall not limit the sense of the words preceding those terms.

(e) The headings in the Contract are for ease of reference only and do not affect the interpretation or construction of the Contract.

(f) A reference to writing or written includes e-mails.

(g) A reference to numbered clauses are references to the relevant clause in this Contract.

(h) Any obligation on any Party not to do or omit to do anything shall include an obligation not to allow that thing to be done or omitted to be done.

2 BASIS OF CONTRACT

2.1 The Contract comprises of the Award Letter and its Schedules, to the exclusion of all other terms and conditions, including any other terms that the Supplier seeks to impose or incorporate (whether in any quotation, confirmation of order, invoice, in correspondence or in any other context), or which are implied by trade, custom, practice or course of dealing.

2.2 If there is any conflict or inconsistency between the Award Letter and its Schedules, the provisions of the Award Letter will prevail followed by the Conditions in this Schedule 1 to the extent necessary to resolve that conflict or inconsistency. Schedule 2 shall take precedence over Schedule 5 Suppliers response.

3 TERM

3.1 This Contract shall take effect on the Commencement Date and shall expire on the Expiry Date, unless it is otherwise extended or terminated in accordance with the terms and conditions of this Contract.

4 SUPPLY OF SERVICES

4.1 In consideration of UKRI's agreement to pay the Charges, the Supplier shall for the Term provide the Services to UKRI in accordance with the terms of this Contract.

4.2 The Supplier shall meet any performance dates for the Services (including the delivery of Deliverables) specified in the Specification or notified to the Supplier by UKRI.

4.3 In providing the Services, the Supplier shall:

(a) co-operate with UKRI in all matters relating to the Services, and comply with all instructions of UKRI using reasonable endeavours to promote UKRI's interests;

(b) perform the Services with reasonable skill, care and diligence in accordance with Good Industry Practice in the Supplier's industry, profession or trade;

(c) use Staff who are suitably skilled and experienced to perform tasks assigned to them, and in sufficient number to ensure that the Supplier's obligations are fulfilled in accordance with this Contract;

(d) ensure that the Services and Deliverables will conform with the Specifications and that the Deliverables shall be fit for any purpose expressly or impliedly made known to the Supplier by UKRI;

(e) provide all equipment, tools and vehicles and such other items as are required to provide the Services;

(f) use goods, materials, standards and techniques, and ensure that the Deliverables, and all goods and materials supplied and used in the Services or transferred to UKRI are of a quality in line with Good Industry Practice and are free from defects in workmanship, installation and design;

(g) obtain and at all times maintain all necessary licences and consents, and comply with all applicable laws and regulations;

(h) not do or allow anything to be done that would, or would be likely to, bring UKRI into disrepute or adversely affect its reputation in any way;

(i) observe all health and safety rules and regulations and any other security requirements that apply at any of UKRI's premises; and

(j) not do or omit to do anything which may cause UKRI to lose any licence, authority, consent or permission on which it relies for the purposes of conducting its business, and the Supplier acknowledges that UKRI may rely or act on the Services.

4.4 UKRI's rights under this Contract are without prejudice to and in addition to the statutory terms implied in favour of UKRI under the Supply of Goods and Services Act 1982 and any other applicable legislation as amended.

5 SUPPLY OF GOODS

5.1 In consideration of UKRI's agreement to pay the Charges, the Supplier shall supply all Goods in accordance with the Contract. In particular, the Supplier warrants that the Goods shall:

(a) conform with their description in the specifications (including the Specification), drawings, descriptions given in quotations, estimates, brochures, sales, marketing and technical literature or material (in whatever format made available by the Supplier) supplied by, or on behalf of, the Supplier;

(b) be of satisfactory quality (within the meaning of the Sale of Goods Act 1979) and fit for any purpose held out by the Supplier or made known to the Supplier by UKRI, expressly or by implication, and in this respect UKRI relies on the Supplier's skill and judgement. The Supplier acknowledges and agrees that the approval by UKRI shall not relieve the Supplier of any of its obligations under this sub-clause;

(c) where applicable, be free from defects (manifest or latent), in materials and workmanship and remain so for 12 months after Delivery;

(d) be free from design defects;

(e) comply with all applicable statutory and regulatory requirements relating to the manufacture, labelling, packaging, storage, handling and delivery of the Goods;

(f) be supplied in accordance with all applicable legislation in force from time to time; and

(g) be destined for supply into, and fully compliant for use in, the United Kingdom (unless specifically stated otherwise in the Specification).

5.2 In supplying the Goods, the Supplier shall co-operate with UKRI in all matters relating to the supply of the Goods and comply with all of UKRI's instructions.

5.3 The Supplier shall ensure that at all times it has and maintains all the licences, permissions, authorisations, consents and permits that it needs to carry out its obligations under the Contract.

5.4 UKRI and its representatives shall have the right to inspect and test the Goods at any time before Delivery.

5.5 If following such inspection or testing UKRI considers that the Goods do not conform or are unlikely to comply with the Supplier's undertakings at clause 5.1, UKRI shall inform the Supplier and the Supplier shall immediately take such remedial action as is necessary to ensure compliance.

5.6 Notwithstanding any such inspection or testing, the Supplier shall remain fully responsible for the Goods and any such inspection or testing shall not reduce or otherwise affect the Supplier's obligations under this Contract, and UKRI shall have the right to conduct further inspections and tests after the Supplier has carried out its remedial actions.

5.7 UKRI's rights under the Contract are without prejudice to and in addition to the statutory terms implied in favour of UKRI under the Sale of Goods Act 1979, the Supply of Goods and Services Act 1982 and any other applicable legislation as amended.

6 DELIVERY

6.1 Unless otherwise agreed in writing by UKRI, the Supplier shall Deliver the Goods to UKRI on the Delivery Date (with the carriage paid) to the address(es) specified in the Specification and in accordance with any other Delivery instructions provided to the Supplier.

6.2 Delivery of the Goods shall be completed once the completion of unloading the Goods from the transporting vehicle at the Delivery address has taken place (as well as any other specific arrangement agreed by the Parties has taken place) and Fermilab has signed for the Delivery. The Supplier will unload the Goods at its own risk as directed by Fermilab. The Goods will remain at the risk of the Supplier until Delivery to Fermilab (including unloading)

is complete and the Supplier has obtained sign-off of the Delivery Note by or on behalf of UKRI.

6.3 Unless otherwise stipulated by UKRI in writing to the Supplier, Deliveries shall only be accepted by Fermilab on Working Days and during normal business hours.

6.4 The Supplier shall ensure that:

(a) the Goods are properly packed and secured in such manner as to enable them to reach their destination in good condition:

(b) each delivery of the Goods is accompanied by a Delivery Note; and

(c) if the Supplier requires UKRI or Fermilab to return any packaging material to the Supplier, that fact is clearly stated on the Delivery Note. Any such packaging material shall be returned to the Supplier at the Supplier's cost.

6.5 If the Supplier delivers to UKRI or Fermilab more than the quantity of Goods ordered, UKRI and Fermilab will not be bound to pay for the excess and any excess will remain at the Supplier's risk and will be returnable to the Supplier at the Supplier's expense.

6.6 If the Supplier delivers less than the quantity of Goods ordered, and UKRI and fermilab accepts the delivery, a pro rata adjustment shall be made to the invoice for the Goods.

6.7 Where it is agreed that the Goods are to be delivered in instalments, they may be invoiced and paid for separately.

6.8 Without prejudice to UKRI's statutory rights, UKRI and Fermilab will not be deemed to have accepted any Goods until it has had 14 Working Days after Delivery to inspect them and UKRI and Fermilab also has the right to reject any Goods as though they had not been accepted for 14 Working Days after any latent defect in the Goods has become apparent within 1 year of delivery of the Goods to UKRI or Fermilab.

6.9 Without prejudice to clause 13.1, any access to UKRI's premises and any labour and equipment that may be provided by UKRI in connection with Delivery of the Goods shall be provided without acceptance by UKRI of any liability in respect of any actions, claims, costs and expenses incurred by third parties for any loss or damages to the extent that such loss or damage is not attributable to the negligence or other wrongful act of UKRI, its servant or agent. The Supplier shall indemnify UKRI in respect of any actions, suits, claims, demands, losses, charges, costs and expenses, which UKRI may suffer or incur as a result of or in connection with any damage or injury (whether fatal or otherwise) occurring in the course of

Delivery to the extent that any such damage or injury is attributable to any act or omission of the Supplier or the Staff.

7 TITLE, RISK AND USE

7.1 Without prejudice to any other rights of UKRI, title and risk in the Goods shall pass to UKRI on completion of Delivery.

7.2 The Supplier warrants that:

(a) it has full clear and unencumbered title to the Goods;

(b) at the Delivery Date of any of the Goods it shall have full have unrestricted right, power and authority to sell, transfer and deliver all of the Goods to UKRI; and

(c) on Delivery, UKRI shall acquire a valid and unencumbered title to the Goods.

8 REMEDIES

8.1 UKRI's rights and remedies under the Contract are in addition to its rights and remedies implied by statute and common law.

8.2 Where (i) the Supplier fails to Deliver the Goods or part of the Goods including any instalment(s) or (ii) the Goods or part of the Goods do not comply with the provisions of clause 5 then without limiting any of its other rights or remedies in this Contract or implied by statute or common law, UKRI shall be entitled to:

(a) terminate the Contract in whole or in part without liability to the Supplier;

(b) accept late delivery of the Goods;

(c) require the Supplier, free of charge, to repair or replace the rejected Goods, or to provide a full refund of the price of the rejected Goods (if paid);

(d) reject the Goods (in whole or part) and return them to the Supplier at the Supplier's own risk and expense and UKRI shall be entitled to a full refund on those Goods or part of Goods duly returned;

(e) buy the same or similar goods from another supplier; and

8.3 Without prejudice to any of its other rights or remedies in this Contract or implied by statute or common law, in the event that:

(a) UKRI considers the Supplier is in breach of, or is likely to breach, clause 4.2 and the breach is capable of remedy; or

(b) the Supplier commits a breach of clause 4.3 which is capable of remedy,

(each a "**Notifiable Breach**"), the Supplier must as soon as practicable but in any event within 15 Working Days (or as otherwise agreed by UKRI) of being notified by UKRI of the Notifiable Breach, submit a draft Remediation Plan to UKRI for approval. UKRI may, acting reasonably, consider the draft Remediation Plan as inadequate to rectify the Notifiable Breach and reject the draft, in which case the Supplier shall submit a revised Remediation Plan to UKRI for review within 10 Working Days (or as otherwise agreed by UKRI) of UKRI's notice rejecting the draft. Once the Remediation Plan is approved, the Supplier shall immediately start work on the actions set out in the approved Remediation Plan.

8.4 Where the Supplier fails to provide a Remediation Plan in accordance with the timescales specified in clause 8.3 or fails to comply with any approved Rectification Plan, UKRI shall be entitled to:

(a) terminate the Contract with immediate effect by giving written notice to the Supplier;

(b) recover from the Supplier any costs incurred by UKRI in performing the Services itself or obtaining substitute services from a third party, Limited to the cost of goods to be provided;

(c) a refund of the Charges paid in advance for Services that have not been provided by the Supplier; and

(d) claim damages for any additional costs, loss or expenses incurred by UKRI which are in any way attributable to the Notifiable Breach and the Supplier's failure as described in this clause 8.4. Limited to the cost of goods to be provided.

8.5 This Contract shall apply to any repaired or replacement Goods and any substituted or remedial Services provided by the Supplier.

9 UKRI OBLIGATIONS

9.1 UKRI shall:

(a) provide the Supplier with reasonable access at reasonable times to UKRI's premises for the purpose of providing the Goods and/or Services; and

(b) provide such information to the Supplier as the Supplier may reasonably request and UKRI considers reasonably necessary for the purpose of providing the Goods and/or Services.

10 CHARGES AND PAYMENT

10.1 The Charges for the Goods and/or Services are set out in Schedule 3, and shall be the full and exclusive remuneration of the Supplier in respect of the supply of the Goods and/or Services. Unless otherwise agreed in writing by UKRI, the Charges shall include every cost and expense of the Supplier directly or indirectly incurred in connection with the provision of the Goods and/or performance of the Services.

10.2 All amounts stated are exclusive of VAT which shall be charged at the prevailing rate where applicable. UKRI shall, where applicable and following the receipt of a valid VAT invoice, pay to the Supplier a sum equal to the VAT chargeable in respect of the Goods and/or Services.

10.3 The Supplier shall invoice UKRI at the times specified in Schedule 3 and in accordance with this clause 10. If an invoicing schedule is not specified in Schedule 3, the Supplier shall invoice UKRI on or after the Delivery of the Goods or completion of the Services.

10.4 Each invoice shall include such supporting information required by UKRI to verify the accuracy of the invoice, including the relevant PO Number and a breakdown of the Goods and/or Services supplied in the invoice period as well as appropriate details in order to allow for payment via BACS transfer (sort code and bank account details).

10.5 In consideration of the supply of the Goods and/or Services by the Supplier, UKRI shall pay the invoiced amounts within 30 days of the date of a correctly rendered invoice after verifying that the invoice is valid and undisputed. Payment shall be made to the bank account nominated in writing by the Supplier unless UKRI agrees in writing to another payment method.

10.6 If UKRI fails to consider and verify an invoice in a timely fashion the invoice shall be regarded as valid and undisputed for the purpose of clause 10.5 after a reasonable time has passed (which shall be no less than 14 calendar days).

10.7 If there is a dispute between the Parties as to the amount invoiced, UKRI may reject the invoice in its entirety. The Supplier shall not suspend the supply of the Goods and/or Services unless the Supplier is entitled to terminate this Contract for a failure to pay

undisputed invoice in accordance with clause 21.5. Any disputed invoices shall be resolved through the dispute resolution procedure detailed in Clause 32.

10.8 If a payment of an undisputed invoice is not made by UKRI by the due date, then UKRI shall pay the Supplier interest at the interest rate specified in the Late Payment of Commercial Debts (Interest) Act 1998, accruing on a daily basis from the due date up to the date of actual payment, whether before or after judgment.

10.9 Where the Supplier enters into a sub-contract, the Supplier shall include in that sub-contract:

(a) provisions having the same effects as clauses 10.3 to 10.8 of this Contract; and

(b) a provision requiring the counterparty to that sub-contract to include in any sub-contract which it awards provisions having the same effect as 10.3 to 10.9 of this Contract.

(c) In this clause 10.9, "sub-contract" means a contract between two or more suppliers, at any stage of remoteness from UKRI in a subcontracting chain, made wholly or substantially for the purpose of performing (or contributing to the performance of) the whole or any part of this Contract.

10.10 The Supplier shall not be entitled to assert any credit, set-off or counterclaim against UKRI in order to justify withholding payment of any such amount in whole or in part. If any sum of money is recoverable from or payable by the Supplier under the Contract (including any sum which the Supplier is liable to pay to UKRI in respect of any breach of the Contract), that sum may be deducted unilaterally by UKRI from any sum then due, or which may come due, to the Supplier under the Contract or under any other agreement or contract with UKRI.

11 TAXATION OBLIGATIONS OF THE SUPPLIER

11.1 The Supplier shall be fully responsible for all its own tax including any national insurance contributions arising from supplying the Goods and/or Services.

11.2 The Supplier shall indemnify, and shall keep indemnified, UKRI in full against all costs, claims, expenses, damages and losses, including any interest, penalties, fines, legal and other professional fees and expenses awarded against or incurred or paid by UKRI as a result of the Supplier's failure to account for or pay any taxes including any national insurance contributions.

12 UKRI PROPERTY

12.1 The Supplier acknowledges that all information (including UKRI's Confidential Information), equipment and tools, drawings, specifications, data, software and any other materials supplied by UKRI (or its agents on behalf of UKRI) to the Supplier ("UKRI's Materials") and all rights in UKRI's Materials are and shall remain at all times the exclusive property of UKRI. The Supplier shall keep UKRI's Materials in safe custody at its own risk, maintain them in good condition until returned to UKRI, and not dispose or use the same other than for the sole purpose of performing the Supplier's obligations under the Contract and in accordance with written instructions or authorisation from UKRI.

12.2 UKRI's Materials shall be returned promptly to UKRI on expiry or termination of the Contract.

12.3 The Supplier shall reimburse UKRI for any loss or damage to UKRI's Materials (other than deterioration resulting from normal and proper use) caused by the Supplier or any Staff. UKRI's Materials supplied by UKRI (or its agents on behalf of UKRI) shall be deemed to be in a good condition when received by the Supplier or relevant Staff unless UKRI is notified otherwise in writing within 10 Working Days.

13 PREMISES

13.1 If, in connection with the supply of the Goods and/or Services, UKRI permits any Staff to have access to any of UKRI's premises, the Supplier will ensure that, whilst on UKRI's premises, the Staff comply with:

(a) all applicable health and safety, security, environmental and other legislation which may be in force from time to time; and

(b) any UKRI policy, regulation, code of practice or instruction relating to health and safety, security, the environment or access to and use of any UKRI laboratory, facility or equipment which is brought to their attention or given to them whilst they are on UKRI's premises by any employee or representative of UKRI.

13.2 All equipment, tools and vehicles brought onto UKRI's premises by the Supplier or the Staff shall be at the Supplier's risk.

13.3 If the Supplier supplies all or any of the Goods and/or Services at or from UKRI's premises, on completion of the Goods and/or Services or termination or expiry of the Contract (whichever is the earlier) the Supplier shall vacate UKRI's premises, remove the Supplier's plant, equipment and unused materials and all rubbish arising out of the provision of the

Goods and/or Services and leave UKRI's premises in a clean, safe and tidy condition. The Supplier shall be solely responsible for making good any damage to UKRI's premises or any objects contained on UKRI's premises which is caused by the Supplier or any Staff, other than fair wear and tear.

13.4 If the Supplier supplies all or any of the Goods and/or Services at or from its premises or the premises of a third party, UKRI may, during normal business hours and on reasonable notice, inspect and examine the manner in which the relevant Goods and/or Services are supplied at or from the relevant premises.

14 STAFF AND KEY PERSONNEL

14.1 If UKRI believes that any of the Staff are unsuitable to undertake work in respect of the Contract, it may, by giving written notice to the Supplier:

(a) refuse admission to the relevant person(s) to UKRI's premises;

(b) direct the Supplier to end the involvement in the provision of the Goods and/or Services of the relevant person(s); and/or

(c) require that the Supplier replace any person removed under this clause with another suitably qualified person and procure that any security pass issued by UKRI to the person removed is surrendered,

and the Supplier shall comply with any such notice.

14.2 The Supplier shall:

(a) ensure that all Staff are vetted in accordance with the Staff Vetting Procedures;

(b) ensure that no person who discloses that he/she has a conviction that is relevant to the nature of the Contract, relevant to the work of UKRI, or is of a type otherwise advised by UKRI (each such conviction a "**Relevant Conviction**"), or is found by the Supplier to have a Relevant Conviction (whether as a result of a police check, the Staff Vetting Procedures or otherwise) is employed or engaged in the provision of any part of the supply of the Goods and/or Services;

(c) if requested, provide UKRI with a list of names and addresses (and any other relevant information) of all persons who may require admission to UKRI's premises in connection with the Contract; and

(d) procure that all Staff comply with any rules, regulations and requirements reasonably specified by UKRI.

15 TUPE

15.1 The Supplier warrants that the provision of the Goods and/or Services shall not give rise to a transfer of any employees of the Supplier or any third party to UKRI pursuant to TUPE.

16 ASSIGNMENT AND SUB-CONTRACTING

16.1 The Supplier shall provide UKRI written notice prior to assigning, sub-contracting, novating or in any way disposing of the benefit and/or the burden of the Contract or any part of the Contract. UKRI may, upon notification, request for additional terms and conditions relating to such assignment, sub-contract, novation or disposal. The Supplier shall be responsible for the acts and omissions of its sub-contractors as though those acts and omissions were its own.

16.2 Where UKRI has consented to the placing of sub-contracts, the Supplier shall, at the request of UKRI, send copies of each sub-contract, to UKRI as soon as is reasonably practicable.

16.3 UKRI may (without any cost to or liability of UKRI) require the Supplier to replace any subcontractor where in the reasonable opinion of UKRI any mandatory or discretionary grounds for exclusion referred to in Regulation 57 of the Public Contracts Regulations 2015 (as amended) apply to the subcontractors.

16.4 UKRI may assign, novate, or otherwise dispose of its rights and obligations under the Contract without the consent of the Supplier provided that such assignment, novation or disposal shall not increase the burden of the Supplier's obligations under the Contract.

17 INTELLECTUAL PROPERTY RIGHTS

17.1 All Intellectual Property Rights in any materials created, developed, or provided by the Supplier pursuant to this Contract or arising as a result of the supply of the Goods and/or Services, including the Deliverables, shall remain the property of the Supplier or as the case may be Fermilab.

17.2 The Supplier warrants that it has all rights and privileges to or has been granted rights and privileges to the Intellectual Property as it pertains to the Deliverables under this Contract.

17.3

17.4 All Intellectual Property Rights in any materials provided by UKRI to the Supplier shall remain the property of UKRI. UKRI hereby grants the Supplier a royalty-free, non-exclusive and non-transferable licence to use:

(a) any Intellectual Property Rights in the materials provided by UKRI to the Supplier;

(b) any Intellectual Property Rights in the materials created or developed by the Supplier pursuant to this Contract and any Intellectual Property Rights arising as a result of the provision of the Goods and/or Services,

as required until termination or expiry of this Contract for the sole purpose of enabling the Supplier to perform its obligations under the Contract.

17.5 The Supplier hereby grants UKRI a royalty-free, irrevocable and non-exclusive licence to use:

(a) any Intellectual Property Rights provided under this Contract for the sole purpose of UKRI's performance of its obligations under this Contract as required until termination or expiry of this Contract.

(b)

18 INDEMNITY

18.1 The Supplier shall indemnify, and shall keep indemnified, UKRI in full against all costs, claims, expenses, damages and losses (whether direct or indirect to include loss of profits, loss of business, depletion of good will and similar losses), including any interest, penalties, fines, legal and other professional fees and expenses awarded against or incurred or paid by UKRI as a result of or in connection with:

(a) the Supplier's breach or negligent performance or non-performance of this Contract;

(b) any claim brought against UKRI for actual or alleged infringement of a third party's Intellectual Property Rights arising out of, or in connection with, the manufacture, receipt, use or supply of the Goods and/or Services, to the extent that the claim is attributable to the acts or omissions of the Supplier or any Staff;

(c) any claim made against UKRI by a third party for death, personal injury or damage to property arising out of, or in connection with, defects in Goods and/or Services, to the extent that the defect in the Goods and/or Services is attributable to the acts or omissions of the Supplier and the Staff; and

(d) any claim whether in tort, contract, statutory or otherwise, demands, actions, proceedings and any awards arising from a breach by the Supplier of clause 15 of the Contract.

18.2 This clause 18 shall survive termination or expiry of the Contract.

19 INSURANCE

19.1 Unless otherwise specified in the Award Letter, during the Term of the Contract and for a period of 6 years thereafter, the Supplier shall maintain in force the following insurance policies with reputable insurance companies to insure the Supplier against all manner of risks that might arise out of the acts or omissions of the Supplier or otherwise in connection with the Supplier's performance of its obligations under this Contract. In cases where individual policy limits are not sufficient, the Supplier's Umbrella Liability policy will be deemed adequate coverage.

(a) Professional indemnity insurance for not less than $1 million per claim;

(b) loss, damage or destruction of any of UKRI's property under the custody and control of the Supplier, with a minimum sum insured of $1 million per claim;

(c) public liability insurance for not less than $1 million per claim;

(d) employer liability insurance for not less than £5 million per claim; and

(e) product liability insurance for not less than $1 million for claims arising from any single event.

19.2 On request from UKRI, the Supplier shall provide UKRI with copies of the insurance policy certificates and details of the cover provided.

19.3 From the Commencement Date, the Supplier shall notify UKRI in writing of any employer's liability or public liability incident arising out of or in connection with this Contract which:

(a)

(b) irrespective of the claim's value, which may reasonably be considered to have the potential to adversely affect the reputation of UKRI,

within five (5) days of such an incident occurring.

19.4 The Supplier shall keep UKRI informed and up-to-date on the progress of any incident referred to in clause 19.3 and related claims, decisions taken in respect of liability and any movement of reserves with respect thereto.

19.5 The Supplier shall ensure that any subcontractors also maintain adequate insurance having regard to the obligations under the Contract which they are contracted to fulfil.

19.6 The Supplier shall:

(a) do nothing to invalidate any insurance policy or to prejudice UKRI's entitlement under it; and

(b) notify UKRI if any policy is (or will be) cancelled or its terms are (or will be) subject to any material change.

19.7 The Supplier's liabilities under the Contract shall not be deemed to be released or limited by the Supplier taking out the insurance policies referred to in clause 19.1.

19.8 If the Supplier fails or is unable to maintain insurance in accordance with clause 19.1, UKRI may, so far as it is able, purchase such alternative insurance cover as it deems to be reasonably necessary and shall be entitled to recover all reasonable costs and expenses it incurs in doing so from the Supplier.

