

**STATEMENT OF WORK FOR  
MPEX IN-VESSEL BRAZED COMPONENTS  
MATERIAL PLASMA EXPOSURE EXPERIMENT  
(MPEX)**

Prepared by

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**Statement of Work for MPEX In-Vessel Brazed Components  
for the  
Material Plasma Exposure Experiment Project  
MPEX-05-SOW-002**

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Material Plasma Exposure Experiment Project  
MPEX-05-SOW-002**

**Revision History**

Revision	Date	DESCRIPTION OF CHANGE	REVISION TYPE	
			Major	Minor
0	October, 2024	Initial Issue	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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			<input type="checkbox"/>	<input type="checkbox"/>

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**Statement of Work for MPEX In-Vessel Components  
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Material Plasma Exposure Experiment Project  
MPEX-05-SOW-001**

**ACRONYMS**

MPEX	Material Plasma Exposure Experiment
TPO	Technical Project Officer
ISO	International Organization for Standardization
NIST	National Institute of Standards and Technology
NQA	ASME Nuclear Quality Assurance
QAP	Quality Assurance Program
SOW	Statement of Work
STEP	Standard for the Exchange of Product Data
PMI	Plasma Material Interaction
COTS	Commercial Off the Shelf
DAP	Delivered at Place
FAT	Factory Acceptance Test
POC	Point of Contact
PO	Procurement Officer
ORNL	Oak Ridge National Laboratory
CMM	Coordinate Measuring Machine
VCR	Swagelok VCR® Metal Gasket Face Seal Fitting
SCI	Sensitive Compartmented Information

## 1. INTRODUCTION

The Material Plasma Exposure eXperiment (MPEX), a superconducting magnet, steady-state plasma device, is being built at Oak Ridge National Laboratory (ORNL) to address the harsh conditions inside a fusion reactor. This device, as designed, will have the unique feature of being able to conduct accelerated lifetime tests of plasma-facing components, including those that have experienced neutron damage. The in-vessel components are plasma-facing components that accept high heat loads and are part of the vacuum envelope of the MPEX Device.

## 2. SCOPE

This Statement of Work (SOW) applies to the brazing, testing, inspection, packaging, and delivery of the in-vessel brazed components identified in Table 1.

**Table 1**

<i>In-Vessel Components</i>	<i>MPEX Drawing Number</i>	<i>Rev</i>	<i>Order Qty</i>	<i>Notes</i>
<i>Limiter</i>	<i>MPEX-05-DES-02-A042</i>	<i>0</i>	<i>1</i>	<i>ORNL is responsible for machining of all components, Seller is responsible for brazing and braze alloys.</i>
<i>Upstream Skimmer</i>	<i>MPEX-05-DES-02-A040</i>	<i>0</i>	<i>1</i>	<i>ORNL is responsible for machining of all components, Seller is responsible for brazing and braze alloys.</i>
<i>Downstream Skimmer</i>	<i>MPEX-05-DES-05-A012</i>	<i>0</i>	<i>1</i>	<i>ORNL is responsible for machining of all components, Seller is responsible for brazing and braze alloys.</i>
<i>Bellows</i>	<i>MPEX-05-DES-02-A043</i>	<i>0</i>	<i>4</i>	<i>ORNL is responsible for machining of all components, Seller is responsible for brazing and braze alloys.</i>

<i>In-Vessel Components</i>	<i>MPEX Drawing Number</i>	<i>Rev</i>	<i>Order Qty</i>	<i>Notes</i>
<i>Target</i>	<i>MPEX-05-DES-06-A002</i>	<i>0</i>	<i>1</i>	<i>ORNL is responsible for machining of all components, Seller is responsible for brazing and braze alloys.</i>

### 3. APPLICABLE DOCUMENTS

Table 2

<i>Document</i>	<i>Revision</i>
<i>MPEX-00-ENG-002 MPEX Vacuum Handbook [1]</i>	<i>0</i>
<i>Quality Assurance Plan for the MATERIAL PLASMA EXPOSURE EXPERIMENT [2]</i>	<i>0</i>

### 4. PERFORMANCE REQUIREMENTS

#### 4.1 TASK 1: QUALITY PLAN AND PROJECT SCHEDULE

The seller shall prepare a quality plan and a project schedule for the manufacture, test, and delivery of the High Heat Flux Brazed Components. 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 ORNL may track procurement, fabrication, testing, and shipping activities. The seller shall propose milestones for tracking progress and payments based on the Tasks outlined here in Section 4 and the activities and milestones listed in Section 5.4 that will require ORNL approval.

