



# ENG-060 - SOW - STATEMENT OF WORK

## STATEMENT OF WORK FOR THE NSTX-U GRAPHITE MATERIAL PROPERTY TEST PROGRAM

*NSTXU\_1-1-1-1\_SOW\_104*

*Rev. 1*

Work Planning #:  
Effective Date: **02/10/2020**  
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Reviewed By	Robert A. Ellis, Chief Engineer	02/10/2020 12:54:57 PM
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**STATEMENT OF WORK**  
**FOR**  
**NSTX-U Graphite Material Property Test Program**

**CAT: A3**

**NSTXU\_1-1-1-1\_SOW\_104**  
**Reference Work Planning #: 2317**

**REVISION 1**

**DATED January 30, 2020**

**PREPARED BY:** Brian Linn, Cognizant Individual

**REVIEWED BY:** Doug Loesser, Responsible Engineer

**REVIEWED BY:** Jerry Levine, ES&H

**REVIEWED BY:** Andres Castaneda, Quality Assurance

**REVIEWED BY:** Bob Ellis, Chief Engineer

**APPROVED BY:** Les Hill, Project Manager

**PRINCETON PLASMA PHYSICS LABORATORY**  
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## **1.0 INTRODUCTION & SCOPE**

To provide accurate mechanical material properties for the analysis of the graphite that will be used to fabricate replacement NSTX-U plasma facing components, a test program is needed. Proposed testing will encompass a wide range of mechanical and thermal property tests including tension, compression, flexural strength, and thermal conductivity.

## **2.0 APPLICABLE DOCUMENTS**

2.1 ASTM E1225-13 – Standard Test Method for Thermal Conductivity of Solids Using the Guarded-Comparative-Longitudinal Heat Flow Technique

## **3.0 APPLICABLE DRAWINGS**

N/A

## **4.0 RESPONSIBILITIES**

### **4.1 PRINCETON PLASMA PHYSICS LABORATORY**

- 4.1.1 PPPL shall designate a technical contact, referred to as Princeton Technical Representative (PTR), and a Quality Assurance (QA) contact at the time of the award.
- 4.1.2 All communications on technical matters shall be directed to the assigned PTR.
- 4.1.3 All communications on administrative matters shall be directed to the PPPL Procurement Representative.
- 4.1.4 Graphite testing samples and inventory/traceability documentation will be provided by PPPL.

### **4.2 SUBCONTRACTOR**

- 4.2.1 The Subcontractor shall provide a single point of contact for any communication between PPPL and the Subcontractor.
- 4.2.2 The Subcontractor is responsible to verify and confirm the scope of work within this Statement of Work and referenced documents. All questions and/or exceptions shall be communicated to PPPL and resolved prior to award.

## **5.0 REQUIREMENTS**

### **5.1 PERFORMANCE REQUIREMENTS**

5.1.1 PERFORMANCE CHARACTERISTICS  
N/A

5.1.2 OPERATING ENVIRONMENT  
N/A

5.1.3 DESIGN LIFE

N/A

5.1.4 RELIABILITY  
N/A

5.1.5 MAINTAINABILITY  
N/A

5.1.6 HUMAN FACTORS  
N/A

5.1.7 SUSTAINABILITY  
N/A

## 5.2 EQUIPMENT DEFINITION

### 5.2.1 SPECIFICATIONS AND STANDARDS

All testing will adhere to ASTM standards, when applicable. The ASTM revisions listed in section 2 shall apply. When ASTM standards are not available, proven test methods, subject to PPPL approval shall be used.

5.2.2 GENERAL DESIGN FEATURES  
N/A

### 5.2.3 MATERIALS

#### 5.2.3.1 PPPL PROVIDED MATERIALS

Samples will be provided as stated in Section 4.1.4 and Section 6.0.

5.2.3.2 SUBCONTRACTOR PROVIDED MATERIALS  
N/A

5.2.4 ELECTROMAGNETIC INTERFERENCE AND SUSCEPTIBILITY  
N/A

### 5.2.5 IDENTIFICATION AND MARKING

Each test piece shall be bagged and tagged with a testing identification number, as assigned by PPPL. The number will follow the format:

(ASTM Standard #)-(graphite grade)-(Block Number)(Test Sample Number)

Example: E1225-ET10-12 corresponds with Thermal Conductivity Test, ET10 graphite, Block Number 1, Sample Number 2.

An inventory document cross referencing the quantity, test procedure, identification number, graphite grade, and billet block number will be provided by PPPL for reference throughout the testing.

### 5.2.6 WORKMANSHIP

N/A

5.2.7 SUBCONTRACTOR EQUIPMENT USE

The Subcontractor shall provide all equipment necessary to complete the work defined herein.

**6.0 TEST & INSPECTION REQUIREMENTS**

**6.1 PERFORMANCE TESTS**

**6.1.1 OVERVIEW**

All tests in this program will be performed at room temperature 22°C (295 K ± 3 K) unless otherwise specified. Test specimens shall not be exposed to chemicals or lubricants (e.g., for machining) of any kind unless prior approval is obtained. All specimens are to be inspected for damage prior to testing and shall be tested as received.

Material properties of samples shall be determined in accordance with the applicable ASTM procedures specified herein. Alternate methods may be proposed by the Subcontractor and are subject to PPPL PTR approval prior to use.

Final reports detailing test methods and conditions, equipment information (make, model, and calibration status), relevant photos, and all measured data, traceable to each test sample, shall be supplied to PPPL following the completion of all tests.