20 LIABILITY

20.1 UKRI shall not be responsible for any injury, loss, damage, cost or expense suffered by the Supplier if and to the extent that it is caused by the negligence or wilful misconduct of the Supplier or the Staff or breach by the Supplier of its obligations under the Contract. The Supplier shall not be responsible for any injury, loss, damage, cost or expense suffered by UKRI if and to the extent that it is caused by the negligence or wilful misconduct of UKRI or by breach by UKRI of its obligations under the Contract.

20.2 Subject to clause 20.6, UKRI shall not have any liability for:

(a) any indirect or consequential loss or damage;

(b) any loss of business, rent, profit or anticipated savings;

(c) any damage to goodwill or reputation;

(d) loss, theft, damage or destruction to any equipment, tools, machinery, vehicles or other equipment brought onto UKRI's premises by or on behalf of the Supplier; or

(e) any loss, damage, costs or expenses suffered or incurred by any third party.

20.3 Subject to clause 20.6, the aggregate liability of UKRI in respect of all defaults, claims, losses or damages howsoever caused, whether arising from breach of the Contract, misrepresentation (whether tortuous or statutory), tort (including negligence), breach of statutory duty or otherwise shall in no event exceed 100% of the Charges paid or payable to the Supplier.

20.4 Subject always to clause 20.5 and 20.6, the Supplier's aggregate liability in respect of all defaults, claims, losses or damages howsoever caused, whether arising from breach of the Contract, the supply or failure to supply of the Goods and/or Services, misrepresentation (whether tortuous or statutory), tort (including negligence), breach of statutory duty or otherwise shall in no event exceed the Limit of Liability.

20.5 The Supplier's liability under the indemnity in clause 18.1(b), 29.1 and 27.2 shall be limited to the cost of Goods provided.

20.6 Nothing in the Contract restricts either Party's liability for:

(a) death or personal injury resulting from its negligence or that of its Staff; or

(b) its fraud (including fraudulent misrepresentation) by it or that of its Staff; or

(c) breach of any obligations as to title implied by Section 12 of the Sale of Goods Act 1979 or Section 2 of the Supply of Goods and Services Act 1982; or

(d) any other matter which, by law, may not be excluded or limited.

21 TERMINATION

21.1 UKRI may terminate the Contract in whole or in part at any time before the Goods and/or Services are provided with immediate effect by giving the Supplier written notice, whereupon the Supplier shall discontinue the provision of the Goods and/or Services (in whole or in part as applicable). UKRI shall pay to the Supplier:

(a) such Charges or that part of the Charges for Goods which have been Delivered to UKRI or, on the deemed date of service of the notice of cancellation, are already in transit and the costs of materials which the Supplier has purchased to fulfil the order

for the Goods and which cannot be used for other orders or be returned to the supplier of those materials for a refund; and/or

(b) the prorated unit price for work-in-progress based on the percentage complete in performing the Services at the time of termination.

21.2 UKRI may terminate the Contract at any time by notice in writing to the Supplier to take effect on any date falling at least 3 months (or, if the Contract is less than 3 months in duration, at least 10 Working Days) later than the date of service of the relevant notice.

21.3 UKRI may terminate the Contract with immediate effect by giving written notice to the Supplier if:

(a) the circumstances set out in clauses 8.2, 8.4 or 29.1 apply; or

(b) the Supplier is in material breach of any obligation under the Contract which is not capable of remedy; or

(c) the Supplier breaches any term of the Contract and (if such breach is remediable) fails to remedy that breach within 30 days of being notified in writing of the breach; or

(d) the Supplier repeatedly breaches any of the terms and conditions of this Contract in such a manner as to reasonably justify the opinion that its conduct is inconsistent with it having the intention or ability to give effect to the terms and conditions of this Contract; or

(e) the Supplier suspends, or threatens to suspend, payment of its debts or is unable to pay its debts as they fall due or admits inability to pay its debts or (being a company) is deemed unable to pay its debts within the meaning of section 123 of the Insolvency Act 1986, or (being an individual) is deemed either unable to pay its debts or as having no reasonable prospect of so doing, in either case, within the meaning of section 268 of the Insolvency Act 1986, or (being a partnership) has any partner to whom any of the foregoing apply; or

(f) the Supplier commences negotiations with all or any class of its creditors with a view to rescheduling any of its debts, or makes a proposal for or enters into any compromise or arrangement with its creditors; or

(g) (being a company) a petition is filed, a notice is given, a resolution is passed, or an order is made, for or in connection with the winding up of the Supplier; or

(h) (being an individual) the Supplier is the subject of a bankruptcy petition or order; or

(i) a creditor or encumbrancer of the Supplier attaches or takes possession of, or a distress, execution, sequestration or other such process is levied or enforced on or sued against, the whole or any part of its assets and such attachment or process is not discharged within 14 days; or

(j) (being a company) an application is made to court, or an order is made, for the appointment of an administrator or if a notice of intention to appoint an administrator is given or if an administrator is appointed over the Supplier; or

(k) a person becomes entitled to appoint a receiver over the Supplier's assets or a receiver is appointed over the Supplier's assets; or

(l) any event occurs, or proceeding is taken, with respect to the Supplier in any jurisdiction to which it is subject that has an effect equivalent or similar to any of the events mentioned in clause 21.3(e) to clause 21.3(k) inclusive; or

(m) there is a change of control of the Supplier (within the meaning of section 1124 of the Corporation Tax Act 2010); or

(n) the Supplier suspends, or threatens to suspend, or ceases or threatens to cease to carry on, all or substantially the whole of its business; or

(o) the Supplier's financial position deteriorates to such an extent that in UKRI's opinion the Supplier's capability to adequately fulfil its obligations under the Contract has been placed in jeopardy; or

(p) (being an individual) the Supplier dies or, by reason of illness or incapacity (whether mental or physical), is incapable of managing his or her own affairs or becomes a patient under any mental health legislation.

21.4 The Supplier shall notify UKRI as soon as practicable of any change of control as referred to in clause 21.3(m) or any potential such change of control.

21.5 The Supplier may terminate the Contract by written notice to UKRI if UKRI has not paid any undisputed invoice within 45 days of it falling due.

21.6 Termination or expiry of the Contract shall be without prejudice to the rights of either Party accrued prior to termination or expiry and shall not affect the continuing rights of the Parties under this clause and clauses 4, 5, 6, 7, 11, 12, 15, 17, 18, 19, 20, 24, 25, 26, 27, 28, 29,

34, 36, 37 or any other provision of the Contract that either expressly or by implication has effect after termination.

21.7 Upon termination or expiry of the Contract, the Supplier shall immediately:

(a) cease all work on the Contract;

(b) deliver to UKRI all Deliverables and all work-in-progress whether or not then complete.. Until the Deliverables and the work-in-progress have been returned to UKRI, the Supplier shall be solely responsible for their safe keeping and will not use them for any purpose not connected with this Contract;

(c) cease use of and return (or, at UKRI's election, destroy) all of UKRI's Materials in the Supplier's possession or control; and

(d) give all reasonable assistance to UKRI and any incoming supplier of the Goods and/or Services (as applicable); and

(e) return or destroy UKRI's Confidential Information in accordance with clause 24.3.

22 DECLARATION OF INEFFECTIVENESS AND PUBLIC PROCUREMENT TERMINATION EVENT

22.1 In the event that a Court makes a Declaration of Ineffectiveness, UKRI will promptly notify the Supplier in writing. The Parties agree that the provisions of clause 21.7 and this clause 22 will continue to apply as from the time when the Declaration of Ineffectiveness is made.

22.2 The Declaration of Ineffectiveness will not prejudice or affect any right, liability or remedy which has accrued or will accrue to either Party prior to or after such Declaration of Ineffectiveness in respect of the period prior to the Declaration of Ineffectiveness.

22.3 Consistent with UKRI's rights of termination implied into the Contract by Public Contracts Regulations 2015 (as amended), in the event of a Public Procurement Termination Event, UKRI shall promptly notify the Supplier and the provisions of clause 21.7 and this clause 22 shall apply as from the date of receipt by the Supplier of the notification of the Public Procurement Termination Event.

22.4 The Public Procurement Termination Event shall not prejudice or affect any right, liability or remedy which has accrued or shall accrue to either Party prior to or after such Public Procurement Termination Event in respect of the period prior to the Public Procurement Termination Event.

22.5 During any Court proceedings seeking a Declaration of Ineffectiveness or following notification of a Public Procurement Termination Event, UKRI may require the Supplier to prepare a contingency plan with the effect of achieving:

(a) An orderly and efficient cessation of the Contract or a transition of the provisions of the Goods and/or Services to UKRI or such other entity as UKRI may specify; and

(b) Minimal disruption or inconvenience to UKRI or to UKRI's supported organisations or clients,

and the Parties agree that this shall have effect in the event a Declaration of Ineffectiveness is made or a Public Procurement Termination Event occurs.

22.6 Where there is any conflict between the provisions of clause 21.7 and this clause 22 and the contingency plan then the clauses of this Contract shall take precedence.

22.7 The Parties will comply with their respective obligations under any contingency plan (as agreed by the Parties, or where agreement cannot be reached, as reasonably determined by UKRI) in the event that a Declaration of Ineffectiveness is made or a Public Procurement Termination Event occurs.

23 GOVERNANCE AND RECORDS

23.1 The Supplier shall:

(a) attend progress meetings with UKRI at the frequency and times specified by UKRI and shall ensure that its representatives are suitably qualified to attend such meetings; and

(b) submit progress reports to UKRI at the times and in the format specified by UKRI .

23.2 The Supplier shall keep and maintain until 6 years after the expiry or termination of the Contract, or as long a period as may be agreed between the Parties, full and accurate records of the Contract including the Goods and/or Services supplied under it and all payments made by UKRI. The Supplier shall on request afford UKRI and its representatives such access to those records as may be reasonably requested by UKRI in connection with the Contract.

23.3 **Not used**

23.4 The Supplier shall keep and maintain records of sub-contractors it uses to supply the Goods and/or Services, including whether the sub-contractor is an SME and the payments it has made to the sub-contractor as a result of the sub-contractor's work under this Contract. The Supplier shall provide such records to UKRI within 10 Working Days of a request from UKRI.

23.5 Where the estimated annual Charges are above £5 million, the Supplier shall:

(a) advertise on the UK Government's Contracts Finder website all sub-contractor opportunities above £10,000 arising from and in connection with this Contract. Each advert shall provide a full and detailed description of the sub-contract opportunity with each of the mandatory fields on Contracts Finder being completed.

(b) within 90 days of awarding a sub-contract, update the notice on Contracts Finder with details of the successful sub-contractor;

(c) monitor the number, type and value of the sub-contract opportunities placed on Contracts Finder in its supply chain during the Term;

(d) provide reports on the information at clause 23.5(c) to UKRI in the format and frequency reasonably requested by UKRI; and

(e) promote Contracts Finder to its suppliers and encourage those organisations to register on Contracts Finder.

23.6 Clause 23.5 shall only apply to sub-contractor opportunities arising after the Commencement Date and UKRI may by giving its prior written approval decide to waive the obligations under Clause 23.5 in respect of any sub-contractor opportunity.

24 CONFIDENTIAL INFORMATION

24.1 Subject to clause 24.2, each Party shall:

(a) treat all Confidential Information it receives as confidential, safeguard it accordingly and not disclose it to any other person without the prior written permission of the Disclosing Party; and

(b) not use or exploit the Disclosing Party's Confidential Information in any way except for the purposes anticipated under the Contract.

24.2 Notwithstanding clause 24.1, a Receiving Party may disclose Confidential Information:

(a) where disclosure is required by applicable law or by a court of competent jurisdiction;

(b) to its auditors or for the purposes of regulatory requirements;

(c) on a confidential basis, to its professional advisers;

(d) to the Serious Fraud Office where the Receiving Party has reasonable grounds to believe that the Disclosing Party is involved in activity that may constitute a criminal offence under the Bribery Act 2010;

(e) where the Receiving Party is the Supplier, to the Staff on a need to know basis to enable performance of the Supplier's obligations under the Contract provided that the Supplier shall procure that any Staff to whom it discloses Confidential Information pursuant to this clause (e) shall observe the Supplier's confidentiality obligations under the Contract; and

(f) where the Receiving Party is UKRI:

(i) on a confidential basis to the employees, agents, consultants and contractors of UKRI;

(ii) on a confidential basis to any other Central Government Body, any successor body to a Central Government Body or any company to which UKRI transfers or proposes to transfer all or any part of its business;

(iii) to the extent that UKRI (acting reasonably) deems disclosure necessary or appropriate in the course of carrying out its public functions; or

(iv) in accordance with clause 28;

(v) and for the purposes of the foregoing, references to disclosure on a confidential basis shall mean disclosure subject to a confidentiality agreement or arrangement containing terms no less stringent than those placed on UKRI under this clause 24.

24.3 All documents and other records (in whatever form) containing Confidential Information supplied to or acquired by the Receiving Party from the Disclosing Party or its representatives shall be returned promptly to the Disclosing Party (or, at the election of the Disclosing Party, destroyed promptly) on expiry or termination of the Contract, and no copies shall be kept.

25 TRANSPARENCY

25.1 The Parties acknowledge that, except for any information which is exempt from disclosure in accordance with the provisions of the FOIA or EIR, the content of the Contract is not Confidential Information and the Supplier hereby gives its consent for UKRI to publish this

Contract in its entirety to the general public (but with any information that is exempt from disclosure in accordance with the FOIA or EIR (as applicable) redacted) including any changes to the Contract agreed from time to time. UKRI may consult with the Supplier to inform its decision regarding any redactions but shall have the final decision in its absolute discretion whether any of the content of the Contract is exempt from disclosure in accordance with the provisions of the FOIA or EIR.

26 PUBLICITY

26.1 The Supplier shall not make any press announcements or publicise this Contract in any way without prior written consent from UKRI.

26.2 UKRI shall be entitled to publicise this Contract in accordance with any legal obligation upon UKRI, including any examination of this Contract by the National Audit Office pursuant to the National Audit Act 1983 or otherwise.

26.3 The Supplier shall not do anything or cause anything to be done, which may damage the reputation of UKRI.

27 DATA PROTECTION

27.1 In this clause 27, the terms, "processing", "data controller" and "data processor", "data protection officer" "data subject" "personal data" "personal data breach" shall have the same meanings given to them under UK GDPR or the EU GDPR as the context requires.

27.2 The Supplier acknowledges the only Processing that it is authorised to do is listed in Schedule 7 *(Processing Personal Data*) by UKRI.

27.3 The Supplier shall notify UKRI immediately if it considers that any of UKRI's instructions infringe the Data Protection Legislation.

27.4 The Supplier shall provide all reasonable assistance to UKRI in the preparation of any Data Protection Impact Assessment prior to commencing any Processing. Such assistance may, at the discretion of UKRI, include:

27.4.1 a systematic description of the envisaged Processing and the purpose of the Processing;

27.4.2 an assessment of the necessity and proportionality of the Processing in relation to the Goods and/or Services;

27.4.3 an assessment of the risks to the rights and freedoms of Data Subjects; and

27.4.4 the measures envisaged to address the risks, including safeguards, security measures and mechanisms to ensure the protection of Personal Data.

27.5 The Supplier shall, in relation to any Personal Data Processed in connection with its obligations under this Contract:

27.5.1 Process that Personal Data only in accordance with Schedule 7 *(Processing Personal Data*), unless the Supplier is required to do otherwise by Law. If it is so required the Supplier shall notify UKRI before Processing the Personal Data unless prohibited by Law;

27.5.2 ensure that it has in place Protective Measures, (if the Supplier is holding UKRI Data, including back-up data, that it is held by a secure system that complies with the Security Policy and any applicable Security Management Plan) which UKRI may reasonably reject (but failure to reject shall not amount to approval by UKRI of the adequacy of the Protective Measures) having taken account of the:

a) nature of the data to be protected;

b) harm that might result from a Personal Data Breach;

c) state of technological development; and

d) cost of implementing any measures;

27.5.3 ensure that:

a) the Supplier Staff do not Process Personal Data except in accordance with the Contract (and in particular Schedule 7 *(Processing Personal Data*));

b) it uses all reasonable endeavours to ensure the reliability and integrity of any Supplier Staff who have access to the Personal Data and ensure that they:

(i) are aware of and comply with the Supplier's duties under this Clauses 28 and 25;

(ii) are subject to appropriate confidentiality undertakings with the Supplier or any sub-processor;

(iii) are informed of the confidential nature of the Personal Data and do not publish, disclose or divulge any of the Personal Data to any third party unless directed in writing to do so by UKRI or as otherwise permitted by this Contract; and

(iv) have undergone adequate training in the use, care, protection and handling of Personal Data;

27.5.4 not transfer Personal Data outside of the UK unless the prior written consent of UKRI has been obtained and the following conditions are fulfilled:

a) the transfer is in accordance with Article 45 of the UK GDPR (or section 73 of DPA 2018); or

b) UKRI or the Supplier has provided appropriate safeguards in relation to the transfer (whether in accordance with UK GDPR Article 46 or section 75 of the DPA 2018) as determined by UKRI which could include relevant parties entering into the International Data Transfer Agreement (the "**IDTA**"), or International Data Transfer Agreement

Addendum to the European Commission's SCCs (the "**Addendum**"), as published by the Information Commissioner's Office from time to time, as well as any additional measures determined by UKRI;

c) the Data Subject (as defined by the Data Protection Act 2018) has enforceable rights and effective legal remedies;

d) the Supplier complies with its obligations under the Data Protection Legislation by providing an adequate level of protection to any Personal Data that is transferred (or, if it is not so bound, uses its best endeavours to assist UKRI in meeting its obligations); and

e) the Supplier complies with any reasonable instructions notified to it in advance by UKRI with respect to the Processing of the Personal Data;

27.5.5 where the Personal Data is subject to EU GDPR, not transfer Personal Data outside of the EU unless the prior written consent of UKRI has been obtained and the following conditions are fulfilled:

a) the transfer is in accordance with Article 45 of the EU GDPR; or

b) the transferring Party has provided appropriate safeguards in relation to the transfer in accordance with Article 46 of the EU GDPR as determined by the non-transferring Party which could include relevant parties entering into Standard Contractual Clauses in the European Commission's decision 2021/914/EU or such updated version of such Standard Contractual Clauses as are published by the European Commission from time to time as well as any additional measures determined by the non-transferring Party;

c) the Data Subject has enforceable rights and effective legal remedies;

d) the transferring Party complies with its obligations under the Data Protection Legislation by providing an adequate level of protection to any Personal Data that is transferred (or, if it is not so bound, uses its best endeavours to assist the non-transferring Party in meeting its obligations); and

e) the transferring Party complies with any reasonable instructions notified to it in advance by the non-transferring Party with respect to the processing of the Personal Data; and

27.5.6 at the written direction of UKRI, delete or return Personal Data (and any copies of it) to UKRI on termination of this Contract unless the Supplier is required by Law to retain the Personal Data.

27.6 Subject to Clause 28.7, the Supplier shall notify UKRI immediately if in relation to it Processing Personal Data under or in connection with this Contract it:

27.6.1 receives a Data Subject Access Request (or purported Data Subject Access Request);

27.6.2 receives a request to rectify, block or erase any Personal Data;

27.6.3 receives any other request, complaint or communication relating to either Party's obligations under the Data Protection Legislation;

27.6.4 receives any communication from the Information Commissioner or any other regulatory authority in connection with Personal Data Processed under the Contract;

27.6.5 receives a request from any third Party for disclosure of Personal Data where compliance with such request is required or purported to be required by Law; or

27.6.6 becomes aware of a Personal Data Breach.

27.7 The Supplier's obligation to notify under Clause 28.6 shall include the provision of further information to UKRI, as details become available.

27.8 Taking into account the nature of the Processing, the Supplier shall provide UKRI with assistance in relation to either Party's obligations under Data Protection Legislation and any complaint, communication or request made under Clause 28.6 (and insofar as possible within the timescales reasonably required by UKRI) including by immediately providing:

27.8.1 UKRI with full details and copies of the complaint, communication or request;

27.8.2 such assistance as is reasonably requested by UKRI to enable it to comply with a Data Subject Access Request within the relevant timescales set out in the Data Protection Legislation;

27.8.3 UKRI, at its request, with any Personal Data it holds in relation to a Data Subject;

27.8.4 assistance as requested by UKRI following any Personal Data Breach; and/or

27.8.5 assistance as requested by UKRI with respect to any request from the Information Commissioner's Office or any other regulatory authority, or any consultation by UKRI with the Information Commissioner's Office or any other regulatory authority.

27.9 The Supplier shall maintain complete and accurate records and information to demonstrate its compliance with Clause 28. This requirement does not apply where the Supplier employs fewer than 250 staff, unless:

27.9.1 UKRI determines that the Processing is not occasional;

27.9.2 UKRI determines the Processing includes special categories of data as referred to in Article 9(1) of the UK GDPR or Personal Data relating to criminal convictions and offences referred to in Article 10 of the UK GDPR; or

27.9.3 UKRI determines that the Processing is likely to result in a risk to the rights and freedoms of Data Subjects.

27.10 The Supplier shall allow for audits of its Data Processing activity by UKRI or UKRI's designated auditor.

27.11 The Parties shall designate a Data Protection Officer if required by the Data Protection Legislation.

27.12 Before allowing any sub-processor to process any Personal Data related to the Contract, the Supplier must:

27.12.1 notify UKRI in writing of the intended sub-processor and processing;

27.12.2 obtain the written consent of UKRI;

27.12.3 enter into a written agreement with the sub-processor which give effect to the terms set out in this Clause 28 such that they apply to the sub-processor; and

27.12.4 provide UKRI with such information regarding the sub-processor as UKRI may reasonably require.

27.13 To the extent that UKRI provides its consent pursuant to clause 28.12, the Supplier shall flow down the contractual obligations contained in this clause 28 to sub-processors. For the avoidance of doubt, the Supplier shall remain fully liable for all acts or omissions of any of its sub-processor.

27.14 UKRI may, at any time on not less than 30 Working Days' notice, revise this Clause 28 by replacing it with any applicable controller to Supplier standard clauses or similar terms forming part of an applicable certification scheme (which shall apply when incorporated by attachment to this Contract).

27.15 The Parties agree to take account of any guidance issued by the Information Commissioner's Office. UKRI may on not less than 30 Working Days' notice to the Supplier amend this Contract to ensure that it complies with any guidance issued by the Information Commissioner's Office.

27.2 Notwithstanding any other remedies available to UKRI, fully indemnify UKRI as a result of any such breach of the GDPR, by the Supplier or any other party used by the Supplier in its performance of the Contract that results in UKRI suffering fines, loss or damages.

28 FREEDOM OF INFORMATION

28.1 The Supplier acknowledges that UKRI is subject to the requirements of FOIA and EIR and shall:

(a) provide all necessary assistance and co-operation as reasonably requested by UKRI to enable UKRI to comply with its obligations under FOIA and EIR in relation to any Requests for Information relating to this Contract;

(b) transfer to UKRI all Requests for Information relating to this Contract that it receives as soon as practicable and in any event within 5 Working Days of receipt;

(c) provide UKRI with a copy of all Information belonging to UKRI requested in the Request for Information which is in its possession or control in the form that UKRI requires within 5 Working Days (or such other period as UKRI may reasonably specify) of UKRI 's request for such Information; and

(d) not respond directly to a Request for Information unless authorised in writing to do so by UKRI.

28.2 UKRI shall be responsible for determining (in its absolute discretion) whether any Information:

(a) is exempt from disclosure in accordance with the provisions of FOIA or EIR;

(b) is to be disclosed in response to a Request for Information,

28.3 The Supplier acknowledges that UKRI may be obliged under the FOIA or EIR to disclose Information, in some cases even where that Information is commercially sensitive:

(a) without consulting with the Supplier, or

(b) following consultation with the Supplier and having taken its views into account.

28.4 Where clause 28.3(a) applies UKRI shall, in accordance with any recommendations issued under any code of practice issued under section 45 of FOIA, take reasonable steps, where appropriate, to give the Supplier advanced notice, or failing that, to draw the disclosure to the Supplier's attention as soon as practicable after any such disclosure.

28.5 Where the Supplier is subject to the requirements of the FOIA and EIR, UKRI shall assist and co-operate with the Supplier to enable the Supplier to comply with its obligations under

the FOIA and EIR in relation to any Requests for Information received by the Supplier relating to this Contract.

29 CORRUPTION

29.1 Without prejudice to any other rights or remedies available to UKRI, UKRI shall be entitled to terminate the Contract immediately and to recover from the Supplier the amount of any loss resulting from such termination if the Supplier or the Supplier's Associate:

(a) offers or agrees to give any person working for or engaged by UKRI, UKRI's staff and agents, or any Public Body any favour, gift or other consideration, which could act as an inducement or a reward for any act or failure to act connected to the Contract, or any other agreement with UKRI or any Public Body;

(b) has entered into the Contract if it has knowledge that, in connection with it, any money has been, or will be, paid to any person working for or engaged by UKRI, or any Public Body by or for the Supplier, or that an agreement has been reached to that effect, unless details of any such arrangement have been disclosed in writing to UKRI before the Contract is entered into;

(c) breaches the provisions of the Prevention of Corruption Acts 1889 to 1916, or the Bribery Act 2010; or

(d) gives any fee or reward the receipt of which is an offence under Section 117(2) of the Local Government Act 1972.