For this task, the seller shall provide the ORNL with:

- Quality plan
- Project Schedule
- Factory Acceptance Test Plan



## 4.2 TASK 2: DRAWING AND SPECIFICATION REVIEW

The seller shall review the MPEX drawings identified by the part number awarded to the seller in Table 1, the specifications of the vacuum components found in [1], and the quality guidelines and requirements outlined in [2]. The seller can propose deviations or changes to these specifications. ORNL will review these change requests. **The specified braze alloy shall be discussed to ensure the seller is qualified to perform braze using indicated material. Seller may specify alternative alloy for review by ORNL.**

Proprietary seller manufacturing processes that are different from the drawing specifications or requirements of [1] shall be identified and reviewed with ORNL. The seller is responsible for documenting any deviation from the MPEX High Heat Flux Brazed Components drawings.

Any deviation request shall be submitted by the seller and approved by ORNL for all process or specification deviations and then must be maintained under revision control after ORNL approval. The seller shall provide ORNL with all released documents.

## 4.3 TASK 3: MANUFACTURING REVIEW

With the completion of Task 2 and with authorization from ORNL, the seller shall prepare a manufacturing plan to demonstrate how the design specifications given in the drawings and [1] and [2] are satisfied. The seller shall prepare a report and participate in a manufacturing review. The Manufacturing review will be held by videoconferencing or at the seller's site based on an agreement between the seller and ORNL. The seller shall prepare written meeting minutes and submit them to ORNL for review within 3 working days after the meeting. Completion of the Manufacturing review and closure of all action items shall constitute a project milestone.

The Manufacturing Review and Report shall include:

- Component fabrication plan, including all purchased and outsourced components.
- Review of materials and processes to be used for brazing, including brazing alloys.
- A project plan summary of how compliance with all MPEX requirements and specifications will be achieved.

## 4.4 TASK 4: HIGH HEAT FLUX BRAZED COMPONENTS FABRICATION

After completion of Task 3 and with approval of ORNL, the seller shall provide an updated manufacturing schedule and begin construction. The seller and ORNL shall establish a recurring fabrication update meeting not to exceed 1 month between meetings. The seller shall prepare a current manufacturing status report and identify any fabrication issues or logistics that will affect the agreed-upon delivery date. ORNL will review and generate actionable items for the seller or ORNL. Status shall be reviewed at all fabrication status meetings. Fabrication status meetings shall be held by videoconferencing or at the seller's site based on an agreement between the Seller

and ORNL. The seller shall prepare written meeting minutes and submit them to ORNL for review within 3 working days after each meeting. Meeting minutes can be used to supplement the monthly reporting requirements of Section 5.5.

At a minimum, the meeting minutes shall include:

- Project schedule update
  - Component brazing status
  - Delivery status
- Quality plan update
  - Quality Control Inspection reports
  - Non-conformance reports
- Status of old action items
- New action items
- Report any variances or deviations from the agreed-upon specifications
- Summary of main discussion topics
- Summary of decisions and agreements between the seller and ORNL.

#### **4.5 TASK 5: DELIVER HIGH HEAT FLUX BRAZED COMPONENTS**

Upon successful completion of Task 4 and with authorization of ORNL, the seller shall perform factory acceptance testing, generate quality plan compliance documentation, and deliver the high heat flux brazed components following the approved approach from Task 3 meeting the drawings requirements and specifications in [1] and [2].

Final acceptance of the high heat flux brazed components will occur upon successful completion of the site acceptance tests at ORNL's facility.

