

**STATEMENT OF WORK FOR A 500 kW, 4-9 MHZ RF
TRANSMITTER
MATERIAL PLASMA EXPOSURE EXPERIMENT
(MPEX)**

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**Statement of Work for a 500 kW, 4-9 MHz RF Transmitter
for the
Material Plasma Exposure Experiment Project
MPEX-03-SOW-005**

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ACRONYMS

DAP	Delivered at Place
FAT	Factory Acceptance Test
ICH	Ion Cyclotron Heating
MPEX	Material Plasma Exposure Experiment Project
NIST	National Institute of Standards and Technology
ORNL	Oak Ridge National Laboratory
POC	Point of Contact
PO	Procurement Officer
QAP	Quality Assurance Program
TPO	Technical Project Officer
SOW	Statement of Work

1. INTRODUCTION

The Material-Plasma Exposure eXperiment (MPEX), a superconducting magnet, steady-state device, is being constructed at Oak Ridge National Laboratory (ORNL), going forward referred to as “the Company,” to address the harsh conditions inside a fusion reactor. This device, as designed, will have the unique feature of conducting accelerated lifetime tests of plasma-facing components, including those that have experienced neutron damage. MPEX will utilize a new high-intensity plasma source concept based on RF technology. This source concept will allow coverage of all expected plasma conditions in the divertor of a future fusion reactor, including very high densities. It will be able to study erosion and redeposition in correct geometries with relevant electric and magnetic fields in front of the target.

The Ion Cyclotron Heating (ICH) system is one of three plasma production and heating systems on MPEX. It consists of an RF transmitter, transmission line, and a launcher that injects the radiofrequency waves into the plasma. The ICH system is the primary system to heat ions in the plasma.

2. SCOPE

This Statement of Work (SOW) applies to the two-phase procurement of a broadband RF transmitter. The first phase of the procurement will be for the design of the RF transmitter. The second phase will be for the manufacture, assembly, inspection, factory acceptance testing, packaging, shipment, and site acceptance testing of the RF transmitter to ORNL.

The Seller is expected to demonstrate that the proposed RF transmitter will meet the technical requirements through the design package presented at a final design review.

3. APPLICABLE DOCUMENTS

- [1] *Performance Specifications for a 500 kW, 4-9 MHz RF Transmitter, MPEX-03-SPC-008 R1*

4. PERFORMANCE REQUIREMENTS

4.1 TASK 1: QUALITY PLAN AND PROJECT SCHEDULE

Prepare a quality plan and a project schedule for the design, manufacture, test and delivery of an RF transmitter. The quality plan shall address how the Seller's Quality Program will be applied to the work in this SOW, and identify procedures and other documentation for all special processes, measurements, etc. The quality plan shall also identify the planned work to be outsourced, list the planned or expected subcontractors and Suppliers, and address how the quality requirements of this SOW will be flowed down to these subcontractors and Suppliers.

The project schedule shall contain sufficient detail so that the Company's Technical Project Officer (TPO) may track design, procurement, fabrication, assembly, testing and shipping activities. The Seller shall propose milestones for tracking progress and payments including at a minimum those listed in Section 4.4.3.2.

4.2 TASK 2: DESIGN

After completion of Task 1 and with approval of the TPO, the Seller shall prepare a design of the RF Transmitter that meets the specifications given in [1]. The Seller shall prepare a final design report and participate in a final design review. The final design review will be held by videoconferencing or at the Seller's site based on agreement between the POC and TPO. The Seller shall prepare written meeting minutes and submit them to the TPO for review within 3 working days after the meeting. The expectation is that the Seller shall be ready for manufacturing upon approval of the final design. Completion of the final design review and closure of all action items shall constitute a project milestone.

The final design review shall:

- Demonstrate compliance and/or the method of compliance with all technical specifications.
- Include final performance modeling
- Include final mechanical drawings
- Include final interface definitions
- Include final electrical schematics
- Address planned major item procurements
- Present a Factory Acceptance Test plan
- Present a Commissioning and Site Acceptance Test plan

4.3 TASK 3: DELIVER RF TRANSMITTER

Upon successful completion of Task 2 and with authorization of the TPO, the Seller shall fabricate, assemble, test, and deliver the RF Transmitter in accordance to the approved final design from Task 2 meeting the specifications in [1]. The Seller shall provide installation supervision and commissioning support at the Company's site, including participation in the site acceptance testing.

Final acceptance of the RF Transmitter will occur upon successful completion of the site acceptance tests at the Company's facility.

4.4 PROJECT MANAGEMENT

4.4.1 Language

All communications and documentation shall be in English.

4.4.2 Communications Protocol

The Seller shall designate an official single POC to interface with the Company's TPO. Only the Company's Procurement Officer (PO) can authorize changes to the price or work scope. SOW or Technical Specification updates can only be issued to the Seller by the Company's PO.

Problems encountered or anticipated shall be communicated as soon as practical.

4.4.3 Reporting

4.4.3.1 Kickoff Meeting

The kickoff meeting will be scheduled at a mutually agreed time as soon as practical after award of the subcontract. The Seller is responsible for recording meeting minutes and submitting them to the TPO within 3 working days after the meeting.

The primary purpose for the kickoff meeting is to confirm that the project participants understand the terms and conditions of the subcontract, SOW, specifications, and work activities.