29.2 The Supplier shall take all reasonable steps, in accordance with Good Industry Practice, to prevent fraud by the Supplier and the Supplier's Associates in connection with the Contract and shall notify UKRI immediately if it has reason to suspect that any fraud has occurred or is occurring or is likely to occur.

29.3 For the purposes of clause 29.1, "loss" shall include, but shall not be limited to:

(a) UKRI's costs in finding a replacement supplier;

(b) direct, indirect and consequential losses; and

(c) any loss suffered by UKRI as a result of a delay in the performance of the Services or its receipt of the Goods (as applicable).

30 MODERN SLAVERY ACT 2015

30.1 In performing its obligations under this Contract, the Supplier shall and shall ensure that any permitted sub-contractors shall comply with:

(a) all applicable laws, statutes and regulations from time to time in force, including but not limited to the Modern Slavery Act 2015; and

(b) Any anti-slavery policy adopted by UKRI from time to time.

30.2 UKRI may from time to time require the Supplier to provide information and evidence to demonstrate its and its sub-contractors' compliance with clause 30.1. The Supplier shall provide such information with 10 Working Days of a request from UKRI for the same. A breach of this clause 30.1 shall be deemed a material breach for the purpose of clause 21.3(b).

31 FORCE MAJEURE

31.1 Neither Party to this Contract shall in any circumstances be liable to the other for any delay or non-performance of its obligations under this Contract to the extent that such delay or non-performance is due to a Force Majeure Event. Subject to Clause 31.3, the date for performance of any affected obligations will be suspended for a period equal to the delay caused by the Force Majeure Event.

31.2 If a Party is delayed in or prevented from performing its obligations under this Contract by a Force Majeure Event, such Party shall:

(a) give notice in writing of such delay or prevention to the other Party specifying the nature and extent of the Force Majeure Event immediately on becoming aware of it; and

(b) use all reasonable endeavours to mitigate the effects of the Force Majeure Event on the performance of its obligations.

31.3 If the Force Majeure Event continues for a period of 30 (thirty) days or more following notification, then either Party may terminate this Contract by giving not less than 10 (ten) days' prior written notice to the other Party.

31.4 UKRI shall not be liable to pay the Charges in relation to any Goods and/or Services that are not provided by the Supplier due to a Force Majeure Event.

32 DISPUTE RESOLUTION

32.1 The Parties agree to co-operate with each other in an amicable manner with a view to achieving the successful implementation of this Contract.

32.2 If a Dispute arises between UKRI and the Supplier during the Term in relation to any matter which cannot be resolved by local operational management either Party may refer the matter for determination in accordance with the procedure set out in Clause 32.3.

32.3 A Dispute referred for determination under clause 32.2 shall be resolved as follows:

(a) by referral in the first instance to the decision of the individuals for each Party referred to in the Award Letter for stage 1 escalations; and

(b) if a Dispute is not resolved within 21 days of its referral pursuant to Clause 32.3(a) such Dispute shall be referred to the individuals for each Party referred to in the Award Letter for stage 2 escalations.

32.4 If the dispute cannot be resolved by the Parties within one month of being escalated as referred to in Clause 32.3(b), the dispute may by agreement between the Parties be referred to a neutral adviser or mediator (the "**Mediator**") chosen by agreement between the Parties. All negotiations connected with the dispute shall be conducted in confidence and without prejudice to the rights of the Parties in any further proceedings.

32.5 If the Parties fail to appoint a Mediator within one month, or fail to enter into a written agreement resolving the dispute within one month of the Mediator being appointed, either Party may exercise any remedy it has under applicable law.

32.6 Neither Party shall be prevented from, or delayed in, seeking orders for specific performance or interlocutory or final injunctive relief on an ex parte basis or otherwise as a result of the terms of this Clause 32, such clause not applying in respect of any circumstances where such remedies are sought.

33 CHANGE CONTROL PROCEDURE

33.1 In the event that either party desires to change the terms of this Contract, the following procedures will apply:

(a) the Party requesting the change will deliver a “Change Request” (in the form (or substantially in the same form) contained in Schedule 4 to this Contract) which describes:

(i) the nature of the change;

(ii) the reason for the change;

(iii) the effect that the requested change will have on the scope or Specification for the Services; and

(iv) any change to the Charges and the Term.

(b) Upon receipt of a Change Request, the receiving Party’s authorised representative will contact his/ her counterpart within 5 working days to discuss and agree the Change Request. The parties will negotiate the proposed changes to the Contract in good faith and agree a timeline in which to finalise the Change Notice.

(c) Neither party is obliged to agree to a Change Request, but if the parties do agree to implement such a Change Request, the appropriate authorised representatives of both parties will sign the Change Request which will be effective from the date set out in the Change Request. If there is no Change Request signed by both parties, the content of that Change Notice shall not be deemed as agreed.

(d) If there is any conflict between the terms and conditions set out in the Contract and the Change Request, then the terms and conditions set out in the most recent fully executed Change Request will apply.

(e) The Supplier shall neither be relieved of its obligations to supply the Goods and/or Services in accordance with the terms and conditions of this Contract nor be entitled to an increase in the Charges as the result of:

(i) a General Change in Law; or

(ii) a Specific Change in Law where the effect of that Specific Change in Law on the Goods and/or Services is reasonably foreseeable at the Commencement Date.

34 ENTIRE AGREEMENT

34.1 The Contract constitutes the entire agreement between UKRI and the Supplier in relation to the supply of the Services and/or Goods and the Contract supersedes and replaces any prior written or oral agreements, representations or understandings between them relating to that subject matter. The Parties confirm that they have not entered into the Contract on the basis of any representation that is not expressly incorporated into the Contract. Nothing in this clause shall exclude liability for fraud or fraudulent misrepresentation.

35 NOTICES

35.1 Any notice to be given under the Contract shall be in writing and may be served by personal delivery, first class or recorded post or, subject to clause 35.3, e-mail to the address of the relevant Party set out in the Award Letter, or such other address as that Party may from time to time notify to the other Party in writing.

35.2 Notices served as above shall be deemed served on the Working Day of delivery provided delivery is before 5.00pm on a Working Day, otherwise delivery shall be deemed to occur on the next Working Day. An email shall be deemed delivered when sent unless an error message is received.

35.3 Notices under clauses 21, 22 and 31 may be served by email only if the original notice is then sent to the recipient by personal delivery or recorded delivery in the manner set out in clause 35.1.

36 GENERAL

36.1 If any court or competent authority finds that any provision of the Contract (or part of any provision) is invalid, illegal or unenforceable, that provision or part-provision shall, to the extent required, be deemed to be deleted, and the validity and enforceability of the other provisions of the Contract shall not be affected.

36.2 If any invalid, unenforceable or illegal provision of the Contract would be valid, enforceable and legal if some part of it were deleted, the provision shall apply with the minimum modification necessary to make it legal, valid and enforceable.

36.3 A waiver of any right or remedy under the Contract is only effective if given in writing and shall not be deemed a waiver of any subsequent breach or default. No failure or delay by a party to exercise any right or remedy provided under the Contract or by law shall constitute a waiver of that or any other right or remedy, nor shall it preclude or restrict the further

exercise of that or any other right or remedy. No single or partial exercise of such right or remedy shall preclude or restrict the further exercise of that or any other right or remedy.

36.4 The Contract shall not constitute or imply any partnership, joint venture, agency, fiduciary relationship or other relationship between the Parties other than the contractual relationship expressly provided for in the Contract. Neither Party shall have, nor represent that it has, any authority to make any commitments on the other Party's behalf.

36.5 A person who is not a Party to this Contract shall have no right to enforce any of its provisions, which expressly or by implication, confer a benefit on him or her, without the prior written agreement of the Parties.

36.6 The Contract cannot be varied except in writing signed by a duly authorised representative of both the Parties.

37 GOVERNING LAW AND JURISDICTION.

37.1 The Contract, and any dispute or claim arising out of or in connection with it or its subject matter or formation (including non-contractual disputes or claims), shall be governed by, and construed in accordance with, English law, and the parties irrevocably submit to the exclusive jurisdiction of the courts of England and Wales.

Schedule 2 - Specification

1 The Suppliers shall provide the Goods and/or Services in accordance with this Schedule 2.

Abbreviations used in this document.

Abbreviation	Meaning
AMU	Atomic Mass Unit
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BoM	Bill Of Materials
BPQ	Brazer Performance Qualification
BPS	Brazing Procedure Specification
CAD	Computer Aided Design
CCG	Cold Cathode Gauge
CF	ConFlat
CT	Computerised Tomography
D3s	Deviations, Discrepancies and Detours
DDP	Delivered Duty Paid
DUNE	Deep Underground Neutrino Experiment
EBW	Electron Beam Weld
EP	Electron Polish
FAT	Factory Acceptance Test
FNAL	Fermi National Accelerator Laboratory
FP	Field Probe
IPA	Isopropanol Alcohol
ISO	International Organization for Standardization
LINAC	Linear Accelerator
LN2	Liquid Nitrogen
LPM	Litre Per Minute
MC	Main Coupler
MCP	Manufacturing Control Plan
MPRR	Material Procurement Readiness Review
MRR	Manufacturing Readiness review
NCR	Non-Conformance Report
OFC	Oxygen Free Conducting
P/N	Part Number
PIP-II	Proton Improvement Plan - II
PO	Purchase Order
PQR	Procedure Qualification Record
QA	Quality Assurance
QAP	Quality Assurance Plan

QC	Quality Control
QMS	Quality Management System
RF	Radio Frequency
RFP	Request For Proposal
RGA	Residual Gas Analyser
RRR	Residual Resistance Ratio
S/N	Serial Number
SMA	Sub Miniature version A
UHV	Ultra-High Vacuum
UK	United Kingdom
UKRI-STFC	United Kingdom Research and Innovation - Science and Technology Facilities Council
USA	United States of America
WPQ	Welding Performance Qualification
WPS	Welding Procedure Specification

Term	Definition
shall, must	Denotes a requirement: a mandatory element
should	Denotes a recommendation: an advisory element.
may	Denotes approval.
might	Denotes a possibility.
can	Denotes both capability and possibility.
is/are/will	Denotes a description.

1. Executive Summary

This procurement covers the manufacturing, treatment, testing and documentation of 20 high- power couplers for 650 MHz cryomodules for the high-β section of the proton LINAC for the Proton Improvement Plan II (PIP-II) at Fermi National Accelerator Laboratory (FNAL) in the USA. UKRI-STFC Daresbury Laboratory (UKRI-STFC) is working in partnership with FNAL for the coupler design and fabrication.

The purchase order will be owned and managed by UKRI-STFC. FNAL personnel shall act as technical consultants upon UKRI-STFC request.

This document establishes the fabrication, facilities and procurement requirements needed to deliver the 20 high power couplers and shall be followed by the Contractor to fill the scope of supply. Section 4 addresses the technical requirements and specifications. The Contractor shall comply with all the requirements defined in this document.

The submitted proposal will be evaluated in accordance with the criteria described in the Award and Selection Questionnaire.

Table 1: Summary of the deliverables

Top Assembly Drawing	Description	Quantity
F10187843 rev. G	650 MHz Coupler, Full Assembly	20
N/A	Associated materials, tooling, and equipment	1
N/A	Spare hardware and parts as described in Section 3.3	1
N/A	All documentation and samples	1
N/A	Warranty as described in Section 3.2	1

This procurement includes several hold points, the most significant of which are:

- Manufacturing Readiness Review (MRR)
- Factory Acceptance Test (FAT)
- Delivery of each coupler (or coupler batches) including required documentation

During the MRR the Contractor shall provide the complete documentation described in Section

6.6 and demonstrate how the specified manufacturing, treatment and testing requirements are going to be implemented. Manufacturing cannot start until all the MRR's recommendations have been addressed and UKRI-STFC has provided a written approval.

The FAT includes all the tests performed at the supplier before shipment can be authorized as described in Sections 4 and 5. UKRI-STFC and its partner FNAL shall be informed 10 working days in advance of each test and allowed to be present. Documentation generated during the required Quality Control (QC) activities, supporting the successful completion of each manufacturing and processing step, shall be provided to UKRI- STFC at each hold point.

Delivery will be considered completed when both hardware and its related documentation is delivered to UKRI-STFC or organization of its choosing, any defined and agreed incoming inspection provision are complete, any non-conformity (if relevant) has been corrected, and all documentary deliverables are updated and validated by UKRI-STFC.

2. The High-Power RF Coupler

The Proton Improvement Plan II aims to build and commission a linear accelerator at the Fermi National Accelerator Laboratory that will generate a high-energy beam of protons for use in neutrino discovery research. It will provide the 'engine' to the Long Baseline Neutrino Facility (LBNF) to drive the Deep Underground Neutrino Experiment (DUNE) – a much larger USA-led, internationally-supported programme that provides opportunities for new discoveries in particle physics. As part of the project, the UK PIP-II team will deliver 20 high power RF couplers.

FNAL, the design authority of the PIP-II project, has developed a high-power coupler design for the for PIP-II 650 MHz cavities to be installed on the PIP-II LINAC.

3. Scope of Supply

3.1. *Contract Scope*

This contract is to deliver 20 high power couplers to FNAL, Batavia, Illinois, USA. The Contractor is to fabricate, assemble, factory QC test and transport these couplers in accordance with the details of this specification and provided drawings.

The Contractor must furnish all required labour, materials, tooling, and equipment other than those explicitly listed to be supplied by UKRI-STFC. Prior to the start of the fabrication, the Contractor is to provide detailed manufacturing documentation for UKRI-STFC's approval. At all stages of manufacture, the Contractor must provide QC documentation of all sub-components and parts, their preparation and any testing performed to ensure manufacturing compliance to specification. The goods are to be covered by a full manufacturing warranty for a minimum of 24 months from the date of the final acceptance by UKRI-STFC.

3.2. *Deliverables*

1. Furnishing all required labour, materials, tooling, and equipment needed for fabrication, assembly, treatment, safe handling, factory test, and transport of the couplers throughout manufacture and delivery, other than those explicitly listed to be supplied by UKRI-STFC.
2. Production of final coupler Bill of Materials (BoM), manufacturing and processing procedures showing all steps, sub-components, and sub-assemblies necessary to produce the couplers. Production of the coupler and tooling, manufacturing drawings for all parts and tooling. Documents must be approved by UKRI-STFC prior to starting coupler production.
3. Fabrication of 2 pre-series and 18 series couplers, as defined by the drawings, including all finishing items shown in the drawings.
4. Delivery of all associated QC documentation to UKRI-STFC for all 2 pre-series and 18 main series couplers. The delivered couplers must conform to this specification and meet all the dimensions and tolerances specified in the provided drawings. UKRI-STFC reserves the right to review and validate any generated test reports.
5. A manufacturing warranty for each coupler delivered, covering all aspects of the mechanical fabrication, assembly, welding, brazing, treatment, and processes under the Contractor's responsibility, for not less than 24 months duration after the final acceptance by UKRI-STFC. The warranty shall be valid for the full 24 months or that specified by the contractor if greater than 24 months regardless of whether couplers have been delivered to third party by UKRI-STFC or

integrated into a cryomodule and delivered to PIP-II.

3.3. *Spare Hardware and Parts to be Procured.*

The items listed in Table 2 shall be delivered with the couplers in the quantities indicated. All parts must be bagged separately with part number and quantity indicated on the bag.

Table 2: List of Spare Hardware to be Procured.

Part #	Rev.	Name	BOM	Spares to Order (for a QTY of 20 couplers)
F10187100	A	MOD 3/8 FITTING	1	3
F10187819	C	THREADED AIR ADAPTER	1	3
F10187828	A	SUPPORT DISC	1	3
F10187840	B	SPLIT RING, VESSEL	2	2
F10187842	A	NUT BACKING PLATE	2	4
F10187855	A	SPLIT RING, WAVEGUIDE	2	2
F10187858	C	AIR SIDE COVER ASSEMBLY	1	2
F10187971	A	METRIC NUT PLATE, 2-3/4" CF FLANGE	6	4
F10193904	-	SMA FEEDTHROUGH, LONG ANTENNA	1	4
FC0006070	-	SHCS,M5x.8x10LGxFT,SS316	8	25
FC0006089	-	SHCS,M6x1x18LGxFT,SS316	16	50
FC0008139	-	HHCS,M8x1.25x16LGxFT,SS316	4	25
FC0008163	-	HHCS,M10x1.5x50LGxFT,SS316	20	50
FC0008928	-	HHCS,M6x1x16LGxFT,BR	8	25
FC0014903	-	NUT_HEX,M10x1.5x8,C10S,ZYC	20	50
FC0016229	-	WASHER,M10-10.5x20x1.8,SS316	40	150
FC0016263	-	WASHER,M6-6.4x12x1.4,SS316L	50	150
FC0016265	-	WASHER,M8-8.4x16x1.4,SS316L	88	250
FC0019004	-	SEAL, 1.33 CF FLANGE, Cu	2	30
FC0019006	-	SEAL, 2.75 CF FLANGE, Cu	3	30
FC0019010	-	SEAL, 6 CF FLANGE, Cu	1	30
FC0019294	-	WASHER-SPLIT,M6,6.5x11.8x1.5,SS316	8	50
FC0024496	-	O-RING, -236, EPDM	1	10
FC0024501	-	O-RING, -241, EPDM	1	10
FC0024505	-	O-RING, -245, EPDM	1	10
FC0024506	-	O-RING, -246, EPDM	1	10
FC0024527	-	O-RING, -267, EPDM	2	10
FC0028293	-	RECEPTACLE, RF/COAXIAL, SHV BHD JACK,	2	50
FC0041393	-	NUT_HEX,M8x1.25x6.5,SB	32	100
FC0042117	-	WASHER,M4-4.3x8.75x0.8,SS316L	6	50
FC0047552	-	STUD, THREADED - M8 X 60 MM LONG 316L RT, EP	12	50
FC0047874	-	HHCS,M8x1.25x16LGxFT,Si Brz	8	20
FC0047881	A	HHCS,M8x1.25x40LGxFT,Si Brz	32	100
FC0052357	-	SHCS,M8x1.25x40LGx28T,SB	12	50
FC0074795	B	COLD CATHODE GAUGE IKR 060	1	4
FC0075829	-	ALL METAL ANGLE VALVE	1	2
FC0082794	-	O-RING, -252, EPDM	1	10
FC0098079	-	WASHER, M12-13X20X2.0,SS316	1	5

FC0098202	-	O-RING, 254, EPDM	1	10
FC0098363	-	SETUP STUD, M8 X 1.25 X 40MM, 10MM X 22MM, SS316	8	25
FC0098370	-	HHCS, M6x1x35LG, SS316L, ROLLED THREAD, ELECTROPOLISHED	18	60
FC0098619	-	PLUG, 3/8 NPT, HEX HEAD, BRASS, SOLID	1	3
FC0104619	-	SEAL, 6 CF FLANGE, CU ANNEALED	1	30
FC0104844	-	HHCS, M6X1X14LGXFT - SS316	24	100
FC0104863	-	HHCS, M4X.7X20LGXFT, SS316L, ROLLED THREAD, ELECTROPOLISH	6	20
FC0104904	-	SHCS, M6x1X10LGXFT, SS316, SEALING BUNA-N O-RING	1	5
FC0109277	-	3/8 TUBE X 3/8 NPT MALE COMPRESSION FITTING, SS316 , HY-LOK, CMC 6-6N	2	3
FC0109280	-	90 DEG COMP. FITTING, 3/8 TUBE, SS316, HY- LOK CLA-6-S316	1	3
FC0109353	-	PANEL NUT, M12X1.5X3MM THK, NICKEL PLATED BRASS, HEYCO P/N 2246	1	10

3.4. *Scope Options*

As well as the above scope and deliverables, the Contractor must ensure they have potential capacity for, and provide a separate fixed price for the following additional scopes of work. These are options to be exercised by UKRI-STFC only if required during the Contract execution phase:

1. Scope option 2.1.1.2: Brazed samples, and any associated documentation. This does not include any ASME or ceramic samples.
2. Scope option 2.1.1.3: Ceramic-copper braze sample generation, excluding all other non- ASME braze samples.
3. Scope option 2.1.1.4: Copper plating samples, and any associated documentation. This excludes the bellows plating sample and Residual-Resistance Ratio (RRR) verification.
4. Scope option 2.1.1.10: ASME Brazing samples and documentation.
5. Scope option 2.1.1.11: The manufacturing, treatment, testing of up to 2 further vacuum side assemblies in addition to the full couplers and all associated documentation: including delivery for acceptance test to Fermi National Accelerator Laboratory (FNAL), IL, USA, or other organizations of UKRI-STFC's choosing. This option shall be available during the warranty period.
6. Scope option 2.1.1.12: The manufacturing, treatment, testing of up to 4 further couplers in addition to the 20 above and all associated documentation: including delivery for acceptance test to Fermi National Accelerator Laboratory (FNAL), IL, USA, or other organizations of UKRI-STFC's choosing. This option shall be available during the warranty period.

As well as the above scope and deliverables, the contractor should indicate their capacity for and provide a separate fixed price for the following additional scopes of work. These are options to be exercised by UKRI-STFC only if required during the Contract execution phase:

1. Scope option 2.1.1.1: Titanium Nitride (TiN) coating, thickness of 10 ± 5 nm, per Section 4.8 shall be quoted per-antenna assembly, which may be exercised up to the full number of antennas.
2. Scope option 2.1.1.5: TiN samples, and any associated documentation.

3. Scope option 2.1.1.6: Gold plating samples, and any associated documentation
4. Scope option 2.1.1.7: Gold plating on the majority of the antenna's copper surfaces. To be quoted per-antenna assembly, which may be exercised up to the full number of antennas.
5. Scope option 2.1.1.8: Gold plating over the copper plated surfaces on the air side outer conductor. To be quoted per unit, which may be exercised up to the full number of antennas.
6. Scope option 2.1.1.9: Gold plating over the copper plated surfaces on the air side outer conductor. To be quoted per unit, which may be exercised up to the full number of antennas.

3.5. *Additional Scope*

UKRI-STFC will provide the ceramic discs (F10187834) required for sample generation and production assemblies to the Contractor. It is strongly preferred that the Contractor perform metallization of the ceramics (see section 4.3.2.9). If the Contractor or the Contractor's subcontractors are unable to complete this, UKRI-STFC can have the ceramics metallized by UKRI-STFC's subcontractor (this should only be considered if absolutely necessary). Whether the Contractor performs metallization must be accounted for during quote generation and must be confirmed in writing as part of the bid.

Ceramic discs will arrive to the Contractor having already been inspected for loss tangent, dimensional accuracy, and surface quality per the inspection requirements listed in Section 4.1.2.

Per Section 4.1.3, the Contractor must procure certain 'off the shelf' ready-made parts and raw material from a specific supplier. A complete list of these items will be provided to the bidder during the Request For Proposal (RFP). UKRI-STFC can also give suggestions for other 'off the shelf' ready-made parts for the bidder's convenience.

4. Technical Requirements

The information provided in this section represents Critical Items and Key Characteristics of the products and processes crucial for achieving the specified coupler performance for PIP-II. Deviation from the requirements in this section is strongly discouraged and must be approved by UKRI-STFC before implementation. Any unapproved deviation from the agreed processes can result in penalties to the Contractor. Detailed procedures related to the coupler fabrication, coating and cleaning shall be provided by the Contractor as part of the Quality Assurance Plan (QAP) and must be approved by UKRI-STFC as part of the contract. Refer to Section 6 for details on Quality Assurance and Control.

4.1. *Material Requirements*

Material certifications, including raw magnetic permeability, physical properties, test reports, and chemical test reports traceable to the mill heat lot number must be included in the coupler documentation package for all metals.

Material specific requirements with acceptable values are listed in the below sections.

4.1.1. Stainless Steel

All stainless-steel material must have a raw magnetic permeability less than 1.06 Mu. It is preferred that this is stated in the material certifications, but verification by the Contractor is also permitted. Verification shall be performed per ASTM A342 or equivalent.

4.1.2. Ceramics

The 99.8% Alumina ceramic will be provided by UKRI-STFC to the Contractor.

The following will be verified and performed by UKRI-STFC or designated organization of its choosing prior to shipment, and reflected in the accompanying documentation:

- Dissipation factor tan < 10^{-4} at room temperature for 650 MHz
- No cracks are present in the ceramic, as checked with UV dye penetrant (MAGNAFLUX® ZL-4C water-based dye penetrant, with ZP-4D powder developer)
- Windows will be carefully cleaned and be free of all contaminates. Cracks, chips, pits, pocks, and porosity are not allowed. Foreign particles, contaminants, or inclusions visible to the unaided eye are not acceptable.
- Windows will be 100% visually inspected on both faces at 5X magnification using appropriate illumination. A fibre optic light source is recommended. Inclusions visible at this 5X magnification are not acceptable.
- Each ceramic will be checked for dimensional conformity and uniform colouration.
- Each ceramic will be packaged separately and packed with sufficient layers of foam to prevent damage during shipment.