### **5. PROJECT MANAGEMENT**

#### **5.1 LANGUAGE**

All communications and documentation shall be in English.

#### **5.2 COMMUNICATIONS PROTOCOL**

The seller shall designate an official single Point of Contact (POC) to interface with ORNL. The interface will be made via ORNL's designated Technical Project Officer (TPO).

Only ORNL's Procurement Officer (PO) can authorize changes to the price, statement of work, or work scope.

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

### 5.3 KICKOFF MEETING

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

The primary purpose of the kickoff meeting is to confirm that the project participants understand the terms and conditions of the subcontract, SOW, drawings requirements and specifications in [1] and [2], 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

The seller should be prepared to review Tasks 1 and 2 during the kickoff meeting.

### 5.4 SCHEDULE AND MILESTONES

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

- Kickoff meeting
- Quality Plan
- Manufacturing Review
- Resolution of deviation requests and approval for construction
- Materials ordered or fabrication started
- Individual high heat flux brazed components complete (Each)
- Factory Acceptance Tests
- Approval of Shipping Plan
- Prepare for shipment
- Customer onsite final acceptance tests
- Complete and submit final documentation

### 5.5 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 ORNL and the seller's 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.

## **5.6 VARIANCE REPORTING**

The seller shall notify ORNL (TPO and 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 the actual cost may exceed the agreement price.

## **5.7 PERIODIC COMMUNICATIONS**

The seller shall participate in a bi-weekly (every other week) meeting (or as agreed to in 5.3) to be held with ORNL 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 ORNL within 3 working days after the meeting.

## **6. QUALITY ASSURANCE**

### **6.1 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. 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).

Before the 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 ORNL and shall occur before award.

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

### **6.2 ACCESS FOR SOURCE SURVEILLANCE INSPECTIONS**

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

### **6.3 SUSPECT/COUNTERFEIT ITEMS PREVENTION**

The Seller's QAP must include a Sensitive Compartmented Information (SCI) Program that is compliant with DOE O 414.1D, Quality Assurance, or approved equivalent. Although there is a provision in the contract describing SCI prevention; we have found many vendors don't focus on the details of SCI nor the impact long-term of counterfeit items prevention.

### **6.4 SELLER REQUESTED DEVIATIONS**

The seller shall propose any deviations to the specifications, drawings, or other technical requirements during the Review of Specifications per Section 4.2 and obtain ORNL's approval before invoking the deviation. Any deviation requests arising from the fabrication phase shall adhere to the seller's quality program procedure and must be approved by ORNL.

### **6.5 NON-CONFORMANCES**

When a nonconformance is identified, the seller shall notify ORNL to determine the required actions 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 ORNL.

### **6.6 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 ORNL.

## **7. TRANSPORTATION**

The equipment shall be packaged according to [1], section 3.10 and 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).

## **8. DELIVERABLES**

The seller shall supply the following:

Deliverable 1 – Within 2 weeks of subcontract award, provide to ORNL the seller's quality assurance program documentation and a project specific quality plan.

Deliverable 2 – At the kickoff meeting defined by 5.3, the seller shall provide to ORNL a list of proposed deviations to any requirements specified in the drawings of the awarded High Heat Flux Brazed Components or governed by MPEX documents [1] and [2].

Deliverable 3 – Manufacturing review shall be held no more than 8 weeks after subcontract award and shall include the following documents:

- Manufacturing review report
- Presentation slides and documents
- Action item resolution documentation
- Fabrication procedures for all brazing processes

Deliverable 4 – High Heat Flux Brazed components shall be delivered with the following:

- Quality inspection data required for all components
- Test data required for all components
- Completed factory acceptance test report shall include as a minimum
  - o Hydrostatic Leak Check on Water Volume Brazes
  - o Vacuum Leak Check on Vacuum Interfaces
  - o Material certifications (brazing alloys)
  - o Critical dimension report

## REFERENCES

- [1] MPEX-00-ENG-002 *Vacuum Handbook*
- [2] MPEX-12-PLAN-001 *Quality Assurance Plan for the MATERIAL PLASMA EXPOSURE EXPERIMENT*