**6.1.2 THERMAL CONDUCTIVITY AS PER ASTM E1225**

Fifteen (15) cylindrical test specimens will be provided. The specimens are nominally 25.4mm in height and 25.4mm in diameter. Measurements of the thermal conductivity per ASTM E1225 are to be carried out and recorded for each sample. Tests shall be conducted at average sample temperatures of approximately 100F, 200F, 500F, and 1000F. A minimum of three thermal equilibrium measurements are to be performed at each test temperature. The average of these measurements shall be used to generate a best-fit curve representing the thermal conductivity of each test specimen over the test temperature range.

**6.2 ACCEPTANCE TESTS**

N/A

**6.3 SUPPLIER HOLD POINTS**

6.3.1 Identification of damage to specimens upon inspection as noted in Section 6.1.1 (as applicable).

6.3.2 Approval of training certifications/records prior to testing (per Section 7.2).

## **7.0 QUALIFICATIONS**

### **7.1 TRAINING**

Personnel are required to be trained in the test methods being performed, as well as the operation of the equipment being used.

### **7.2 RECORDS**

A copy of training certifications/records for personnel performing the tests within this SOW is required. This deliverable shall be provided before testing begins.

## **8.0 ENVIRONMENT, SAFETY, AND HEALTH**

N/A

## **9.0 QUALITY ASSURANCE REQUIREMENTS**

### **9.1 SUBCONTRACTOR QUALITY ASSURANCE PROGRAM**

The Subcontractor shall establish and maintain an effective Quality Assurance Program to assure that the Subcontractor's work meets the required level of quality and is performed in accordance with contractual requirements.

- The Subcontractor's quality assurance function shall be organized to have sufficient authority and independence to identify quality problems, verify conformance of supplied items or services to specified requirements and obtain satisfactory resolution of conflicts involving quality.
- The Subcontractor shall perform planned, periodic audits of the various aspects of its QA Program by persons not directly responsible for the area being audited. Written reports of these audits shall be made available to PPPL upon request.

### **9.2 INSPECTION/SURVEILLANCE/AUDIT BY PPPL**

Authorized representatives of PPPL and the U. S. Government shall have the right at all reasonable times to visit the Subcontractor's premises and those of Subcontractor's suppliers during the performance of the procurement for the purposes of inspection, surveillance, audit and/or obtaining any required information as may be necessary to assure that items or services are being furnished in accordance with specified requirements. Such visits shall be coordinated with the Subcontractor's personnel to minimize interference with the normal operations of said premises. The Subcontractor shall make available records and documentation necessary for this function and shall provide all reasonable facilities and assistance for the safety and convenience of PPPL and/or U. S. Government representatives in the performance of their duties. PPPL and the U. S. Government recognize the Subcontractor's right to withhold information concerning proprietary processes.

### **9.3 SUBCONTRACTOR'S RESPONSIBILITY FOR CONFORMANCE**

Neither PPPL's review and/or approval of Subcontractor's documents nor PPPL's inspection of Subcontractor's items or services shall relieve the Subcontractor of responsibility for full compliance with requirements of the purchase order/contract. Any proposed use of sub-tier suppliers for portions of the work affecting fit, form, or function shall be communicated

to and approved by PPPL prior to contract award. The Subcontractor is responsible for assuring that all requirements and restrictions are imposed on any sub-tier suppliers.

#### 9.4 CALIBRATION OF TEST AND MEASURING EQUIPMENT

Tests shall be performed using properly calibrated measuring equipment. Calibration standards shall be traceable to the National Institute for Standards and Technology (NIST) or equivalent. Where such standards do not exist, the basis used for calibration shall be documented. Standards used for calibration shall not be used for shop inspections and shall be protected against damage or degradation.

#### 9.5 NON-CONFORMANCES & CORRECTIVE ACTION NOTIFICATION

Nonconforming items or services shall be identified, and, where possible, segregated to prevent use. The Subcontractor shall document each nonconformance. The written approval of PPPL is required prior to the use of the nonconforming item or service. The Subcontractor's system shall provide not only for timely resolution of non-conformances but also for analysis of non-conformances to determine causes and to implement appropriate corrective actions (determination of cause and corrective action may be waived by PPPL for specific situations).

#### 10.0 SHIPPING STORAGE AND HANDLING

Material returned to PPPL shall be packaged as to maintain the pre-shipping state of the sample. If there are multiple pieces to a failed sample, the pieces will be collected into a single container (e.g. plastic bag) with identification as noted in 5.2.5 and packaged so as to maintain the pre-shipping state.

#### 11.0 WARRANTY

N/A

#### 12.0 ATTACHMENTS

N/A



### 13.0 DOCUMENTATION & DELIVERABLES

#### Deliverables List

PO / Subcontract / BOA / BPA #: \_\_\_\_\_

#	Physical Deliverables Required	When Deliverable Is Required	Deliverable Received (✓)
1	All test samples	At Completion of Contract	
Exceptions (Add justification for any missing physical deliverables that will not be received):			

#	Document Deliverables Required	When Deliverable Is Required	Deliverable format (paper, electronic etc.)	Storage Location for Deliverable	Deliverable Received (✓)
1	Training Records (Section 7.2)	With proposal	Electronic	OPS	
2	Non-Conformance Reports (Section 9.5 – as applicable)	Upon detection	Electronic	OPS	
3	Final Reports (Section 6.1.1)	At Completion of Contract	Electronic	OPS	
Exceptions (Add justification for any missing document deliverables that will not be received):					

Princeton Technical Representative/COG: \_\_\_\_\_  
(Sign-off and provide to the Operations Center when job is completed, and deliverables are dispositioned and placed/filed in Operations Center (or other Project, Department or Division designated file center))