If metallization is performed by UKRI-STFC's subcontractor, UKRI-STFC shall perform a visual inspection of the metallization. Blisters, peeling, surface voids, cracks, and other defects are not acceptable. The ceramic will not be checked for gas impenetrability by UKRI- STFC.

4.1.3. Parts with Specified Suppliers

The Contractor shall procure certain 'ready-made' parts and raw material from a specified supplier. A complete list of these items will be provided to the bidder during the RFP. UKRI-STFC can also give suggestions for other ready-made parts for the Contractor's convenience. If a component drawing lists a material specific to a given supplier (such drawings will indicate P/N and supplier name), the Contractor shall purchase the material from that supplier. Should the Contractor be unable to purchase any specified component / raw material, or the procurement lead time will have a schedule impact on the project deliverables, the Contractor shall contact UKRI-STFC to determine a path forward.

4.2. *Pressure Vessel Code Conformance*

4.2.1. ASME Brazing Samples and Documentation – OPTION 2.1.1.10

All brazing and welding which is part of F10187847, Vacuum Side Outer Conductor, or F10187823, Ceramic Window Assembly, must be qualified, inspected, and documented according to 2021 ASME Boiler and Pressure Vessel Code (BVPC) Section IX.

The following section is written for the as-designed coupler, which only uses brazed connections for the vacuum side assembly. Should a contractor require any welding on the assembly, it will need to be qualified in a similar manner. Please reach out to UKRI-STFC as necessary to determine requirements. Ultimately, the contractor's responsibility is to provide the necessary samples and documentation. UKRI-STFC has given a full faith effort to approximate the exact scope of this work, but given a contractor's specific practices, the scope may change.

Should the Contractor have any questions, or seek more clarity in the requirements, they are advised to contact UKRI-STFC immediately. If the Contractor has current documentation/samples which could meet the requirements of this section and records of such are provided, this option can be given an exemption by UKRI-STFC.

The Contractor will not be responsible for validating the design of the coupler. The Contractor must only document brazing/welding per required standards and make samples as necessary to validate the expertise of their personnel.

4.2.1.1. Assumptions made of Brazing Process

- Vacuum outer conductor will be brazed using a single filler material, with down flow and horizontal flow.
- Antenna assembly will be brazed in two steps, first the window sub-assembly, followed by the entire assembly. Assumed down flow only.
    - The antenna assembly will use two different filler materials, which are assumed to have the same F-number.
    - Please reach out to STFC-UKRI with details of what two fillers will be used so STFC-UKRI can confirm the number of samples required.

4.2.1.2. Brazing Sample Required

The following samples are required per brazer which will perform the processes related to those samples. If only one brazer will make the ceramic window sub-assemblies, F10187834, only that person needs to be qualified.

The contractor may request changes to the braze sample dimensions, but this requires UKRI- STFC's approval. UKRI-STFC will provide drawings of the samples after the kick-off meeting, once the dimensions are finalized between UKRI-STFC and the contractor. All samples, except the ceramic window, will be sent to FNAL for destructive testing, with testing paid by UKRI-STFC. The ceramic window will be sectioned and examined by the contractor.

Joint clearances and filler material for samples will be determined by the vendor and must be consistent with the design and processes used for the Vacuum Outer Conductor and Ceramic Window Antenna Assembly.

The pass/fail criteria are listed in each section. Samples are required to pass before the MRR.

SS-Cu-SS Samples

The vendor will provide two SS-Cu-SS samples per brazer.

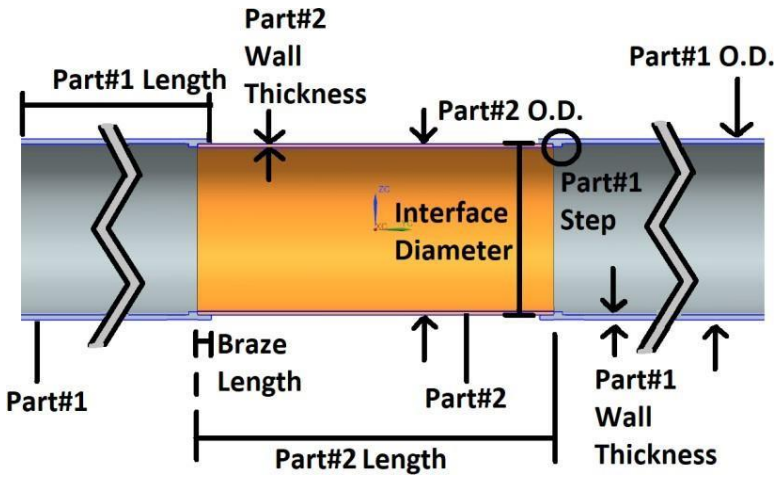


Figure 1: One sample of SS-Cu-SS

Sample Parameters:

- Part #1:
    - Material = SS316L UNS S31603
    - Interface Diameter = 24.00 mm (vendor applies tolerance)
    - O.D. = 25.4 mm (as made tube O.D. OK)
    - Wall Thickness = 0.90 mm
    - Length = 152.4 mm / 6” (each)
    - Step = 0.2 mm x 1 mm length
- Part #2:
    - Material = OFHC Copper, UNS C10100
    - Interface Diameter = 24.00 mm (vendor applies tolerance)
    - Outer Diameter = 24.00 mm
    - Wall Thickness = 0.50 mm
    - Length = 50.0 mm
- Braze Length = 2.0 mm
- Orientation during brazing: Vertical Flow

Sample Pass/Fail Criteria

- Tension test: Failure is expected in the copper. The minimum tensile strength for annealed UNS C10100 copper is 205 MPa. The sample must survive an axial force ≥ 7.6 kN (36.91 mm^2 x 205 N/mm^2), assuming the dimensions given are used.
- Section test – will verify <20% porosity.
- **Samples are required to pass tests.**

SS-SS-SS Samples

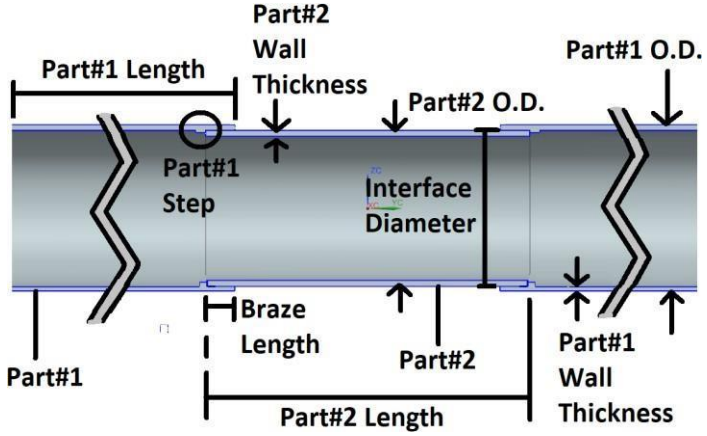


Figure 2:One Sample of SS-SS-SS

Sample Parameters:

- Part #1:
    - Material = SS316L UNS S31603
    - O.D. = 25.4 mm (as made tube O.D. OK)
    - Interface Diameter = 24.00 mm (vendor applies tolerance)
    - Wall Thickness = 0.80 mm

    - Length = 152.4 mm / 6” (each)
    - Step = 0.2 mm x 1 mm length
- Part #2:
    - Material = SS316L UNS S31603
    - Outer Diameter = 24.00mm
    - Interface Diameter = 24.00 mm (vendor applies tolerance)
    - Wall Thickness = 0.80 mm
    - Length = 50.0 mm
- Braze Length = 2.0 mm
- Orientation during brazing: Horizontal Flow

Sample Pass/Fail Criteria

- Tension test: Failure is expected in the middle SS tube. The minimum tensile strength for SS316L UNS S31603 is 485 MPa. The sample must survive an axial force ≥ 31.7 kN (65.31 mm^2 x 485 N/mm^2), assuming the dimensions given are used.
- Section test – will verify <20% porosity.
- **Samples are required to pass tests.**

Ceramic Window Sample

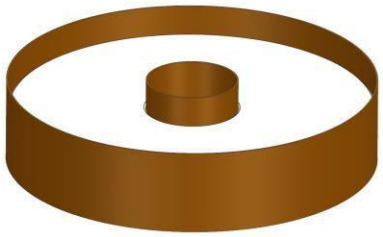


Figure 3: Ceramic Window Sub-Assembly

Sample Parameters

- 1x Ceramic window sub-assembly, per drawing F10187818

Sample Pass/Fail Criteria

- No tension tests.
- Section test – will verify <20% porosity. Vendor will perform sectioning.
    - Using appropriate measures to preserve braze joint, section the sub-assembly in half.
    - Inspect the sectioned braze joints at sufficient magnification to determine the length of unbrazed length at each joint. No joint may exceed 20% unbrazed length.
- Sample(s) is required to pass tests.

4.2.1.3. Required Documentation

Any confidential or proprietary information in these documents MAY BE REDACTED so long as the contractor retains an unredacted copy. The documents necessary should only take ≈ 3 hours to complete, and UKRI-STFC will help the contractor as necessary to complete them. The BPS, PQR, and BPQ have an ASME standard, and the parameters only need to be written in (no from- scratch document creation).

Brazing Procedure Specification (BPS)

The BPS serve as a record / guide for how a given assembly should be brazed. One Brazing Procedure Specification will be written for each brazing process (total 3, Ceramic window sub- assembly, antenna assembly, vacuum outer conductor). The following critical parameters (mandatory) must be recorded for each type brazing process: base metal, filler material, braze temperature, atmosphere, flow position, joint design, post braze heat treatment. Non-critical (optional) parameters to be recorded: technique, brazing time.

Procedure Qualification Record (PQR)

The PQR is a record of the variables used to make the brazing coupons, and the results of the tests. The same parameters as the Brazing Procedure Specification are to be recorded, but more specific to the samples made. One PQR is needed for each sample type (3 total).

Brazer Performance Qualification (BPQ)

The BPQ is a record of who performed the coupons, the parameters used in the test, and the test results. This copies over almost all the information from the PQR. One BPQ is needed per brazer.

In Process Examination Document

This document will be created jointly by UKRI-STFC and the contractor and will clearly describe the in-process examination required for each of the brazed assemblies. The document must contain the following information: contractor name, examination methods, procedure number, revision date. Any visual examination must be used with additional lighting.

Each component's traveler may serve as the record of examination. As such, the following information must be included in the traveler: Date of examination, Examiner name, list of brazes to be inspected, reference to procedure, examination results.

The contractor shall certify that each examiner is sufficiently trained to identify brazing defects.

4.2.1.4. Welding

If any welding is performed, equivalent documents and samples are required. Inquire to UKRI- STFC with any questions on the cope of this work. Each type of welding process will require approximately the same number of coupons and documentation.

4.2.2. Pressure Test

All coupler vacuum side assemblies shall be pressure tested. The test configuration shall match that shown for the vacuum side assembly F10187825, transport configuration. Metal seals shall be used. All couplers will receive a pressure test, with the final pressure falling between 4 and 10 bar absolute (final value provided by UKRI-STFC prior to MRR). The pressure test should take place after all manufacturing steps have been completed.

The method of testing pneumatic, and nitrogen shall be used to pressurize the coupler. Safety of personnel is of the utmost importance, and UKRI-STFC and the vendor will work together to ensure all necessary precautions are taken. Documentation of the pressure test result will be part of the travelers created for the couplers.

A summary of the test procedure is outlined below. A final procedure will be agreed upon by the vendor and UKRI-STFC prior to the MRR.

1. Verify parts are free of grease, chips, dirt, and oil, clean the parts if necessary.
2. Assemble the vacuum side coupler per F10187825, transport configuration.
3. Perform a leak check on the coupler. Verify leak rate required per drawings is met.
4. Connect the pressure system to the bakeout chamber. Take any necessary safety precautions.
5. Pressurise to 2 bar(a), hold for 2 minutes. Verify no drop in pressure > 0.1 bar(a).
6. Increase in increments of 1.3 bar(a) or less, holding pressure for 1 minute at each step, until the final pressure is reached. Hold final pressure for 10 minutes. If the pressure drops by > 0.5 bar at any time, the system should be depressurized, and the test stopped.
7. Depressurise gradually.
8. Perform a leak check on the coupler. Verify leak rate required per drawings is met.

4.3. *Brazing*

4.3.1. Contractor Design Responsibilities and Design Optimisation

4.3.1.1. Joint Design

It is the sole responsibility of the Contractor to ensure all brazed joints have tolerance to provide an optimal joint design. Modifications of joint detail (including but not limited to, tolerances, geometry of joint, changing brazed joints to welded joints, etc...) from those specified in the mechanical drawing must not affect overall assembly dimensions, surface qualities, and appropriateness for RF and vacuum environment must be maintained.

All changes to the UKRI-STFC drawing package must be submitted in writing and approved prior to the Material Procurement Readiness Review (MPRR).

The coupler ceramic window is expected to experience a significant number of thermal cycles (>100,000) from 0°C to 60°C over the course of 50 years of service. Based on the Contractor 's experience, if the design of the brazed joints can be optimized to better withstand the thermal cycling, the Contractor should relay their recommendations to UKRI-STFC for consideration.

4.3.1.2. Braze Material Selection

The Contractor shall determine optimum braze material for each joint type (ceramic-copper, stainless steel-copper, etc.), to be approved by UKRI-STFC. Copper-gold braze filler is recommended for all joints. Brazing filler material should be selected for optimal RFperformance, vacuum requirements, and assembly requirements. If sequential brazing is required, this should be accounted for by using filler material of a lower melting temperature for each sequential brazing process. The brazing filler material shall be approved by UKRI-STFC. Assemblies will be subject to temperatures over 400°C in an ultra-high vacuum ($<10^{-9}$ mbar) environment post brazing and should remain ductile with very low outgassing rates (10^{-12} mbar l/s cm^2).

4.3.2. Requirements and Allowed Processes

4.3.2.1. Form of Filler

All brazing filler material used must be braze rings / wire filler. No paste or powder filler is acceptable. The Contractor must redesign braze joints as necessary to achieve this per Section 4.3.1

4.3.2.2. Braze Fill and Inspections

All brazes shall be made fill and flush, without excessive material, and without underfill. 100% of braze joints must be inspected to ensure joints have uniform fill without excessive braze material or under fill. Joints must also be free from visible surface irregularities and vacuum virtual leaks. Inspection shall be performed with an additional light source and 2.5X magnification or greater. Braze fillets are permissible but should be kept on the less critical side of the brazing whenever possible (i.e. away from the vacuum and RF volumes, which are clearly shown in Section 4.15.3).

4.3.2.3. Furnace Requirements

All brazing must be performed in a vacuum furnace, 5×10^{-5} Torr or better is recommended. An exception can be made for hydrogen furnaces, but only when used for the air side assembly components. Any furnace used should be suitably clean to braze UHV parts without risk of contamination. UKRI-STFC's written approval of the furnace performance specifications is required.

4.3.2.4. Outgassing Cycle

The outgassing process for the stainless-steel parts may be included in the brazing thermal cycle.

4.3.2.5. Ceramic Protection

All non-brazing surfaces of the ceramic must be protected during brazing to avoid all contamination by metal vapours.

4.3.2.6. Cleanliness

All parts and associated tooling must be cleaned to UHV cleanliness standards prior to brazing, and assembly must take place in a clean industrial area. Before each brazing, any dust must be removed with dry nitrogen.

4.3.2.7. Nickel Strike

For any components which receive a nickel-strike during manufacturing, the residual magnetic field should be verified per the requirements in Section 4.14 prior to the next step of manufacturing.

4.3.2.8. CT Scanning

All ceramic window sub-assemblies (F10187818), both samples and those used in production, shall be examined by CT Scanning at UKRI-STFC's expense, including shipping costs. The Contractor should use UKRI-STFC's subcontractor. The Contractor will ship the items, properly packaged to ensure no damage occurs, to UKRI-STFC's subcontractor. The windows will then be scanned and returned to the Contractor. The Contractor can expect return of the windows within two working weeks from the time they arrive at UKRI-STFC's subcontractor. UKRI-STFC will provide cases for the shipment of the window sub-assemblies. These will help to prevent damage to the windows. The case is made of plastic and will not affect the quality of the CT scan. The window will always remain in the case during this process. UKRI-STFC shall retain the CT scan results provided by the subcontractor. Inspection of the results will be used to identify internal defects, such as:

- Filling imperfections
- Solid inclusions
- Gas entrapment
- Flux inclusion

- Lack of fusion

4.3.2.9. Metallisation

If metallisation is performed by the Contractor, the following criteria applies:

- Metallization shall be of molybdenum-manganese composition.
- Location of metallization shall be on inner and outer diameter surfaces of the ceramic window which contact the copper sleeves.
- Metallisation shall be of uniform thickness with no foreign inclusions or irregularities.
- Procedure for metallization, including expected final thickness of metallisation layer, must be approved by UKRI-STFC prior to metallisation.

4.3.3. Metal Braze Sample Generation – Scope Option 2.1.1.2

All findings shall be documented in a report and sent to UKRI-STFC for approval following completion of testing. The samples shall also be sent to UKRI-STFC.

4.3.3.1. Sample Requirements

The Contractor shall perform preliminary validation tests for each brazed material combination used for the manufacturing of the couplers, as listed below:

- Copper-Copper
- Copper-316 Stainless Steel
- 316 Stainless Steel-316 Stainless Steel

For each material combination, the Contractor will establish an operational method (material, tools, chemicals, procedures, qualified personnel) for approval by UKRI-STFC prior to the start of fabrication. Re-validation is required for any process changes and must be approved by UKRI- STFC. The Contractor will create three brazing samples of each material combination that are similar in shape and form to their coupler counterparts for validation.

4.3.3.2. Sample Visual Inspection

The Contractor shall examine all samples for defects. ISO standard 18279:2003 “Brazing — Imperfections in brazed joints” shall be used as a guideline to categorize defects. Inspect all exposed regions of the braze joints for the external braze imperfections mentioned in ISO 18279, which include underfill, cracks, surface breaking porosity, incomplete fillets, and spatter. Samples should be free of all defects, and any defects present require the acceptance of UKRI-STFC.

4.3.3.3. Sample Physical Inspection

The Contractor shall perform metallographic examination for internal braze imperfections of the samples as follows:

Perform an industry standard dye penetrant test on the samples. If any defects are found, notify UKRI-STFC prior to further testing.

Prepare a transverse cross section of one sample of each type by cutting with a diamond saw (or equivalent) and polishing surfaces sufficiently to show details of the all the braze interfaces. Care shall be taken to not damage the joint integrity when cutting.

Using a microscope (50x or greater) examine each of the braze interfaces for imperfections using ISO 18279 as a reference. Inspect all exposed regions of the braze joints for the internal braze imperfections mentioned in ISO 18279.

Any imperfections that encompass less than 20% of the projected area of the braze can be accepted by UKRI-STFC.

An image, under sufficient magnification to identify braze quality, of each sample cross section is required.

4.3.4. Ceramic Braze Sample Generation – Scope Option 2.1.1.3

All findings shall be documented in a report and sent to UKRI-STFC for approval following completion of testing. The samples shall also be sent to UKRI-STFC.

4.3.4.1. Sample Requirements

The Contractor shall perform preliminary validation tests for Copper-Ceramic brazing. The Contractor will establish an operational method (material, tools, chemicals, procedures, qualified personnel) for approval by UKRI-STFC prior to the start of fabrication. Re-validation is required for any process changes and must be approved by UKRI-STFC.

The Contractor will create three brazing samples that are identical to drawing F10187818, Ceramic Window Assembly, and subject to the same requirements. These three samples are explicitly reserved for testing and may not be used for production coupler assemblies.

To allow for positional identification of defects during CT scanning, a small notch shall be made in the outer and inner copper sleeve of each sub-assembly after brazing. The notches do not need to be precise and should be no more than 0.5 mm in depth. The notches should be aligned with one another and the centre of the subassembly. For example, the Contractor could create such notches with small hand file and a guide. Additionally, each sample should be serialized with a removeable label. Each window will receive a unique serial number, to be on the outer sleeve, with the scheme agreed upon by UKRI-STFC and the Contractor.

4.3.4.2. Visual Inspection

Same as in Section 4.3.3.2 above.

4.3.4.3. Leak Check

The Contractor shall leak check all samples per requirements on the drawings.

4.3.4.4. CT Scanning

Same as in Section 4.3.2.8 above. Any imperfections that encompass less than 20% of the projected area of the braze can be accepted. Any cracks in the ceramic are cause for rejection.

4.3.4.5. Physical Inspection

Metallographic examination for internal braze imperfections of the ceramic window assembly F10187818 shall be performed as follows on one of the samples, following CT scanning. The sample selected shall be of the 'most interest' based on the CT scans.

The Contractor shall apply dye penetrant to the surface of both sides of the ceramic and allow to dry. The penetrant will be used to highlight cracks in the ceramic and braze areas and will help to differentiate between cracks caused by manufacturing and those caused by sample preparation. The type of penetrant may be selected by the Contractor. After penetrant application, the window will be fixed in resin.

The Contractor will prepare five transverse cross sections of the ceramic window assembly F10187818 by cutting with a diamond saw (or equivalent) and polishing surfaces sufficiently to show details of the all the braze interfaces. The exact position of each cut shall be determined by UKRI-STFC and provided to the Contractor based on the CT scan results. Care shall be taken to not damage the ceramic and joint integrity when cutting.

Using a microscope (50x or greater) examine each of the braze interfaces for imperfections using ISO 18279 as a reference. Inspect all exposed regions of the braze joints for the internal braze imperfections mentioned in ISO 18279.

Any imperfections that encompass less than 20% of the projected area of the braze can be accepted. Any cracks in the ceramic are cause for rejection.

Images, under sufficient magnification to identify braze quality, of each sample cross section are required.

4.4. *Welding*

4.4.1. Vendor Design Responsibility

It is the sole responsibility of the Contractor to ensure all welded joints have proper tolerance to provide an optimal joint design. All changes to the UKRI-STFC drawing package must be submitted in writing and approved prior to the MPRR.

4.4.2. Welding Requirements

UHV standards must be followed during initial cleaning prior to welding, handling, and welding of parts. All welds must be full (100%) penetration.

Stainless-stainless welds shall use filler material ER316LMn, bare wire, AWS 5.9 Class ER316LMn / ASME SFA 5.9 Class ER316LMn.

4.5. *Copper Plating*

4.5.1. Requirements and Mandatory Testing

4.5.1.1. Quality

Plating shall be of the highest quality in order remain intact (e.g., no delaminating or flaking) at temperatures that range from 4 K to 450 K. The copper plating shall be smooth, fine grained, adherent, free from blisters, pits, scale, nodules, and other defects which the vendor knows to affect RF

performance. Transitions between the plated and non-plated regions must be smooth. Copper plating on parts shall be free of oxidation upon delivery to FNAL, Batavia, Illinois, USA .

4.5.1.2. Mandatory Sample Plating

Four coupons shall be generated, larger than 26 mm x 26 mm, with a nominal plating thickness of 10 ± 5 µm (to be verified via micrometer). All coupons will be used to validate RRR and surface roughness requirements stated below.

Results of the RRR and surface roughness tests shall be documented in a report and sent to UKRI-STFC. The report must include the surface roughness measurement machine make, model, and calibration date. The Contractor shall send two of the four sample coupons to UKRI- STFC or an organization of its choosing for cross-validation.

RRR Value

The copper plating shall have a RRR value within the range of 10-50. Sampling of RRR is to be performed at the beginning of qualification and production runs and when any of the chemical baths for the copper plating process have been replaced. The Contractor shall measure the RRR value and include in the reports.

Surface Roughness

The copper plating shall have a surface roughness of Ra < 0.8 µm. Surface roughness may be measured using either contact or non-contact methods. Sampling of surface roughness must be performed at the beginning of qualification and production runs and when any of the chemical baths for the copper plating process have been replaced.

4.5.1.3. Plating Location

The copper plating for a given component shall stop at the indicated location on the drawing, ±

1.5 mm. No copper plating is permissible on metal gasket sealing surfaces.

4.5.1.4. Plating Thickness Validation

For each vacuum side outer conductor, F10187847, the component weight before and after copper plating shall be recorded in the traveller. Weight prior to plating should be measured after the nickel strike. Weight after plating shall be taken only once the component has been stripped of excess plating and has had sufficient time to dry, but before the remaining nickel strike is removed. Accuracy of measurement system shall be sufficient to determine copper plating thickness to ± 1 µm, as calculated by plating surface areas. The approximate coated surface area of the vacuum outer conductor is 74,229 mm^2 which is based on the CAD model, as shown in Figure 4.