The following topics will be discussed:

1. Flow down of requirements.
2. Work activities, schedules, and deliverables
3. Expectations for satisfying quality standards and documentation

4.4.3.2 Schedule and Milestones

At a minimum, the schedule shall include the following activities or milestones:

- Early draft mechanical and electrical interface drawings released
- Final Design Review
- Final Design Review findings updated
- Complete system assembly
- Complete checkout of controls
- Factory Acceptance Tests
- Prepare for shipment
- Delivery to customer site
- Customer site final acceptance tests
- Complete final documentation

4.4.3.3 Monthly Reports

Monthly reports shall be submitted by the third calendar day of each month or on the Seller's usual reporting schedule as mutually agreed between the TPO and the Seller's designated POC.

Monthly report data shall include actual schedule progress, milestones reached, corrective actions needed, display of the present critical path for the Seller's work, and a brief narrative describing the status of work, significant accomplishments, actual and potential problems and risk mitigations or corrective actions.

4.4.3.4 Variance Reporting

The Seller shall notify the TPO and the PO immediately in writing when it is determined the actual cost may exceed the Agreement price. In no case shall the Seller continue work without authorized funding if it is determined that actual cost may exceed the Agreement price.

4.4.3.5 Periodic Communications

The Seller shall participate in a bi-weekly phone conference to be held with the Company's TPO to discuss any technical issues and schedule, personnel, and any other items pertinent to the work activities. The bi-weekly phone conference will serve as a mechanism to get early visibility of potential problems and issues arising during the performance of this subcontract. The Seller shall prepare written meeting minutes and submit these to the TPO within 3 working days after the meeting.

5. QUALITY ASSURANCE

5.1 QUALITY PROGRAM

The Seller shall have a Quality Assurance Program (QAP) that, at a minimum, is ISO 9001 certified, but preferably compliant with NQA-1 2008/2009a or equivalent. The Seller shall be able to demonstrate that it can fulfill the quality assurance requirements in this SOW and in [1]. At a minimum, the prospective supplier shall have an established, documented, and effectively implemented quality assurance program describing controls for: work processes (controlled by instructions/procedures), personnel training and qualification, document and records control, design, procurement, inspection and testing; including the use of measuring and test equipment when used, corrective action, and assessments (audits).

Prior to subcontract award, the seller's QAP shall be evaluated to determine the degree of effective implementation of the quality program. Deficiencies, if any, identified during the evaluation shall be addressed and corrected to the satisfaction of the Company and shall occur prior to award.

All suppliers/sub-suppliers, subcontractors and fabricators (as applicable) shall have a Quality Assurance Program that meets or exceeds the requirements listed above.

5.2 ACCESS FOR SOURCE SURVEILLANCE INSPECTIONS

As part of the Company's quality assurance program, the Company reserves the right to perform source surveillance activities and may be conducted at the Seller's facility or any sub-tier seller facility that the Company determines necessary to ensure that quality objectives are met.

The Company reserves the right to observe the Factory Acceptance Testing at the Seller's facility.

5.3 SELLER REQUESTED DEVIATIONS

The Seller shall propose any deviations to the specifications, drawings, or other technical requirements prior to award and obtain the Company's approval prior to invoking the deviation. Any Deviation Requests arising during the design or fabrication phase shall adhere to the Seller's Quality Program procedure and must be approved by the TPO.

5.4 NON-CONFORMANCES

When a nonconformance is identified, the Seller shall notify the Company TPO to determine what actions are required and document the nonconformance following the Seller's Quality Program procedure. All nonconformances shall be summarized in the Final Report. Items that do not conform to specified requirements shall be controlled to prevent inadvertent installation or use. Controls shall provide for identification, documentation, evaluation, segregation when practical, disposition of the nonconforming items, and for notification to the Company.

5.5 MEASUREMENT AND TEST EQUIPMENT

Tools, gages, instruments, and other measurement and test equipment used for activities affecting quality shall be controlled, calibrated at specified periods, adjusted, and maintained to required accuracy limits.

Measurement and test equipment used by the Seller to perform work under this Statement of Work must be calibrated and traceable to NIST standards. Calibrations must be current. Calibration records must be provided to the Company.

6. TRANSPORTATION

The equipment shall be packaged in a manner that protects the equipment from damage and, facilitates movement, loading, and unloading by fork truck or crane. Any special lifting fixtures or related hardware that are required to move, load, or unload the equipment shall be considered part of the equipment. Incoterms: Delivered at Place (DAP) (ORNL Facility – Oak Ridge TN).

7. DELIVERABLES

The Seller shall supply the following:

Deliverable 1 – Within 2 weeks of subcontract award, provide to the TPO the Seller's Quality Assurance Program documentation and a project specific Quality Plan.

Deliverable 2 – Final design review shall be held no more than 5 months after subcontract award and shall include the following documents:

- All documents, drawings, specifications and information called for in Section 4.2
- Final Presentation slides and documents

Deliverable 3 – The RF Transmitter shall be delivered to the Company site no more than 15 months after contract award and shall include:

- Test data for all components
- Completed factory acceptance test report
- Mechanical drawings and electrical schematics
- Transmitter installation and maintenance manual
- Transmitter operations manual

The following spare parts are to be provided with Deliverable 3:

- 1 final amplifier tube (if applicable)
- 3 spare input line fuses
- Other spares such as control power supply modules, mechanical relays and power semiconductors may be requested depending on the design

Deliverable 4 – Complete Commissioning and Acceptance Tests at the Company's facility no more 6 months after delivery of the Transmitter to the Company's facility. Seller shall provide personnel to supervise the installation and commissioning of the Transmitter. This deliverable will not be complete until Company acceptance of the final Commissioning and Acceptance test report.