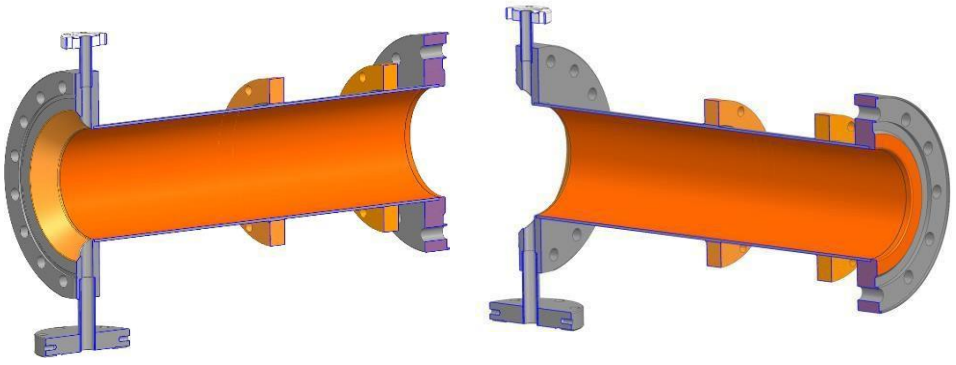


Figure 4:Vacuum Outer Conductor Plating Surface Area

4.5.1.5. 400°C Quality Control Bake

As part of Quality Control process, all copper plated parts must be vacuum baked at 400 °C for 2 hours in a clean vacuum oven. Copper plated parts which receive gold plating must be baked after the gold plating.

Prior to the bake, the components must be cleaned per section 4.5.2.

The bake must be conducted under vacuum while actively pumping the hot zone with a cryogenic or turbo molecular pump. During baking, the vacuum level must remain below $6.7x10^{-6}$ mbar ($6.7x10^{-4}$ Pa), although below $6.7x10^{-7}$ mbar ($6.7x10^{-5}$ Pa) is desirable.

After baking, the Contractor must visually inspect each part for evidence of delamination or flaking. The Contractor must perform a detailed inspection of previously masked areas to ensure copper plating is adherent and smooth at the edge. The parts will be acceptable if the test shows no evidence of any blistering or flaking of the copper plating. If defects are found, they should be reported and addressed as per Section 5.6.

Ensure uniform heating of components at a controlled rate to prevent the bellows, a subcomponent with low thermal conductivity, from exceeding 425 °C.

Prior to the 400 °C bake, the Contractor shall submit a bake plan for each component, to be approved by UKRI-STFC prior to baking.

4.5.2. Pre-Plating Cleanliness

4.5.2.1. Cleaning

All metal parts must be cleaned prior to copper plating. ASTM B322-99 “Standard Guide for Cleaning Metals Prior to Electroplating” is recommended as a baseline for cleaning metals prior to electroplating.

4.5.2.2. Water Break Test

A water break test shall be performed to validate that each part is thoroughly cleaned prior to electroplating. Surfactants, such as soap, reduce the sensitivity of the test and must be thoroughly rinsed off prior to testing.

4.5.3. Plating Process

4.5.3.1. Process

Copper plated areas are to be plated using a cyanide generic process with periodic reversal.

4.5.3.2. Water Resistivity

De-ionized water resistivity must be verified to be <1 MΩ prior to plating. This value shall be recorded in the reports.

4.5.3.3. Plating Reports

Plating shop lab reports documentation must be provided for plating tested at the beginning of qualification and production runs and when any of the chemical baths for the copper plating process have been replaced. Impurity and QC reports, similar to those shown in Table 3 and Table 4, are required as part of the QC documentation which shall be delivered with the couplers.

Table 3: Impurities Report

Material	Date of test	Findings – Summary of impurities (%)	Comments
Nickel Strike			
Copper Strike			
Copper Plating			

Table 4: Chemical Reports

Material (ox/gal)	Date of Test	Limits: Min & Max	Comments
Free Cyanide			
Total Copper			
Potassium Hydroxide			
Rochelle Salt			

4.5.4. Copper Plating Sample Generation – Scope Option 2.1.1.4

The following tests are required to check the adhesion between the copper plating and base material. Sample testing to validate the copper adhesion is required at the beginning of qualification and production runs and when any of the chemical baths for the copper plating process have been fully replaced. In addition, all copper plated parts must undergo a vacuum bake-out test. A report describing the results of the tests shall be provided to UKRI-STFC for approval up on completion of tests. The samples are to be provided to UKRI-STFC.

4.5.4.1. Bend Test

Bend test per ASTM B571-18 “Standard Practice for Qualitative Adhesion Testing of Metallic Coatings” of one test coupon. An acceptable test result will show no evidence of swelling and peeling of plating layer.

4.5.4.2. Peel Test

Peel test per ASTM B571 on one test coupon. An acceptable test result will show no evidence of any peeling of plated parts, or copper deposit on the tape.

4.5.4.3. Ultrasonic Bath Test

Ultrasonic bath test on one test coupon. Place test coupon in an ultrasonic bath with the following parameters:

- Power level: 10 ± 2 W/litre
- Detergent: 5% Tikopur R33 or equivalent
- Temperature: 50 ± 5 ° C
- Duration: 10 ± 1 minutes

After ultrasonic bath, visually inspect with 10x magnification. An acceptable test result will show no evidence of peeling, loose plating, or damage to the copper plating. If the contractor plans to use an alternative to Tikopur R33 it must be raised in the kick-off meeting, the decision to accept or reject the alternative shall be made by UKRI-STFC within 2 weeks after the meeting.

4.5.5. Mandatory Bellows Plating Sample

A report describing the results of the tests shall be provided to UKRI-STFC for approval up on completion of tests. The samples are to be provided to UKRI-STFC.

4.5.5.1. Requirements

Copper plating within bellows convolutions can vary greatly if the methods of plating are not precisely controlled. The bellows used to create the samples do not need to be identical to those used in the coupler air side assembly, however, they must be similar in size and depth of convolution and must be of identical material. It is suggested that the vendor purchase ready- made bellows for such samples. Only one sample for each bellow size (F10187844 and F10187849) is required.

Upon plating the sample bellow, the Contractor shall perform a section cut of the bellows to allow for thickness measurements of the plating. Measurements on a section should be performed with an optical microscope which can resolve the thickness with <10% measurement error.

Successful results will show the copper plating at the specified thickness at five or more points evenly spaced along three different convolutions (per bellow). Any deviation from these requirements must be reviewed by UKRI-STFC.

4.6. *Electropolishing*

A report describing the results of the tests shall be provided to UKRI-STFC for approval up on completion of tests. The samples are to be provided to UKRI-STFC.

4.6.1. Requirements

As indicated on the drawings, electropolishing should create a 'mirror-like' surface finish on the components, with a surface roughness meeting the requirements specified on the part drawings. The electropolished part must meet all specified tolerances. The stage of assembly at which components are electropolished must be in accordance with what is specified on the relevant drawings.

4.6.2. Mandatory EP Sample Generation

The Contractor shall procure two or more samples identical to the copper antenna tube, F10187821.

The Contractor shall keep one sample as a reference for quality prior to electropolishing. The Contractor shall generate at least one electropolished sample which meets the requirements listed in Section 4.6.1, to be verified by surface roughness measurements.

4.7. *Gold Plating*

4.7.1. Requirements

4.7.1.1. Quality

Plating shall be of the highest quality in order remain intact (e.g., no delaminating or flaking) at temperatures that range from 4 K to 450 K. The gold plating shall be smooth, fine grained, adherent, free from blisters, pits, scale, nodules, and other defects which the vendor knows to affect RF performance. Transitions between the plated and non-plated regions must be smooth. Gold plating on parts shall be free of oxidation upon delivery to UKRI-STFC.

4.7.1.2. Cleanliness

The same pre-plating cleanliness requirements for copper plating in section 4.5.2 apply to gold plating.

4.7.1.3. Plating Thickness Validation

The gold plating thickness for components should be validated using similar methods as those described in section 4.5.1.4.

4.7.1.4. Plating Process

The plating process used, gold purity, and chemical bath report format shall be proposed by the Contractor and confirmed by UKRI-STFC prior to the bid award.

Plating shop lab reports documentation must be provided for plating tested at the beginning of qualification and production runs and when any of the chemical baths for the gold plating.

process have been replaced. Impurity and QC reports are required as part of the QC documentation which will be delivered with the couplers.

4.7.2. Gold Plating Sample Generation – Scope Option 2.1.1.6

4.7.2.1. Gold Plated Copper Samples

Four coupons shall be generated, larger than 26 mm x 26 mm, with a nominal gold plating thickness of 2 ± 0.5 µm. Thickness is to be verified by a method proposed by the vendor and agreed to by UKRI-STFC. All coupons shall be tested per the requirements below. The coupon material shall be Oxygen Free Copper (OFC).

The following tests are required to check the adhesion between the gold plating and base material. Sample testing to validate the gold adhesion is required at the beginning of qualification and production runs and when any of the chemical baths for the gold plating process have been fully replaced.

A report describing the results of the tests shall be provided to UKRI-STFC for approval up on completion of tests. The samples are to be provided to UKRI-STFC.

Bend Test

Bend test per ASTM B571 of one test coupon as described in Section 4.5.4.1.

Peel Test

Peel test per ASTM B571 on one test coupon as described in Section 4.5.4.2

Ultrasonic Bath Test

Ultrasonic bath test on one test coupon as described in Section 4.5.4.3 An acceptable test result will show no evidence of peeling, loose plating, or other damage to the gold plating.

4.7.2.2. Gold Plated Copper-Stainless Steel Samples

Four coupons shall be generated, tested, and a report provided for as described in 4.7.2.1, with the only difference being the coupon material shall be 316 stainless steel with a 20 ± 5 µm copper plating.

4.7.2.3. Gold Plated Bellows Sample

If this option, 2.1.1.6, is exercised, the bellows which are copper plated per 4.5.5 shall receive a 2 µm ± 0.5 thick gold plating over the copper plating prior to the examination which will be performed per 4.5.5. Requirements of the gold plating on the bellows are the same as for the copper plating listed in 4.5.5.

4.7.3. Gold Plating of Antenna – Scope Option 2.1.1.7

4.7.3.1. Requirements

The vendor shall apply a 2 ± 0.5 µm thick gold plating on the antenna, from the tip of the antenna to 380 ± 5 mm, as illustrated in Figure 5. This is to be performed as the final step of manufacturing for the antenna assembly.

Figure 5: Gold Plating Location

4.7.4. Gold Plating of Inner Conductor – Scope Option 2.1.1.8

The Contractor shall apply a 2 ± 0.5 µm thick gold plating on the inner conductor, F10187831, overtop the copper plated surfaces indicated in the drawing, with the same positional requirements s for the copper plating. The timing of the gold plating in the manufacturing process must be agreed upon before the MRR is completed.

4.7.5. Gold Plating of Outer Conductor – Scope Option 2.1.1.9

The Contractor shall apply a 2 ± 0.5 µm thick gold plating on the outer conductor, F10187845, overtop the copper plated surfaces indicated in the drawing with the same requirements as for the copper plating. The timing of the gold plating in the manufacturing process must be agreed upon before the MRR is completed.

4.8. *Titanium Nitride Coating – Scope Option 2.1.1.1*

4.8.1. Requirements

Titanium Nitride (TiN) shall be applied to vacuum surfaces of the ceramic windows in accordance with the engineering drawings. Once the TiN coating has been applied, the ceramic window must never be subjected to temperatures exceeding 400 °C. The TiN coating shall not compromise the dissipation factor tan of $< 10^{-4}$ at room temperature for 650 MHz.

4.8.2. Sample Generation – Scope Option 2.1.1.5

A report describing the results of the tests shall be provided to UKRI-STFC for approval up on completion of tests. The samples are to be provided to UKRI-STFC.

4.8.2.1. Requirements

The Contractor shall generate three TiN coated ceramic samples. Each ceramic shall only have one side coated. Ceramics must NOT be metallized so that UKRI-STFC can measure loss tangent.

The ceramics used in production couplers can only be TiN coated after brazing with the copper sleeves (see assembly F10187818). As such, the test coating tooling must imitate the sleeves, as they can obstruct the coating. The tooling design is to be approved by UKRI-STFC between the kick-off meeting and the MRR.

Samples will be deemed acceptable if upon delivery to UKRI-STFC the measured dissipation factor tan is < 10^{-4} at room temperature for 650 MHz. Upon receipt, UKRI-STFC shall perform the necessary measurements on the samples within 10 working days.

4.9. *Instrumentation*

4.9.1. SMA Feedthrough, F10193904

The SMA Feedthrough shall conform to the requirements per the drawing F10187825. As this is a custom feedthrough, the lead-times should be considered when purchasing.

Upon receipt, the vendor shall NOT assemble the feedthrough's accessories to the electrical connector. The bag of accessories each feedthrough comes with shall be set aside and shipped to UKRI-STFC with the delivery of the completed assemblies.

4.9.2. Cold Cathode Gauge, FC007495

The Cold Cathode Gauge (CCG) model and Contractor shall match that listed on the coupler vacuum assembly drawing, F10187825.

Upon receipt, the Contractor shall remove all stickers from the CCG and clean with IPA as needed to remove adhesive. Afterward, the Contractor shall serialize the magnet and gauge per the scheme in Figure 6, following the requirements below:

- Electric engraver should be used.
- Numbers must be legible – use stencil if necessary.
- Serial numbers must be in positions shown in Figure 6
- Scheme for numbers to be provided by UKRI-STFC prior to implementation.

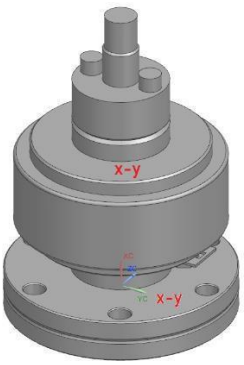


Figure 6: CCG Serial Code Locations

After serialization, all magnets shall be removed and set aside, do NOT bake the magnets. The Contractor should take special care not to misplace the screw and metal tab which pair with each magnet. The magnets will then be shipped to UKRI-STFC with the delivery of the completed assemblies. Magnets must NOT be allowed to come into direct contact with one another.

4.10. *Serialisation*

The components listed below shall have unique serial numbers, in the locations shown in the following figures. The final scheme will be provided to the Contractor prior to the MRR. Serial numbers shall be applied with either a laser engraver, or by a handheld engraver utilizing a stencil.

4.10.1. Vacuum Outer Conductor – F10187847

Serialization of the vacuum outer conductor must be performed before copper plating.

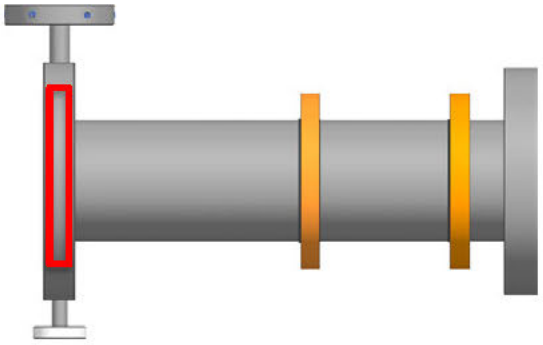


Figure 7: Vacuum Outer Conductor S/N location

4.10.2. Antenna Assembly / Ceramic Window – F10187823

Figure 8: Antenna and Window assembly S/N location

4.10.3. Air Outer Conductor – F10187845

Serialization of the air outer conductor must be performed before copper plating.

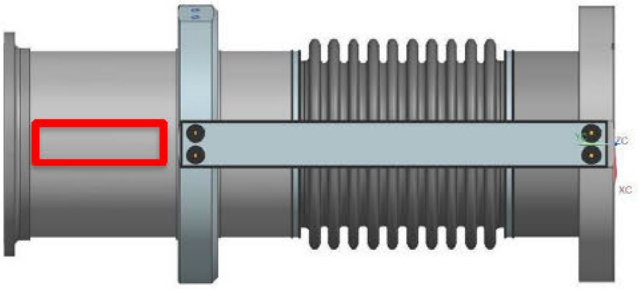


Figure 9: Air Outer Conductor S/N location

4.10.4. Air Inner Conductor – F10187831

Serialization of the air inner conductor must be performed before copper plating. If a hand engraver is used, remove any burrs with fine sandpaper prior to copper plating.

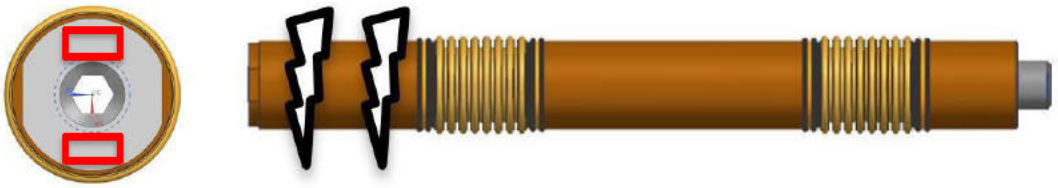


Figure 10: Air Inner Conductor S/N location

4.10.5. Waveguide Assembly – F10187820

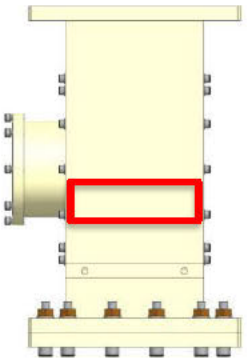


Figure 11: Waveguide S/N location

4.10.6. Enclosure Assembly – F10187853

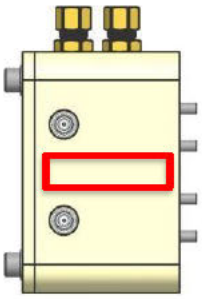


Figure 12: Enclosure S/N location

4.11. *Metrology and Visual Inspection*

4.11.1. Metrology Inspection Requirements

All sub-components and components shall be inspected by the Contractor upon receipt from subcontractors or internal machine shops prior to further assembly, any time that the component is received by the Contractor. The final agreed upon drawing set shall serve as the reference for dimensional conformance, and parts shall meet all specified tolerances. If sampling is proposed by the Contractor, UKRI-STFC is to review and approve the percentage of parts to be sampled. For all measurements, care should be taken not to damage sensitive components or surfaces.

4.11.1.1. Vacuum End Assembly Requirements

Each completed vacuum side outer conductor, F10187847, and ceramic window antenna assembly, F10187823, shall be inspected after final brazing but prior to final assembly and cleaning. All dimensions given on the subassembly drawing shall be verified.

A metrology inspection report containing measured values of required acceptance criteria must be generated for each component. The report and any relevant inspection sheets shall be linked to the corresponding traveler

4.11.2. Visual Inspection Requirements

All sealing surfaces must undergo a receiving inspection per section 4.13.1 upon receipt from subcontractors or internal machine shops prior to further assembly, any time that the component is received by the Contractor. Inspection shall utilize additional magnification (2.5X or greater) and lighting.

Part specific visual inspection points will be identified during traveler / inspection sheet generation and must address all drawing and specification requirements.

4.12. *Alodine Coatings*

For parts which will receive Alodine coating, per drawings, the Alodine (or equivalent) must be yellow in colour (clear is not acceptable).

4.13. *Vacuum Leak Tightness*

"Diamond seal" surfaces are defined as the flat sealing surfaces which pair with a hexagonal aluminium seal.

4.13.1. Sealing Surface Quality

All sealing surfaces, whether diamond seal or conflat (CF), MUST meet the requirements specified on the drawings. The surfaces are to be free of all radial scratches, nicks, and damage that can affect the leak tightness of the joint. Sealing surfaces must be checked for damage upon initial component receipt and should be periodically checked at other critical phases of manufacturing.

Irrespective of a successful leak check, the sealing surface MUST NOT have any damage as described in the technical drawings. Parts with such damage will be REJECTED and returned to the vendor for re-work as described in Section 5.6.5

4.13.1.1. Rework of Damaged Sealing Surfaces

Should any damaged sealing surfaces be discovered, the Contractor shall notify UKRI-STFC at the earliest convenience, then rework the surface to conformance and document the occurrence in the component's traveler.

After rework, the components must still meet any tolerances and dimensions specified in the drawings, and the Contractor must provide images of the reworked areas to UKRI-STFC for approval. Should the parts be deemed unsatisfactory, they shall not be used in any assembly. CF seals must retain their 'knife edge' to ensure proper sealing.

Guidelines for rework are to be provided by UKRI-STFC upon request from the Contractor. Diamond seals require a small amount of tooling to repair. Spot polishing of diamond seals is NOT permitted as it can create an uneven surface.

4.13.1.2. Protection of Sealing Surfaces

The Contractor, and any subcontractors, shall use plastic protective covers to protect the sealing surfaces. The covers shall be in place anytime reasonably permitted by the manufacturing cycle, including, but not limited to, transportation (pre-final assembly), storage, and internal handling.

The Contractor shall never use a bare metal tool to remove metal seals from flanges after leak checks. The ideal method of removal should be a plastic razor blade, or by hand.

4.13.2. Leak Checks

All parts, brazed and welded joints, CF-style and diamond seal flanges, shall be helium leak checked during sub-assemblies – where required and after final assembly as specified on the drawings. O-rings may be used for intermediate leak checks, but the final leak check must be done with new metal seals which match UKRI-STFC supplied drawings. The vendor shall follow leak check parameters detailed on drawings.

4.13.2.1. Equipment Requirements

The leak checks shall utilize a helium mass spectrometer that meets the sensitivities required per component drawings. The leak checking vacuum system shall be designed to eliminate any risk of hydrocarbon contamination of the parts being tested.

The Contractor shall design and fabricate any mating hardware required to perform leak tests.

4.13.2.2. Special Seals

UKRI-STFC can provide the aluminium diamond seals (F10187959) to the vendor in sufficient quantity to leak check all assemblies.

UKRI-STFC will NOT provide the annealed 6” CF seals (FC104619).

4.13.2.3. Reporting

The Contractor shall record leak check results for subassemblies on relevant travelers and inspection sheets.

4.13.3. Cold Shock Testing

The Vacuum Side Outer Conductor, F10187847, shall be cold cycled three times to Liquid Nitrogen (LN2) temperatures before leak checking per the requirements below:

The cold shocks shall be performed before the 400 °C bake, but after copper plating.

When the outer conductor is removed from LN2 it should be immediately placed into a non- oxidizing environment such as nitrogen or another inert gas in a sealable container, to prevent oxidation.

4.14. *Residual Magnetic Field*

The residual magnetic field of all components on assembly F10187825, must be verified to be below 5 mG at a distance of less than or equal to 5 mm from the outer surfaces. Flanges are of particular concern.

Certain portions of the Coupler Storing Chamber Assembly, F10187763, are excluded from this requirement. These excluded areas include the right-angle valve, 2-3/4" CF flange, and the baseplate. Additionally, the CCG is excluded. Figure 13 serves as a reference for parts to check / not check.

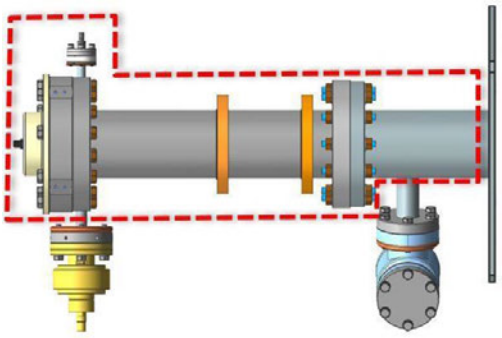


Figure 13: Components Within Dotted Line must be Verified for Acceptable Residual Mag. Field

4.15. *Cleanliness*

All parts and assemblies shall be free of cutting fluid, flux, atmospheric dust, and other contaminants, visible to the naked eye. Parts shall be cleaned prior to any brazing, furnace treatment, welding, or plating, per the requirements given in the relevant Sections.

4.15.1. Pre-Cleaning Visual Inspection

Before cleaning it is strongly suggested that the Contractor performs a visual inspection of the antenna and vacuum outer conductor. The checked points should include any visual inspections which are part of the traveler.

4.15.2. Cleanroom Requirements

4.15.2.1. Facilities, Equipment, and Certifications

Cleanrooms must be ISO- certified, and the certification must be up to date. Operations and clean room attire shall adhere to relative ISO classification.

Any leak checking or RGA equipment used must be up to date on calibrations and certifications.

4.15.2.2. Component Cleaning

Any water used for cleaning must be Ultrapure Water. All cleaning of components which are part of the vacuum end assembly, F10187825, must take place in an ISO 7 or better cleanroom (ISO 6 is preferred).

The cleaning of the antenna and outer conductor should take place immediately prior to the final assembly. Should the clean and dry components be expected to sit in the open air for more than one hour prior to assembly, they shall be placed in a clean non-oxidizing environment. It is suggested to have a nitrogen cabinet in the cleanroom for this purpose.

Details for cleaning of the components can be provided by UKRI-STFC up on request. These are to be agreed at or prior to the MRR.

4.15.2.3. Component Assembly

All assembly of components which are part of the vacuum end assembly, F10187825, must take place in an ISO 5 or better cleanroom (ISO 4 is preferred).

The final assembly process must be as particle-free as possible. Best practices suggestions can be provided by UKRI-STFC upon request.

The final leak check must be performed in the ISO 5 cleanroom to maintain component cleanliness in case of a leak.

4.15.2.4. Oxidation

All copper surfaces, solid or plated, must be free of oxidation upon delivery to UKRI, except for the thermal strap mounts, F10186990 and F10186991.

4.15.3. Particle Count Specification

After cleaning (or post cleaning inspection) and immediately before assembly, particle counts of the following components shall take place:

- Antenna assembly, F10187823
- Vacuum outer conductor, F10187847
- Cold cathode gauge, FC0074795
- SMA Feedthrough, F10193904
- chamber weldment, F10187967
- Right angle valve, FC0075829
- All seals

Before particle counting, an ethanol wipe shall be used to wipe down all surfaces which are not within the UHV space. Wiping must reveal no signs of contamination. Do not wipe any UHV surfaces.

The Contractor should then blow UHV surfaces with boil-off nitrogen or bottled nitrogen (Ultra High Purity 99.9999%), without particle counting for a few minutes. This will lessen the time to achieve the count requirements. Gas delivery system must have a filter at the Dewar and a nitrogen ionizer that has a point of use 0.02 µm or better filter.

All UHV surfaces of the listed components must meet the particle count specifications as defined in Table 5. UHV surface locations are defined for the antenna and outer conductor in Figure 14 and Figure 15. For the other components, refer to drawings as necessary. The particle counts specified are for a sample ≥ 28.3 Litre (1 cubic foot). The pumping speed of the Contractor's particle counter shall be used to determine the time duration of the sample, and the counter shall be set with this value. For example, a 100LPM unit requires only 15 second samples, while a 25 LPM model would require roughly 1-minute samples.

Particle detection will be performed using filtered nitrogen as described earlier in this section. When qualifying all parts, the nitrogen ionizer pressure is to be 6 bar (90 psi), the spray gun is to be within 25 cm of the part, and the isokinetic sample probe shall be positioned no more than 5 cm away from the part being sampled. Care must be taken when blowing the antenna not to apply a high amount of force which could result in bending.

Should a given area of the part not be particle free after particle counting for 5 continuous minutes, the part shall be deemed unfit, and must be recleaned. An exception to this is made for the right- angle valve and cold cathode gauge, which are known to take longer than average to blow clean due to their internal geometry. If these parts take longer than 15 min to blow clean, then reclean with the appropriate methods.

Table 5: Particle Count Requirements, ≥ 28.3 L Sample Size

Particle Size	**0.3 µm**	**0.5 µm**	**1 µm**	**5 µm**
UHV Surface Counts	5	0	0	0

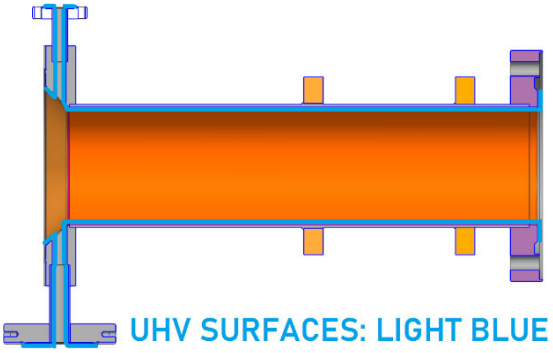


Figure 14: Outer Conductor UHV Surface Locations

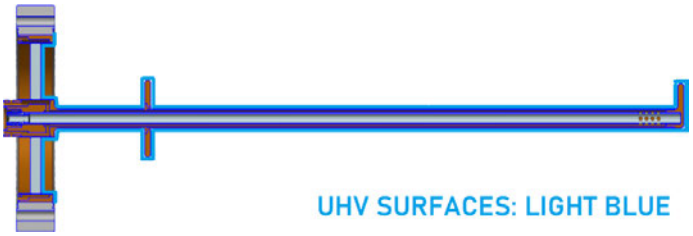


Figure 15: Antenna Assembly UHV Surface Locations

4.15.4. Final Assembly Tooling

The following tooling is required during final assembly for the protection of the vacuum side components. The exact design is left to the vendor to determine, although suggestions are provided.

- A Teflon base for the antenna assembly to rest on for stability. See Figure 16 for an example design.
- A guide for assembly of the outer conductor to the antenna assembly, and for the assembly of the vacuum storage chamber to the outer conductor. The materials used for the guide must be clean room compatible. Anodized T-slotted extruded aluminium framing (e.g., 80/20 brand) is permissible, but any fasteners must be stainless steel. See Figure 17 for an example.

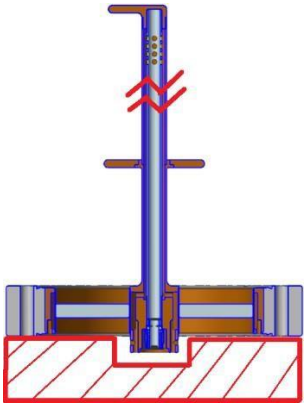


Figure 16: Antenna Teflon Base Example (red)

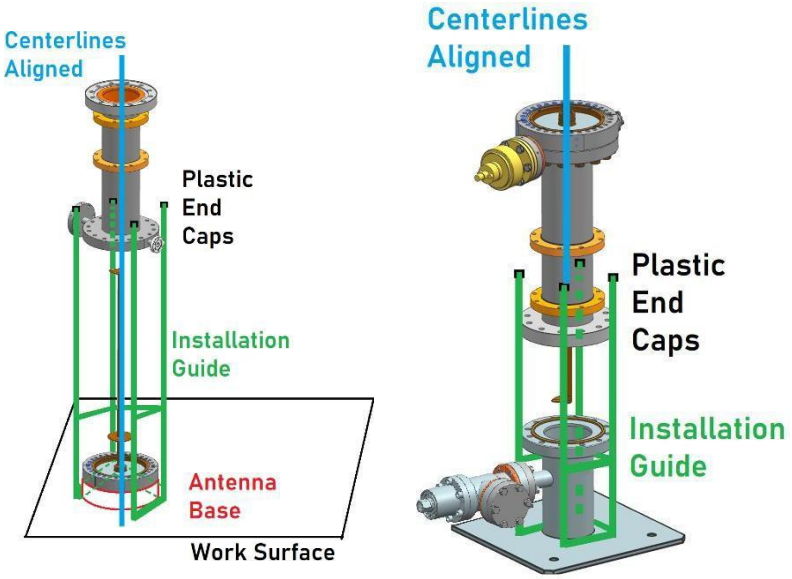


Figure 17: Installation Guide Design Example

4.15.5. Final Assembly Requirements

Final assembly must take place immediately following successful particle counting. The final assembly configuration for work in the cleanroom is shown as '120°C Bakeout Configuration' on the vacuum end assembly drawing.

The rotational alignment of the antenna assembly and vacuum outer conductor will be provided to the vendor by UKRI-STFC prior to assembly.

4.15.6. Leak Check and Pre-Bake RGA

After the final assembly, the final leak check shall be performed per Section 4.13.2. This must take place in an ISO 5 or better clean room in case the system is not leak tight. It is recommended to perform the pre-bake RGA at this time, but not required.

4.16. *Low Temperature Bakeout and Desorption Requirements*

Low temperature bakeout shall only take place after the final assembly and successful final leak check. Refer to the vacuum end assembly drawing for the required configuration. The baked assembly shall remain under vacuum upon completion of baking and shall NOT be disassembled or vented.

4.16.1. Desorption Requirements

The desorption rate of all the UHV surfaces of the vacuum end assembly, F10187825, shall be $r \leq 5 \times 10^{-12}$ ATM-CC/sec cm^2. Cleaning and handling procedures and practices and shipping containers shall be designed and implemented to satisfy desorption specification on assemblies as received at UKRI-STFC.

4.16.2. Configuration

The vacuum end coupler assembly shall be baked in the baking configuration shown on its drawing, F10187825. The entire assembly shall be baked at a temperature of 120ºC (±5ºC) for 48 hours. The vacuum at the start of the bake must be < 2.7×10^{-6} mbar (2.7×10^{-4} Pa) and remain below this level for the duration of the bake. The bake out vacuum system configuration shall have an RGA sensor head for the vacuum volume. It is preferred to have constant RGA monitoring, but RGA before and after baking is acceptable. The oven atmosphere is preferred to be nitrogen to avoid oxidation of the exterior coupler parts. The RGA must be able to read between 1-100 AMU, but it is preferred that it can read between 1-200 AMU. Ensure that the brass crush nut is NOT installed on the antenna and that the magnet is NOT installed on the vacuum gauge.

4.16.3. Measurements

The temperature and vacuum history are to be recorded and a plot provided with the coupler document package (i.e., one linear plot showing all the temperatures, and one log plot showing the vacuum pressure, both with the same time range). The plots should also show the initial and final pressures at room temperature. The acceptable post-bake vacuum pressure at room temperature is less than 1.3×10^{-8} mbar (1.3×10^{-6} Pa).

4.16.4. RGA Scan Criteria

After initial pump down, while the coupler assembly is at room temperature, record the full spectrum RGA scan as soon as the pressures allow for the operation of the Electro-Multipliers at

< 1.3×10^{-6} mbar (1.3×10^{-4} Pa). Record total pressure. Repeat RGA scan at the completion of the bake cycle, but while the system is still at 120 ºC. The final RGA scan shall be performed when the assembly has returned to room temperature.

Table 6 lists the acceptance criteria for the bake and RGA scan.

Table 6: Bake and RGA Acceptance Criteria

Conditions/ Criteria	Limits
Temperature of entire vacuum system and RGA head ionizer	120° C ±5° C
Ratio of partial pressures of water vapor, (18 AMU) to hydrogen (2 AMU)	$P18 < P2/2$
Partial pressure from sum of all peaks >44 AMU	P < 1.3×10^{-11} mbar (1.3×10^{-9} Pa)

Maximum post-bake single-peak partial pressure for >44 AMU	$P < 6.7 \times 10^{-12}$ mbar (6.7×10^{-10} Pa)
Maximum post-bake pressure at room temperature.	1.3×10^{-8} mbar (1.3×10^{-6} Pa)
Desorption rate after baking	$\leq 5 \times 10^{-12}$ ATM-CC/sec-cm^2.

4.17. *Packaging and Shipping*

The Contractor's plan for packaging and shipment must be approved by UKRI-STFC prior to purchasing any packaging materials and as part of the MRR.

Coupler assemblies shall be shipped per requirements listed below.

4.17.1. Vacuum Side Packaging

The vacuum side assembly, F10187825, must be assembled to match the transportation configuration shown on its drawing. To preserve exterior cleanliness, the assembly shall be packaged in single, clear, durable, clean room compatible plastic bag (over 0.1 mm thick). The bag does not need to be sealed leak tight and may be bunched and closed with a plastic cable tie.

4.17.2. Air Side Packaging

The air inner conductor, F10187831, and air outer conductor, F10187845, MUST be packaged separately from the other components of the air side assembly, F10187833. The outer conductor must have its support brackets installed, and the bellows on the inner conductor must be protected from any damage and flexing. Any other fasteners or components which would typically connect with the inner or outer conductor must be packaged separately in resealable bags with labels.

Both the inner and outer conductor shall be double bagged and back-filled with filtered ionized boiled-off nitrogen gas. Packaging shall be a plastic bag which is heat sealable, clear, durable, clean room compatible and >0.1 mm thick.

The remaining parts of the air side assembly shall be packaged in single, clear, durable, clean room compatible plastic bags (>0.1 mm thick). The bags do not need to be sealed leak tight and may be bunched and closed with a plastic cable tie. Any other fasteners small components must be packaged in resealable bags with labels.

4.17.3. Packaging Materials

No paper or air-filled bags will be used as shipping material.

4.17.4. Crate Configuration

Containers shall be structurally sound for shipment of components without damage. Containers shall use 'double box/double crate' construction with adequate shock protection. 5G Shock loggers and tilt indicators shall be attached appropriately on the container. The outer container shall be secured and shipped on a pallet which will prevent stacking, tilting, and lifting by hand OR shall be of adequate footprint to minimize the chances of tipping. Any material within the first box / crate must not be able to

puncture/abrade the coupler bagging material. Removing the components from the inner crate must be able to be performed safely and ergonomically. The inner crate shall have provisions to use a pallet mover.

4.17.5. Shipment Methods

Shipment is desired to be by the fastest mode of transport. Shipment by sea is not permitted.

5. General Terms

The Contractor will be required to co-operate closely with UKRI-STFC and its authorised representatives at all stages of the Contract. Technical issues will be resolved after adequate discussion. UKRI-STFC may request to access the Contractor's or its sub-contractor's premises for a visit or inspection.

UKRI-STFC's PIP-II partners and independent consultants might be included in the non- commercial communication with the Contractor for technical advisory support at UKRI-STFC's discretion. Communication is defined as any written correspondence, meetings (remote or in person), and site visits or inspections. UKRI-STFC remains the sole decision-making responsible authority on this contract. UKRI-STFC's PIP-II partners and independent consultants do not become parties to the contract nor undertake obligations under the contract.

Couplers are to be produced strictly observing specifications and processes approved by UKRI- STFC, using best practice for producing high power RF couplers. Failure to comply with the requirements and instructions can lead to a rejection of the material or any part of the finished product at any stage of the manufacturing. The Contractor can make proposals to UKRI-STFC concerning repair, reworking, reuse, etc., which UKRI-STFC may, however, decline. In this case, the Contractor must start again with a new sub-components or assemblies at their own expense and with all practical effort to maintain the schedule and minimise delay.

The pre-series couplers will be used for Contractor qualification: to demonstrate that the Contractor can fulfil the specified requirements. UKRI-STFC will conduct an inspection of the first two couplers as described in Hold Point 4, Section 5.4.3 **Manufacturing of the series couplers, shall only proceed after UKRI-STFC's review of the pre-series couplers data and written approval**

The pre-series couplers will be used for Contractor qualification: to demonstrate that the Contractor can fulfil the specified requirements. Pre-series couplers shall be manufactured and tested in sequence to allow for process evaluation and corrections. Mechanical fabrication, including welding and brazing, of the main series couplers, shall only proceed after UKRI-STFC's review of the pre-series couplers data and written approval.

5.1. *Inputs and Supplies from UKRI-STFC*

For the provision of the Contract UKRI-STFC will ensure that the Contractor has: The latest specification for the manufacture of the couplers and the latest electronic coupler design drawings. A 3D STEP file of the coupler can be provided by UKRI-STFC. The STEP file will contain all parts associated with the design to assist in the quotation. The Contractor should verify that the STEP file is accurate to the drawings. In case of any discrepancies between this specification and the drawing, the Contractor should consult UKRI-STFC.

5.2. *Contractor's Responsibility*

1. Production of Couplers that meet all listed requirements within specified tolerances.
2. Production of a set of manufacturing drawings from the provided Coupler drawings and models. Including braze and weld tolerance changes and other design changes listed in section 4.3.1. **The dimensions of these drawings must allow for weld shrinkage and braze tolerances so that after welding the specified tolerances are achieved**. An itemized list of all deviations from the drawings provided by UKRI-STFC, or changes to the previous revision, must be included. The Contractor is solely responsible for the content of these documents.
3. Procurement of all materials, tooling, and equipment required for component fabrication, welding, coating assembly, safe handling, and factory test of the couplers throughout manufacture and transport, other than those explicitly listed as to be supplied by UKRI-STFC.
4. All necessary quality assurance documentation, quality control activities, and the Contractor's quality control system. The Contractor and all its sub-contractors are required to maintain a Quality Management System (QMS) according to ISO 9001:2015 or equivalent. An active participation in quality planning is required, including process flow and Manufacturing Control Plans generation as a minimum.
5. Ensuring the requirements and processes are understood and followed, including but not limited to the training record maintenance and translation of the relevant documents to the Contractor's official language.
6. Regular progress reporting including monthly written reports of progress against schedule and technical status, progress to date, and material used to date; regular video conferences, face-to-face project meetings at least every 3 months. The frequency of the meetings and visits will be determined by the project needs.
7. Quality assured shipping and handling process under DDP 2020 incoterms including the design and procurement ofshock assured containers, tracking and shock logging equipment, and the shipping route/qualification. UKRI-STFC approval is required.
8. Support to UKRI-STFC throughout the Contract duration and up to 3 months after UKRI- STFC's final acceptance of the last coupler. Support is defined as provision of staff effort for follow-up enquiries regarding the delivered couplers.
9. The Contractor shall furnish any aspects of the coupler fabrication that are not explicitly detailed by this specification, but obviously necessary to meet the requirements. The Contractor should choose the most appropriate method of manufacturing for coupler and subassemblies, subject to UKRI-STFC's approval. In the event of an oversight and/or apparent error in this specification, the Contractor shall notify UKRI-STFC for clarification/correction prior to proposal submission.

5.3. *Timescales and Delivery*

As well as technical performance and adherence to the fabrication processes and quality metrics defined, the schedule of production and delivery is critical. Contractors must take a systematic approach to schedule planning, estimating, tracking progress, and applying all reasonable corrective action to eliminate or minimise delays. The Contractor shall incorporate project Risk Management into their day-to-day work under this Contract. This includes the use of appropriate methods, processes, and tools for schedule management, as well as regular formal reporting of status, progress, issues etc.

The schedule shall include all fabrication and processing steps with a duration equal or greater than 5 business days and all QC activities/Hold Points as reported in section 5.4 Supporting documentation, to demonstrate that the bidder will deliver within the specified timeframe, is recommended.

5.4. *Reviews, Hold Points and Reports*

A kick-off meeting shall be scheduled within two weeks from the contract award, to initiate technical and commercial discussion between the UKRI-STFC and the Contractor representatives.

A hold point is defined as the moment in time, usually at the end of a fabrication, processing or quality control step, wherein the process needs to be stopped in order to allow the UKRI-STFC representative to review documentation, monitor the progress, and perform additional QC, where deemed necessary. The purpose of a hold point is to determine conformance of products and processes to the requirements of this specification before continuation of further activities. Data review hold-points will be put in place for each coupler during the manufacturing. UKRI-STFC can request to witness any of these hold point. UKRI-STFC's written approval and the Contractor's QA/QC representative signature are required for each hold point.

At a minimum, for the series couplers, UKRI-STFC approval to proceed is required after mechanical fabrication. UKRI-STFC and the Contractor will finalize the hold points during the Manufacturing Control Plan (MCP) development. UKRI-STFC's acceptance or approval of parts and material during manufacturing shall not be interpreted as a guarantee of its acceptance in the finished product. All couplers must pass Contractor's inspections prior to delivery. All couplers must undergo a pre-shipment review with UKRI-STFC.

Pre-series couplers will be used for process qualification and will require additional hold points and measurements; for example, thickness measurements to verify uniform material coating during plating or process qualification data review. This will depend on the existing qualifications of the Contractor and the manufacturing methods.

In the event of a major non-conforming condition, further processing of the Non-Conforming item shall be put on hold until the corrective action has been accepted by UKRI-STFC. Refer to Section

5.6 for more details.

5.4.1. Material Procurement Readiness Review

The Contractor shall hold a Material Procurement Readiness Review (MPRR) with UKRI-STFC and FNAL representatives before starting any procurements or fabrication, including procurement of the raw materials.

Manufacturing drawing package and subcomponents inspection plans will be reviewed by UKRI- STFC at this stage, see Table 7 for MRRP deliverables.

Upon conclusion of the MPRR and after UKRI-STFC's written approval, the Contractor may proceed with the procurement of raw materials and subcomponents provided by a third party, and manufacturing individual subcomponents in-house. **No assembly or further processes shall take place,** aside from any sample generation.

5.4.2. Manufacturing Readiness Review

The Contractor shall hold a Manufacturing Readiness Review (MRR) with UKRI-STFC and FNAL representatives prior to the start of manufacturing.

During the MRR the Contractor shall prove their abilities to successfully perform required manufacturing steps, including but not limited to copper plating, brazing, and welding. Documentation supporting the

successful completion of these activities shall be provided to UKRI-STFC and detailed MCPs shall be presented.

The coupler fabrication cannot begin until all the MRR's recommendations have been addressed and UKRI-STFC has provided a written approval. Review's recommendations (if any) based on the presented material (see MRR deliverables in Table 7), shall be addressed within two weeks from the conclusion of the MRR.

5.4.3. General Reviews and Hold Points

A summary of the required documents for each hold point is presented in Table 7. Documentation generated during the required QC activities, supporting the successful completion of a relevant manufacturing or processing step, shall be provided to UKRI-STFC at each Hold Point. Hold points and deliverables at each one may be adjusted, created or removed during the procurement after the changes have been agreed upon by both UKRI-STFC and the Contractor.

Table 7: Hold Points and Deliverables

Hold Point	Description	Deliverables	Comments
N/A	Bid submission	Response to the Request for Proposal Questionnaire	
		High-level Manufacturing, Quality Assurance and Quality Control Plans Pricing Delivery Schedule Organisational chart	
Hold Point 1.	Kick-off meeting	Updated schedule, resource plan including availability of the key staff and equipment, project staff roles and responsibilities, manufacturing plan.	Within 4 weeks from the contract award
Hold Point 2.	Material Procurement Readiness Review (MPRR)	Drawing package of all items and assemblies which deviate from UKRI-STFC's original drawing package. This includes all braze/weld tolerance changes, joint design changes, and other design changes as described in Sections 4.3.1.An itemized list of all the deviations must be included. Bellows drawing package, including written confirmation that cycle requirements will be met. Subcomponents inspection plans	Before starting any procurement or fabrication activity

Hold Point 3.	Manufacturing Readiness Review (MRR)	Procurement plan Manufacturing and inspection plan Quality control plan Travelers and inspection sheets ASME Qualification of Brazes and Welds Report and Samples (option) Brazing report and samples (option) Ceramic brazing report and samples (option) Copper plating samples (option) Bellow plating sample Copper plating reports Electropolished sample Gold plating samples and report (option) Titanium Nitride Coating samples (option) Packaging and Shipping Plan Manufacturing Plan	
Hold Point 4.	Pre-series Coupler inspection	Upon completion of the first two units, before cleaning and baking A representative from UKRI-STFC will visit the Contractor to inspect the units and provide feedback. The UKRI-STFC representative will then observe all cleaning, assembly, and leak checking of the Vacuum Side Coupler Assemblies (F10187825).	
Hold Point 5.	Pre-shipment Review	Completed Travelers and Inspection Sheets Metrology Inspection Reports RGA Scan Reports In-Process ASME Documentation Material Certifications	Contractor must not ship any item without prior written authorization

5.4.4. Progress Reports

The Contractor shall submit a monthly progress report to UKRI-STFC. The purpose of the monthly reports is to document manufacturing progress and ensure UKRI-STFC provides timely support to address any concerns as they arise, preventing bigger problems. Reports must include a schedule showing progress to date vs planned, technical status including any topics requiring immediate attention, material used to date, and any other information the contractor deems necessary for the purpose. Pictures should be included in the report to document actual status of operations. If any deviations arise in the month, these must be included in the report. This report shall be submitted by the 10th day of the following month. The format and contents of the report should be subject to periodical review to ensure it remains useful.

Monthly meetings will be held by videoconference. Bi-weekly updates by e-mail shall be delivered to UKRI-STFC by close of business on an agreed day. UKRI-STFC personnel will periodically visit the contractor facility during fabrication and assembly of the couplers to monitor progress and perform inspections. Such visits can be requested by either UKRI-STFC or the Contractor and should be requested no less than two weeks in advance. UKRI-STFC reserves the right to change frequency of the updates and meetings and visit the contractor's facility as necessary to ensure the quality of the couplers is realised.

5.4.5. Pre-shipment Reviews

A pre-shipment review must be held before each coupler is shipped. The Contractor shall furnish a certificate of compliance to UKRI-STFC that coupler was manufactured and inspected in accordance with the requirements of this Specification and that the coupler has been found to meet all requirements

(except as documented in UKRI-STFC-approved Non-Conformance Reports with a concession). Documents for multiple couplers may be submitted for a review. Shipment of the completed coupler shall not occur until all inspections identified in the Contract have been completed and the travelers have been received and accepted by UKRI-STFC. Authorization to ship the coupler will be communicated in writing following the review. The format of this review, whether through email or a meeting, will be determined at the MRR.

5.5. *Coupler Acceptance*

The 650 MHz Main Coupler Assemblies must satisfactorily pass contractor inspections prior to delivery.

Finished couplers will be conditionally accepted if they are deemed conforming to the contract after incoming inspection and documentation review. Final acceptance is conditional on the results of the RF qualification. UKRI-STFC will have up to two months after receipt of delivery to inspect and provide final acceptance of the assemblies. The acceptance check list can be found in appendix.

While no minimum performance guarantee is required, exceptionally bad performance can be an indicator of a problem during manufacturing, which is the Contractor's responsibility to either rework or replace at UKRI-STFC's discretion.

UKRI-STFC can choose to perform additional inspection of the couplers if investigation and troubleshooting are required after RF qualification. If a coupler fails an incoming inspection as a consequence of an event during transportation, the coupler will be rejected by UKRI-STFC and sent back to the Contractor. The Contractor is responsible for the transportation of the coupler back to their premises and costs of the transportation. UKRI-STFC and the Contractor will jointly decide rework and/or optimization and recovery workflows for all couplers.

5.6. *Non-Conformance Reporting, Analysis and Corrective Action*

In the event of non-conformance, the Contractor shall maintain a non-conformance reporting (NCR), analysis, and corrective action system which must, at a minimum, evaluate, analyse, and correct non-conformances occurring during end-item acceptance testing and inspection. The results of all non-conformance evaluations and analyses must be documented and available for review. Suspect/Counterfeit Items fall within the scope of non-conforming product and should be reported and dispositioned through the normal NCR process. There are two levels of non- conformance, as defined below.

The Contractor shall define the difference between minor and major Non-Conformances in the Quality Control documents specific to this project, and reaction plans for reporting.

UKRI-STFC's and the Contractor's representatives should be available to resolve urgent matters during reasonable working hours, considering a potential time difference.

The frequency, time, and format of the meetings should take into account the project status, the time zones, and other factors (e.g., COVID-19 pandemic). All parties should make reasonable effort to provide a sufficient notice for the meetings, and time to review the meeting materials.

5.6.1. Minor Non-Conformance

A minor non-conformance is defined as follows:

The non-conformance can be corrected to meet all drawings and specifications without the need for UKRI-STFC involvement (including damaged sealing surfaces) AND the non-conformance will result in schedule impact < 1 week.

Minor non-conformances must still be documented for traceability and reported to UKRI-STFC monthly.

5.6.2. Major Non-Conformance

A major non-conformance is defined as follows:

The non-conformance results in schedule impact >1 week AND/OR the non-conformance results in request for drawing / specification deviation.

Should any major nonconformance be found, the contractor shall notify UKRI-STFC as soon as possible. These non-conformances require UKRI-STFC acceptance and possible determination of corrective action, and root cause analysis.

5.6.3. Out of ordinary events

Out of ordinary events are urgent events which must be reported to UKRI-STFC as soon as possible.

Major non-conformances that require immediate action before a formal reporting process is complete, and changes or deviation that need to be made to a process immediately to avoid a non-conformance are considered out-of-ordinary events. Reaction Plans must include a contingency plan for reporting.

5.6.4. Deviations, Discrepancies and Detours (D3s)

Deviations, Discrepancies and Detours (D3s) are defined as minor events related to the procedures and processes that did not lead to a non-conformity but caused a small deviation from the prescribed steps. For example, unusual smell, faster than expected etching rate, restarting the machine, or a flickering power during a process. D3s capture the information that would otherwise be lost during the production run. D3s shall be reported per agreed Reaction Plans.

5.6.5. Inspection and Final Acceptance

The 650 MHz Main Coupler Assemblies must pass vendor inspections prior to delivery. Inspections and Tests must be conducted by trained personnel. Non-conforming parts may only be accepted with an UKRI-STFC-approved concession. Final acceptance of all coupler items shall take place after delivery to UKRI-STFC. The terms and conditions of the contract between UKRI-STFC and the vendor shall define the time UKRI-STFC has to inspect and provide final acceptance of the assemblies.

6. Quality Assurance, Planning and Control

To fulfil the described specification, the Contractor must comply with various national and international rules and regulations. The Contractor is responsible for identifying and complying with all applicable legislation in all stages of the production and Contract.

If requirements presented in the specifications contradict the standards and regulations that are cited in it, the requirements established in the specifications shall apply, unless they conflict with standards and regulations regarding work safety. In any of these cases, the Contractor must make UKRI-STFC aware at the earliest possible opportunity, preferably at the bid stage.

Failure to comply with requirements and instructions may lead to rejection of the material, components, and the product at any stage of the manufacturing. The Contractor may make proposals to UKRI-STFC concerning repair, reworking, reuse, etc., which UKRI-STFC is not obligated to accept. In this case, the Contractor must start again with a new sub-components or assemblies at their own expense and with all practical effort to maintain the schedule and minimise delay.

The production process is to be configured to allow execution of all and any subsequently required tests and demonstrations. If random sampling for testing is carried out or required (in place of 100% inspection), the fraction of units sampled is to be significantly increased following a change of supplier material, or process until it is demonstrated that the requirements are stably and reliably maintained.

6.1. *Quality Management System (QMS) Requirements and Scope*

The Contractor and all its sub-contractors shall maintain their own Quality Management System (QMS) according to ISO 9001:2015 or equivalent. The QMS scope shall cover the full extent of the project, i.e. design, procurement, manufacturing, inspection, installation, test and shipping. High-level Manufacturing, Quality Assurance and Quality Control Plans specific to this project shall be submitted with the Contractor's proposal.

In addition to the QA/QC measures carried out by the Contractor according to their own quality management, UKRI-STFC can request additional quality checks including audits.

The contractor must use Process Flow Charts, Manufacturing Control Plans (for both mechanical fabrication and processing steps). The Contractor is free to choose a method to identify and manage risks of the processes to the satisfaction of UKRI-STFC. The Contractor will be responsible for the creation and management of this process to the satisfaction of UKRI-STFC. Regular reviews will be held to assess the effectiveness of the process.

6.1.1. Document Control

The Contractor’s QMS shall provide for a system of distribution and control of approved engineering and procurement documents (including specifications, drawings, CAD files, procedures, purchase orders, certificates, test reports and other critical documents) as well as changes thereto. Such a system shall provide version control, including control of voided documents. Documents should follow a naming convention to be agreed before commencement of the documentation review.

6.1.2. Inspection Records

The Contractor and all sub-contractors shall maintain records of all inspections and tests, including internal reports, for at least one year after the warranty period for the last component on the contract ends. The records shall also indicate the nature and number of observations, the number and type of deficiencies found, and the corrective action taken. Where applicable, manufacturing data is required to be recorded and made available prior to any adjustments either as part of a planned process or otherwise.

The inspection and test data must be provided in a suitable controlled and traceable form/report proposed by the Contractor to be agreed by UKRI-STFC near the time of production. Forms/reports shall be simple in construction, contain relevant and traceable specifications, and show responsible approvals to allow for swift and easy assessment of key characteristics relationship to a specification.

6.1.3. Manufacturing and Traceability Documents

The Contractor will be required to provide a traveler before shipment of each coupler. The traveler should contain the results of all inspections, analyses, and tests performed by the Contractor or their designated test agency, to determine conformance of all products to this specification.

The record generated for each coupler should include but is not limited to:

- Contact of testing agency (if other than the Contractor), including dates of inspection, analysis, or test.
- Results of inspections and mechanical measurements for serialized parts and subassemblies at various stages of fabrication
- Plating thickness measurements
- Results of weld/brazing inspections
- RGA scan results
- Bakeout temperature, duration, and pressure
- Leak checking reports on subassemblies and finished couplers
- Mechanical dimensions of “as manufactured” couplers
- Documentation on any manufacturing irregularities such as dimensional errors, surface defects, welding/brazing problems, and repairs
- Records of any local grinding or polishing
- Other information as agreed between the Contractor and UKRI-STFC. Pre-

series couplers will require process validation documentation.

6.2. *Calibration of Measuring and Test Equipment*

The Contractor and all sub-contractors shall have a measuring and test equipment procedure and program to control the periodic calibration and thus the traceability of measurements and test equipment used in the fulfilment of this sub-contract. The calibrations shall be to ISO 17025:2017 standards whenever possible to ensure complete traceability.

The system shall include, as a minimum, prescribed calibration intervals, source of calibration and a monitoring/recall system to control adherence to calibration schedules. Documentation records in support of this requirement shall be readily available to UKRI-STFC. Key measurement processes shall be validated by the supplier for repeatability and reproducibility as part of their Manufacturing Control Plan submission.

6.3. *Manufacturing Plan, Procedures, and Facility Descriptions*

The Contractor shall prepare a Manufacturing Plan with their proposal that will include milestones and a workflow chart. Milestones may include staged delivery of the couplers. This plan must identify and describe all aspects of work to be executed.

The Manufacturing Plan must be comprised of the following as a minimum:

- Manufacturing strategy document specifying what parts or processes (if any) are contracted to other companies.
- Breakdown of fabrication process for each part showing major fabrication steps
- Tooling qualification requirements and high-level plans
- Necessary and available staffing effort & equipment resources

The Contractor should have detailed procedures for each manufacturing step. General, high-level procedures should be submitted with the bid, detailed procedures must be submitted before the Manufacturing Readiness Review.

Documents to be submitted:

- Procurement plan
- Manufacturing and inspection plan
- Quality Control Plan
- Travelers and inspection sheets
- ASME Qualification of Brazes and Welds Report and Samples
- Brazing report and samples
- Ceramic brazing report and samples
- Copper plating samples
- Bellow plating sample
- Copper plating reports
- Electropolished sample
- Gold plating samples and report
- Titanium Nitride Coating samples
- Packaging and Shipping Plan
- Manufacturing Plan

The Contractor will be required to submit description of the existing facilities and any additional equipment they would need to install or modify to complete this project.

6.4. *Quality Assurance Plan (QAP)*

The Contractor shall create a QAP based around ISO 9001:2015 as a guideline that will be used to define the criteria and processes that will ensure and verify that the process outputs will meet specific quality objectives. The QAP shall be submitted to UKRI-STFC for acceptance, and it must be accepted prior to use.

The QAP should include the following as a minimum:

- The system and the processes undertaken to manage, manufacture and deliver the product in terms of quality.
- Description of equipment for inspection and dimensional control of parts
- How the key inspection equipment will be maintained, calibrated to the appropriate standards, and cross-checked.
- Identify what staffing effort & equipment resource is expected for performing quality assurance activities.
- Plans to ensure that staff are sufficiently & appropriately trained or qualified.
- Reaction plans in an event of a problem.
- Management of change requests.
- Description of Quality Control (QC) process, including Manufacturing Control Plans management.
- Data management plan, including data sharing with UKRI-STFC.
- Description of document control system (including traceability)
    - The Contractor's QMS shall provide for a system of distribution and control of approved engineering and procurement documents (including specifications, drawings, CAD files, procedures, purchase orders, and other critical documents) as well as changes thereto.
    - Such a system shall provide version control, including control of voided document.
- Procedure for classification and reporting non-conforming items.
- Relevant certificates.

6.5. *Manufacturing Control Plans*

A Manufacturing Control Plan (MCP) is a documented linking manufacturing process steps to key inspection and control activities. MCP should demonstrate that the manufacturer is taking necessary steps to control and monitor the entire manufacturing process, and to ensure that the requirements for the products, processes, and equipment are met. Manufacturing Control Plans should be maintained and updated through the life of the project.

For the series couplers as a minimum, each major manufacturing step should have a reasonably detailed MCP. For the pre-series couplers, MCPs should also include equipment and process qualification and validation. The Contractor and UKRI-STFC should jointly review the list of the controlled Key Characteristics for each MCP.

Detailed MCPs should be developed post-award. UKRI-STFC can assist in managing the plans development.

6.6. *Documents Submitted*

The Contractor shall provide enough documentation to prove their ability to manufacture and process, in the specified timeframe. The following documentation is required:

With the bid

- Response to the Request for Proposal Questionnaire

    - Processing and manufacturing facilities overview, including necessary modifications, additional equipment, and procedural changes required to fulfil this contract
    - High-level Manufacturing, Quality Assurance and Quality Control Plans
    - General procedures for the major fabrication and processing steps
    - Organizational chart with the staff roles, responsibilities, qualifications, and evidence of availability to fulfil the project needs.
- Pricing
- Delivery Schedule

Before MPRR

The following documentation shall be provided to UKRI-STFC at least 10 working days in advance of the **MPRR**.

- Drawing package including an itemized list of all the deviations from UKRI-STFC-provided drawings.
- The bellows drawing and an inspection plan including written verification that cycle requirements will be met.
- Inspection plan for components received either internally or from subcontractors. Plan must meet requirements in section 4.11.1

Before the MRR

The following documentation shall be provided to UKRI-STFC at least 10 working days in advance of the **MRR**.

- Changes to the Contractor's team, if any, and evidence of availability to fulfil the project needs.
- Updated delivery schedule.
- Manufacturing and inspection plans listing the sequence of manufacturing operations.
- Detailed Manufacturing Control Plans, including hold points,
- Non-Conformance reporting including reaction plans procedures.
- Travelers' templates that will be used during fabrication and quality controls. The travelers can be a part of the other QC documents and plans, or separate documents.
- ASME-compliant Qualification of Brazes and Welds Report and Samples.
- Copper plating, bellow plating, gold plating and electropolishing samples as defined in sections 4.5.4, 4.5.5, 4.7.2 and 4.6.2 respectively.
- Copper and gold plating reports.
- Titanium Nitride coating sample as defined in section 4.8.2.
- Cleanroom cleaning procedures of all components including all hardware. This shall include cleanroom certificate of compliance with ISO standard.
- Packaging and Shipping plan.

List of required documents will be updated with accordance to the selected contract scope options.

7. Appendices

7.1. *Appendix I – List of drawings*

Part #	Rev.	Name
F10187843	E	650 MHz Main Coupler
F10186707	C	ENCLOSURE BOX
F10186784	B	ENCLOSURE COVER PLATE
F10186803	A	HV WIRE LEAD ASSEMBLY
F10186896	A	BELLOWS INTERFACE RING, OUTER CONDUCTOR
F10186929	A	BELLOWS INTERFACE RING, INNER CONDUCTOR
F10186990	B	5K HEAT INTERCEPT
F10186991	B	50K HEAT INTERCEPT
F10187100	A	MOD 3/8 FITTING
F10187175	C	PROTECTION BRACKET
F10187762	-	BASE PLATE
F10187763	C	COUPLER STORING CHAMBER ASSEMBLY
F10187764	A	TUBE, GAUGE PORT
F10187811	B	VESSEL INTERFACE FLANGE
F10187812	C	SLEEVE, LARGE
F10187813	A	DOOR KNOB
F10187814	B	WASHER, ANTENNA ASSEMBLY
F10187815	B	TUBE, VACUUM GAUGE
F10187816	B	TUBE PORT, SMA
F10187817	C	CONNECTOR TO AIR
F10187818	D	CERAMIC WINDOW ASSEMBLY
F10187819	C	THREADED AIR ADAPTER
F10187820	C	WAVEGUIDE ASSEMBLY
F10187821	B	ANTENNA TUBE
F10187822	A	SLEEVE
F10187823	E	CERAMIC WINDOW / ANTENNA ASSEMBLY
F10187825	E	ASSEMBLY, COUPLER VACUUM END - COPPER COATED
F10187826	B	CF FLANGE
F10187827	B	FLANGE, NON-ROTATABLE
F10187828	A	SUPPORT DISC
F10187829	C	CONNECTOR, TO WINDOW
F10187830	A	INNER SLEEVE, WINDOW
F10187831	D	INNER CONDUCTOR
F10187832	C	CONNECTOR, VACUUM SIDE, WINDOW ASSY
F10187833	D	650MHZ COUPLER AIR SIDE
F10187834	C	CERAMIC WINDOW
F10187835	C	FLANGE
F10187836	C	ANTENNA TIP
F10187837	A	POCKET FLANGE, OUTER CONDUCTOR BELLOW ASSY
F10187838	C	WINDOW AIR COVER
F10187840	B	SPLIT RING, VESSEL

F10187841	-	TUBE - LONG
F10187842	A	NUT BACKING PLATE
F10187844	B	BELLOW OUTER CONDUCTOR
F10187845	C	OUTER CONDUCTOR
F10187846	B	DOOR RING
F10187847	B	VACUUM SIDE OUTER CONDUCTOR
F10187848	-	TUBE, MIDDLE - COUPLER ASSEMBLY WARM INNER CONDUCTOR
F10187849	B	BELLOWS, INNER CONDUCTOR
F10187850	B	TUBE SHORT, AIR OUTER CONDUCTOR
F10187851	B	FLANGE
F10187852	B	RING
F10187853	C	ENCLOSURE ASSEMBLY
F10187854	B	TUBE, PRIMARY, VACUUM OUTER CONDUCTOR
F10187855	A	SPLIT RING, WAVEGUIDE
F10187856	B	WAVEGUIDE WR1150 MOD
F10187857	B	LONG TUBE, AIR OUTER CONDUCTOR
F10187858	C	AIR SIDE COVER ASSEMBLY
F10187860	B	OUTER SLEEVE, WINDOW
F10187861	D	INNER CONDUCTOR ASSEMBLY
F10187862	B	FLANGE-CF, 2.75 MODIFIED
F10187959	A	SCRF SEAL FOR NW78 FLANGE
F10187963	C	AIR TUBE
F10187967	C	WELDMENT, 650 MHz COUPLER STORING CHAMBER
F10187968	A	TUBE, 650MHz COUPLER STORING CHAMBER
F10187969	B	FLANGE, 650MHz COUPLER STORING CHAMBER
F10187971	A	METRIC NUT PLATE, 2-3/4" CF FLANGE
F10193890	A	RF TEST DISK
F10193904	-	SMA FEEDTHROUGH, LONG ANTENNA
F10194651	A	CF FLANGE WITH POCKET, SMALL
F10194987	-	LUG, WAVEGUIDE
F10198006	A	CONNECTOR, AIR SIDE
F10198029	-	CONNECTOR FOR PLUNGER

7.2. *Appendix II – Acceptance Criteria List*

Acceptance Checklist PIP-II HB 650 MHz Contribution
INCOMING INSPECTION - VACUUM SIDE

Number	Requirement Definition	Performance Criteria or Quantity	Units	Verification Method	Location Performed	Procedure Summary	Reference Document
1.1	Shipping Container (External)	Free of damage		Visual	Receiving Area	Visual inspection. Document any damage	FNAL Traveler 464699 (placeholder)
1.2	Shipping Container (Internal)	Free of damage/not punctured, Cleanliness, Appropriate packing		Visual	Receiving Area	Visual inspection. Document any damage	FNAL Traveler 464699 (placeholder)
1.3	Validation of Vendor Documentation	Vendor provided travelers and documentation conform to requirements.		Visual	Receiving Area	Visual Inspection, note anything which is missing and contact the vendor to receive documents. Verify the list of critical dimensions and manufacturing QC steps in the traveler.	FNAL Traveler 464699 (placeholder)
1.4	Antenna / Outer Conductor Isolation Check	Resistance between antenna and outer conductor verified to be >1G Ohm @ 1kV	Ohm	Electrical	ISO 6 CR	Measure resistance from IC to OC using ohm-meter.	FNAL Traveler 464699 (placeholder)
1.5	E-Pick Up Isolation Check	Resistance between IC and OC of E-Pick Up verified to be >1G Ohm @ 1kV	Ohm	Electrical	ISO 6 CR	Measure resistance from IC to OC using ohm-meter.	FNAL Traveler 464699 (placeholder)
1.6	Incoming Leak check	No leak detectable on the most sensitive scale of a helium leak detector with a minimum sensitivity of 2x10^-10 mbar x		Leak check	Iso 4 CR	Use B6 leak check method where entire component is bagged with helium.	FNAL Traveler 464699 (placeholder)

		Liter/Sec while assembled to the shipping manifold.					
1.7	Incoming RGA	RGA pass while coupler is assembled to the shipping manifold. P18<P2/2, P(sum>44AMU) < 1e-11 torr, Pmax(single peak > 44 AMU) < 5e-12 Torr	Amu sum	RGA	Iso 4 CR	Connect to vacuum cart, after leak check perform RGA scan.	FNAL Traveler 464699 (placeholder)
1.8	Vacuum Gauge Operational	Vacuum gauge is working and reading is within 50% of pumping . Turn off pumping to take the reading (static measurement).	%	Visual	Iso 4 CR	While connected to vacuum cart, connect to vacuum gauge and turn on once pressure is estimated to be below 1e-4 mBar. Verify the reading of gauge is accurate relative to cart.	FNAL Traveler 464699 (placeholder)
1.9	Particle Count	All beamline volume surfaces blow with 0 particles counted for a sample of ≥ 28.3L (1CFM). External surfaces should be free of any contamination as shown by a clean wipe down with ethanol and a white sealed border wiper.		Particle Counter	Iso 4 CR	After removal from the shipping manifold, blow clean with dry N2.	FNAL Traveler 464699 (placeholder)
1.10	Sealing Surfaces	Sealing surfaces are free of damage.		Visual with magnification	Iso 4 CR	Diamond sealing surface and conflats are inspected at 5x magnification. No radial scratched on diamond, no damage to knife edge on conflat.	FNAL Traveler 464699 (placeholder)

1.11	Visual Inspection and Critical Point Inspection	Free of visual defects.		Visual	Iso 4 CR	No obvious damage. No significant oxidation. Copper plating intact and ends at specified locations. Overall quality of work. Proper fill of brazes. Accurate rotational orientation of flanges / antenna tip. Ceramic is free of discoloration. Antenna checked for approximate straightness with the clean room compatible tooling. All components are present and in the correct quantities and configuration. Images shall be taken during inspection for traceability.	FNAL Traveler 464699 (placeholder)
1.12	Antenna angle verification	Verify the antenna 'goose foot' is at the correct angle with respect to the outer conductor during re-assembly. This can vary per cavity / coupler, so refer to the traveler and the coupler's serial number for orientation.		Visual	Iso 4 CR	Set the antenna into the assembly tooling and align the witness mark to the 'zero' location. Ensure that the vacuum outer conductor is set in its nominal position, as marked on the tooling. Rotate the antenna to the appropriate angle with the tooling, and then assemble to the vacuum outer conductor.	FNAL Traveler 464694 (placeholder)
1.13	Vacuum Level Check on RF Chamber Assembly	Vacuum level should be <5e-6 mbar.		Coupler Vacuum Gauge	Iso 4 CR	Check the vacuum level of the chamber using the vacuum gauges on the couplers.	FNAL Traveler 464694 (placeholder)

1.14	Leak Check on RF Chamber Assembly	No leak detectable on the most sensitive scale of a helium leak detector with a minimum sensitivity of 2x10^-10 mbar x Litre/Sec while assembled to the shipping manifold.		Leak check	Iso 4 CR	Use B6 leak check method where entire component is bagged with helium.	FNAL Traveler 464694 (placeholder)

INCOMING INSPECTION - *AIR SIDE*

Number	Requirement Definition	Performance Criteria or Quantity	Units	Verification Method	Location Performed	Procedure Summary	Reference Document
2.1	Shipping Container (External)	Free of damage		Visual	Receiving Area	Visual inspection, Document any damage	FNAL Traveler 464704 (placeholder)
2.2	Shipping Container (Internal)	Free of damage, Cleanliness, Appropriate packing. N2 bagging not punctured.		Visual	Receiving Area	Visual inspection, Document any damage	FNAL Traveler 464704 (placeholder)
2.3	Validation of Vendor Documentation and Critical Dimensions	Vendor provided travelers and documentation conform to requirements		Visual	Receiving Area	Visual inspection, note anything which is missing and contact the vendor to receive documents. Verify the list of critical dimensions and manufacturing QC steps in the traveler.	FNAL Traveler 464704 (placeholder)

2.4	Visual Inspection and Critical Point Inspection	Free of visual defects.		Visual	Open air on a table	No obvious damage. No damage to bellows, outer conductor checked internally with a mirror or equivalent. No significant oxidation. Copper plating intact and ends at specified locations. Overall quality of work and cleanliness. Proper fill of brazes. Accurate rotational orientation of flange. Alodine present on Alum parts. All components are present and in the correct quantities and configuration. Verify fitment of inner conductor to waveguide w/ 5 layers kapton. Check all RF surfaces for surface quality. Images shall be taken during inspection for traceability.	FNAL Traveler 464704 (placeholder)
2.5	Leak Check outer conductor	No leak detectable on the most sensitive scale of a helium leak detector with a minimum sensitivity of 2x10^-8 mbar x Litre/Sec.		Leak check	Open air on a table	Rubber seal leak check. Support bars must be installed to prevent compression of the bellows.	FNAL Traveler 464704 (placeholder)
2.6	Inspection of Sealing Surfaces	Sealing surfaces are free of damage.		Visual	Open air on a table	Conflats are inspected at 5x magnification. no damage to knife edge on conflat.	FNAL Traveler 464704 (placeholder)

RF QUALIFICATION

Number	Requirement Definition	Performance Criteria or Quantity	Units	Verification Method	Location Performed	Procedure Summary	Reference Document
3.1	Incoming Vacuum Level	Vacuum level should be <5e-6 mbar.	mBar	Coupler Vacuum Gauge	Open Air	Check the vacuum level of the chamber using the vacuum gauges on the couplers.	FNAL Traveler 464506-A (placeholder)
3.2	RF Power Level Reached	Coupler is able to reach 35 kW power at arbitrary reflection phase		Testing	Meson Detector Building	Tested in Pulse and CW regime at Full Power at 8 different phases for reflection. Tested to 35 kW input with full reflection and arbitrary reflection phase. With bias on, there should be no Multipacting, and temperatures remain below limits.	FNAL Traveler 464506-A (placeholder)
3.3	RF Reflection	RF Reflection verified to be < -20 dB @ 650MHz (S11,S22<-20dB)	dB	Testing	Meson Detector Building	Perform Reflection measurements.	FNAL Traveler 464506-A (placeholder)
3.4	E-Pickup Behaviour	<1 mA during all RF operation including at full power after all phases tested.	mA	Testing	Meson Detector Building	Check values of E-Pickup.	FNAL Traveler 464506-A (placeholder)
3.5	Vacuum level when operating at full power	Coupler test chamber vacuum remains < 1e-7 torr when the coupler is at full power AFTER all the phases have been tested		Vacuum gauge	Meson Detector Building	Once coupler has been RF conditioned, the outgassing rate at 35kW with arbitrary phase must be below 1.9e-7 mbar/s/cm2.	FNAL Traveler 464506-A (placeholder)

SHIPMENT READINESS - *VACUUM SIDE*

Number	Requirement Definition	Performance Criteria or Quantity	Units	Verification Method	Location Performed	Procedure Summary	Reference Document
4.1	Visual Inspection and Critical Point Inspection	Free of visual defects.		Visual	Iso 4 CR	No obvious damage. No significant oxidation. Copper plating intact. Ceramic is free of discoloration. components are present and in the correct quantities and configuration. Images shall be taken during inspection for traceability.	FNAL Traveler 464707 and 464699 (placeholders)
4.2	Particle Count	All beamline volume surfaces blow with 0 particles counted for a sample of ≥ 28.3L (1CFM). External surfaces should be free of any contamination as shown by a clean wipe down with ethanol and a white sealed border wiper.		Particle Counter	Iso 4 CR	After removal from the test chamber, blow clean with dry N2.	FNAL Traveler 464707 and 464699 (placeholders)
4.3	Outgoing RGA	RGA pass while coupler is assembled to the shipping manifold. P18<P2/2, P(sum>44AMU) < 1e-11 torr, Pmax(single peak > 44 AMU) < 5e-12 Torr	Amu sum	RGA	Iso 4 CR	Connect to vacuum cart, after leak check perform RGA scan.	FNAL Traveler 464707 and 464699 (placeholders)
4.4	Outgoing Vacuum Level	Vacuum level at cart is < 1e-6 torr prior to closing the RAV on the shipping manifold.		Vacuum Cart / Gauge	Iso 4 CR	Check reading on cart and verify.	FNAL Traveler 464707 and 464699 (placeholders)

4.5	Outgoing Leak check	No leak detectable on the most sensitive scale of a helium leak detector with a minimum sensitivity of 2x10^-10 mbar x Litre/Sec while assembled to the shipping manifold.		Leak check	Iso 4 CR	After coupler has been assembled to the shipping manifold, and connections torqued per traveler, use B6 leak check method where entire component is bagged with helium.	FNAL Traveler 464707 and 464699 (placeholders)
4.6	Packaging Complete	Vacuum Side + Manifold are double bagged in N2, packed in double layer crate, tip / shock detectors installed.		Visual	Iso 6 CR / Packing area	Verify coupler packing meets necessary requirements - assembly is double bagged in clean room, then packaged in crate.	FNAL Traveler 464707 and 464699 (placeholders)
4.7	Documentation Complete	All required documentation is packed with Vacuum Side		Visual	Any	Verify list of documentation being sent with couplers is complete.	FNAL Traveler 464707 and 464699 (placeholders)

SHIPMENT READINESS - *AIR SIDE*

Number	Requirement Definition	Performance Criteria or Quantity	Units	Verification Method	Location Performed	Procedure Summary	Reference Document

5.1	Visual Inspection and Critical Point Inspection	Free of visual defects.		Visual	Open Air	No obvious damage. No significant oxidation. Copper plating intact. Bellows free of damage. Components are present and in the correct quantities and configuration. Images shall be taken during inspection for traceability. Check for arcing evidence.	FNAL Traveler 464704 (placeholder)
5.2	Packaging Complete.	Bellows Components have shipping restraints installed, are separated into sub-assemblies, bolts are checked to be tight, double bagged in N2, and crated, tip / shock detectors installed.		Visual	Open Air	Verify coupler packing meets necessary requirements - assembly is double bagged with N2, then packaged in crate.	FNAL Traveler 464704 (placeholder)
5.3	Documentation Complete	All required documentation is packed with Air Side		Visual	Any	Verify list of documentation being sent with couplers is complete.	FNAL Traveler 464704 (placeholder)

DELIVERABLE DOCUMENTATION AND RECORDS VALIDATION

Number	Requirement Definition	Performance Criteria or Quantity	Units	Verification Method	Location Performed	Procedure Summary	Reference Document

6.1	Engineering note of coupler pressure safety	Including weld certification, Material Certification		Visual	Shipping area	Verify pressure test and note completed for the given production run. Perform RGA on coupler after the fact and include which S/N it had.	ED0018996 (placeholder)
6.2	Vendor Documentation	Includes traveler set, CMM Reports, RGA scans.		Visual	Shipping area	Verify list of documentation being sent with couplers is complete.	FNAL Traveler 464704 and 464699 (placeholder)
6.3	Import / Export Control Documents	All documentation must be completed.		Visual	Shipping area	Verify import/export control documents are completed.	Consult with procurement (placeholder)
6.4	Fermilab Travelers	All travelers for the coupler are completed and closed. Must include all attached images and RGA reports.		Visual	Shipping area	Verify list of documentation being sent with couplers is complete.	All travelers referenced in Acceptance Criteria Checklist

Schedule 3 - Charges

1 The Charges for the Goods and/or Services shall be as set out in this Schedule 3.

2 The total value of the contract shall not exceed $1,904,900.00 Ex Vat, as per the below breakdown. The initial purchased shall include 20 X Part No VWP3180 650 MHz main Coupler. UKRI STFC may at its own option decide to purchase, part numbers VWP3180 and MISC-PARTS PL22.

FOIA Section 43 Commercial

Notes

FOIA Section 43 Commercial

FOIA Section 43 Commercial

Schedule 4 - Change Control Notice

Contract Reference:	
1. Change Request Number:	
2. Requested amendments to Contract (including reasons):	
2.1 Effective date:	
This change is effective from: _____	
2.2 The Contract Term is amended as follows:	
Original Expiry Date: _____	
New Expiry Date: _____	
3. Cost impact	
3.1 The Charges are amended as follows:	

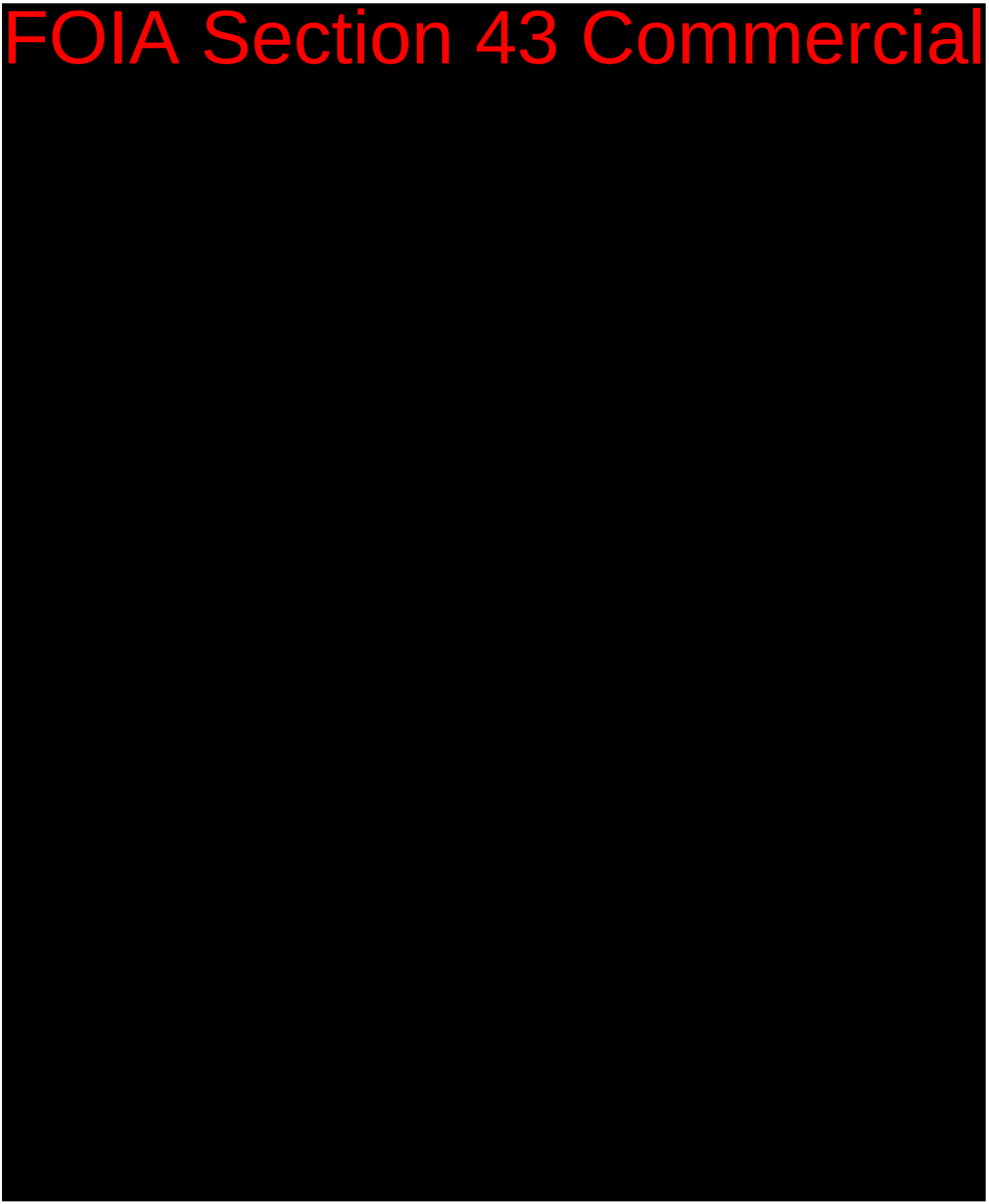
	Quantity	**Unit cost (£)**	**Net cost (£)**	**VAT (£)**	**Gross cost (£)**
Original Contract Value					
New contract Value					

3.2 New Contract terms:

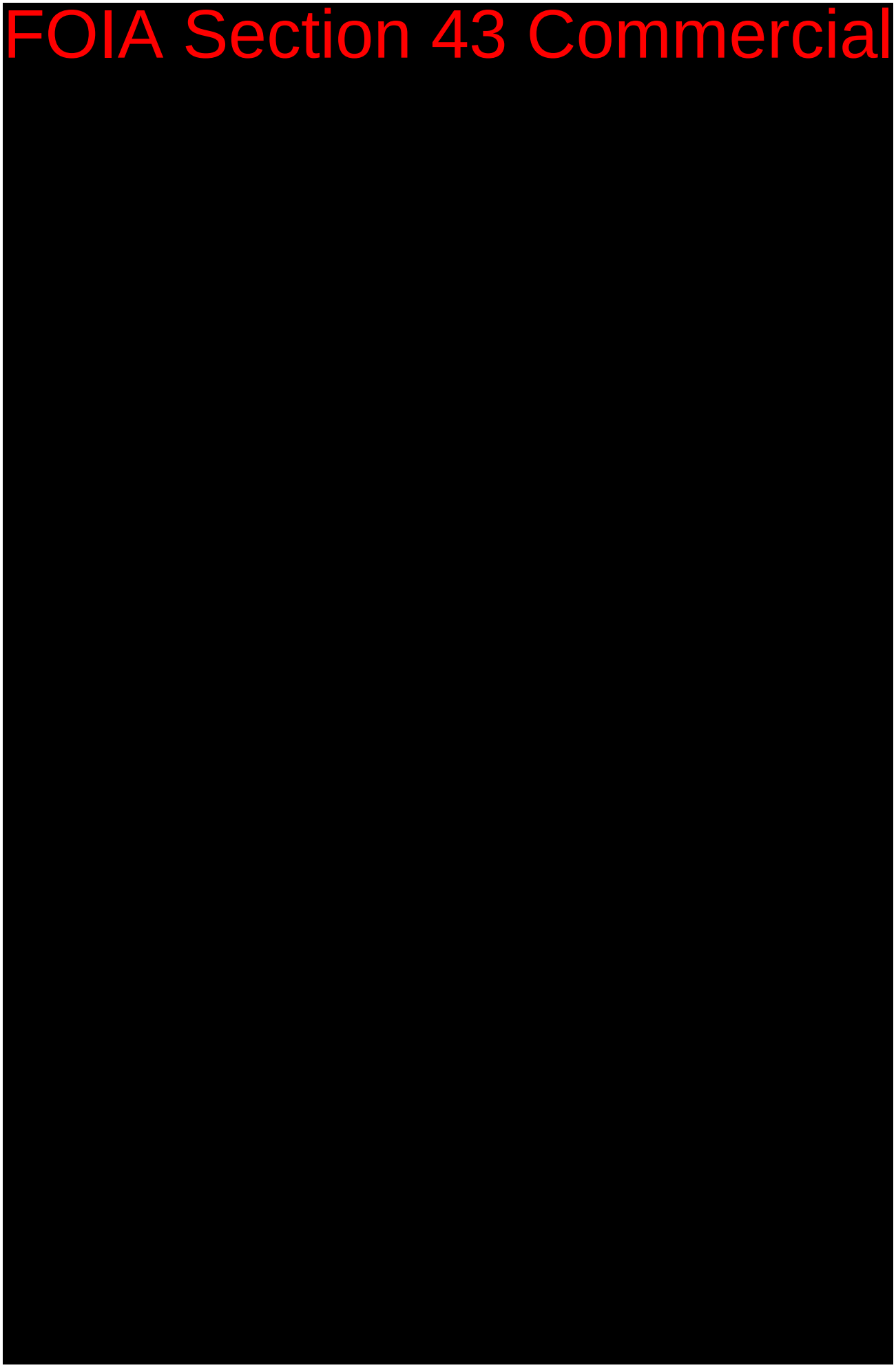
Both UKRI and the Supplier agree that they are bound by the terms and conditions set out in this Change Request and, except as set out in this Change Request, all terms and conditions of the Contract remain in full force and effect.

Signed on behalf of	Signed on behalf of
UK Research and Innovation	**Communications & Power Industries LLC**
by:	by:
Signature of authorised officer	Signature of authorised person
Name of authorised officer (please print)	Name of authorised person (please print)
Date	Date

Schedule 5- Supplier response



FOIA Section 43 Commercial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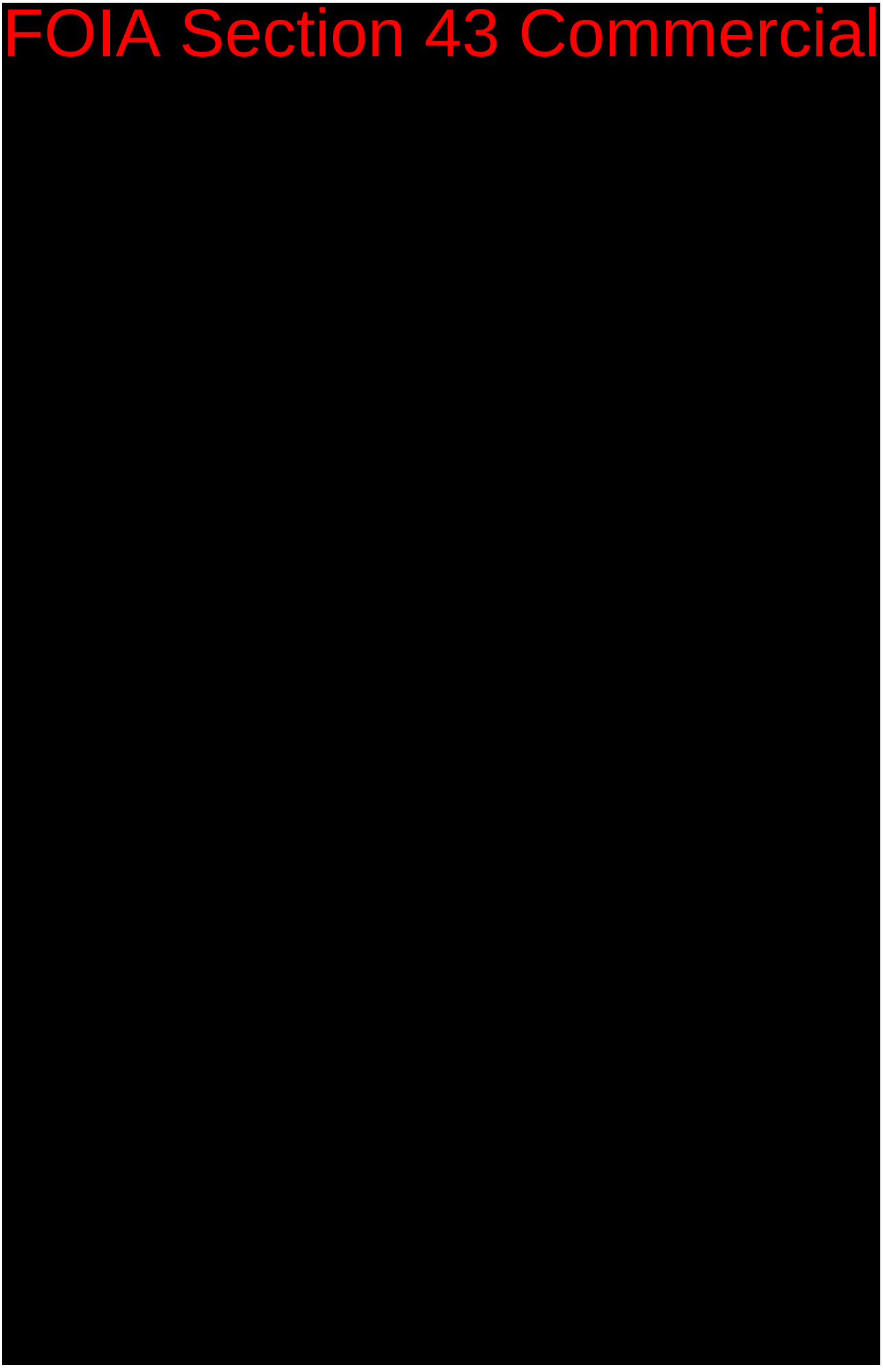
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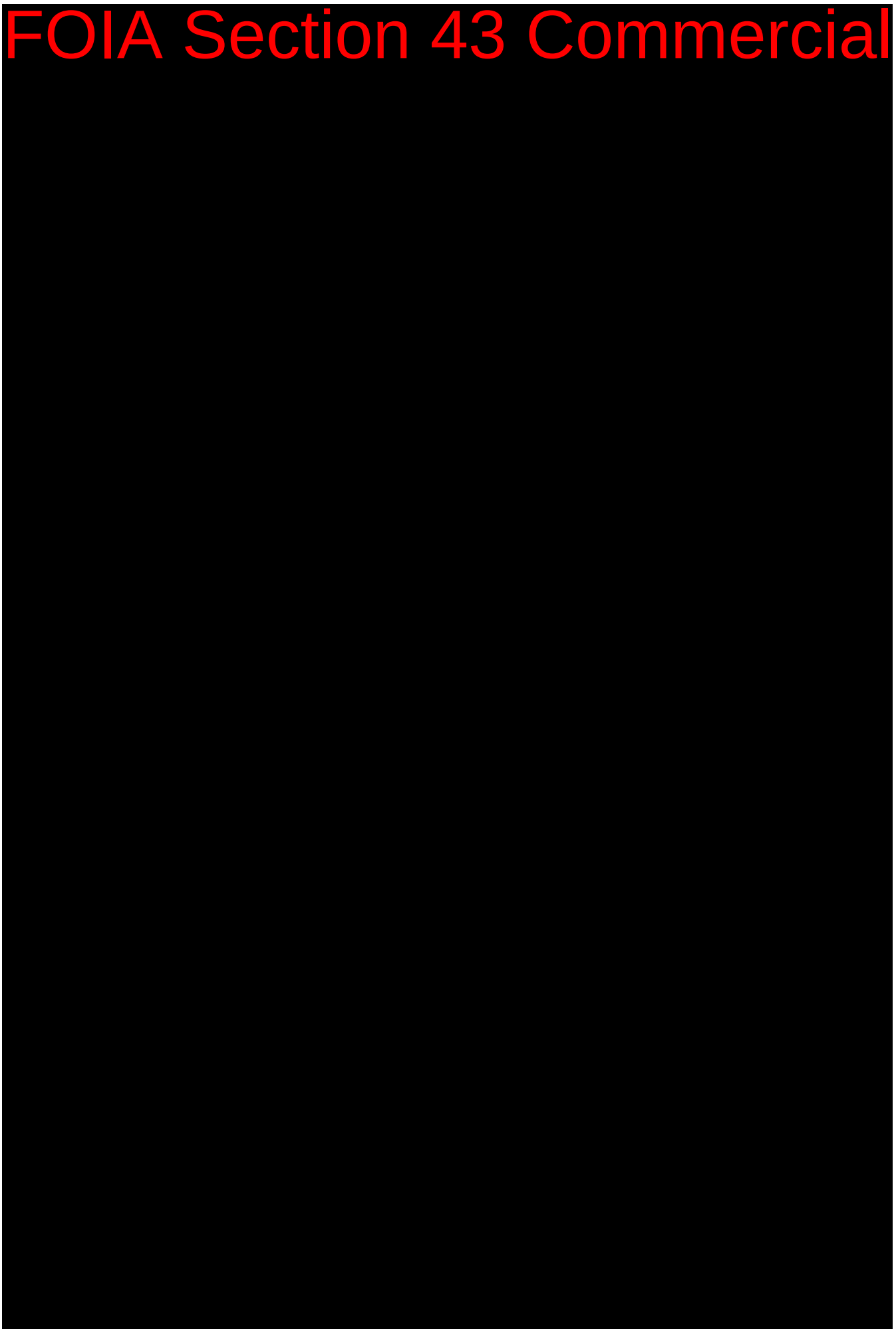

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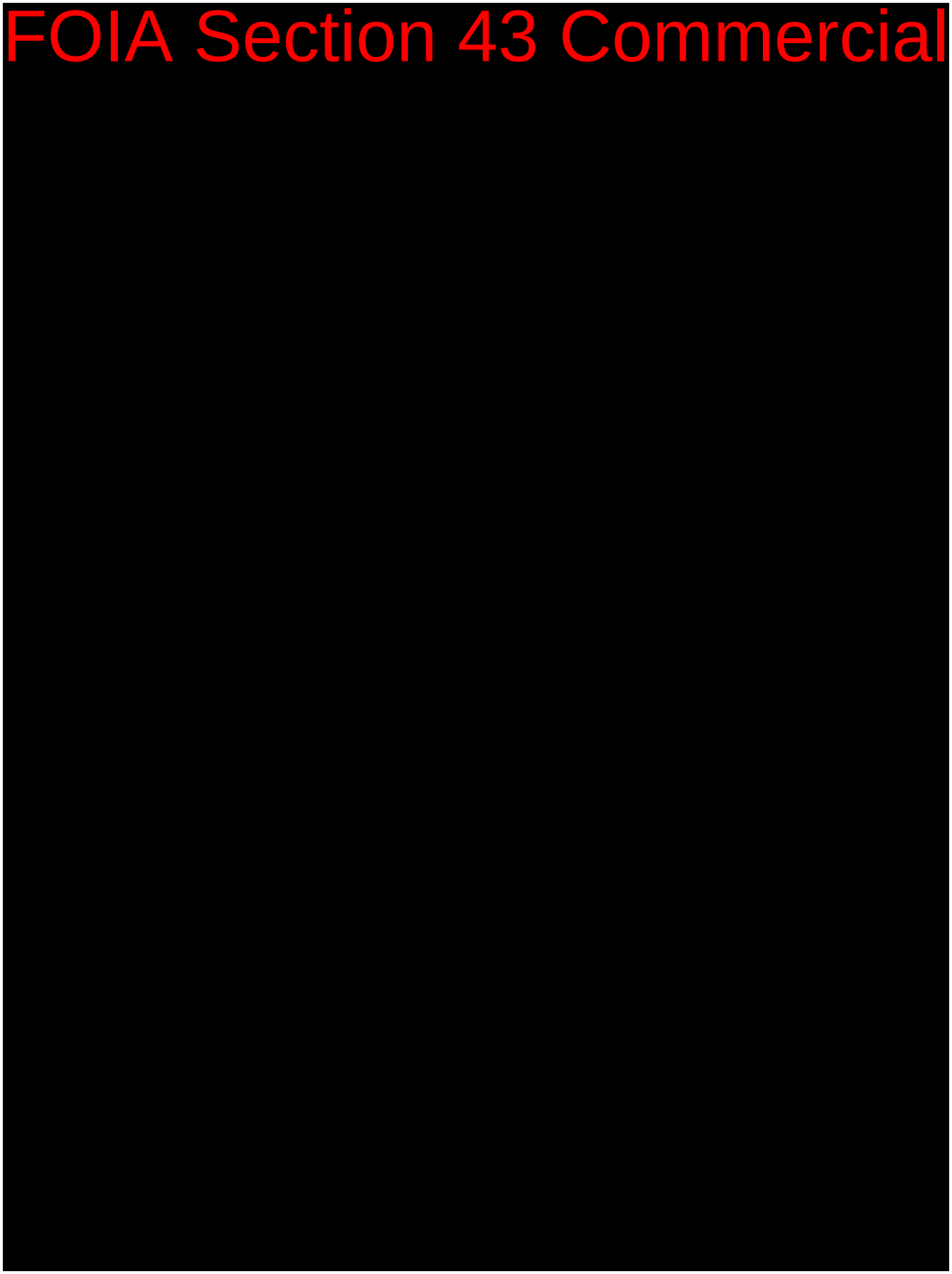
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