

National Compact Stellarator Experiment (NCSX)

Statement of Work

Vacuum Vessel Field Weld Joint R&D Test Program

NCSX-SOW-121-02-03

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Record of Revisions

Revision	Date	Description of Revision
0	March 18, 2004	Initial Issue
1	May 17, 2004	Corrected Sections 2.2 and 2.3
2	September 10, 2004	Change in design caused the following sections to be revised: <ul style="list-style-type: none"> • Section 2.1 - Updated drawing list • Section 3.2 – Relabeled Section 3.2 to “Fabrication Steps,” deleted Section 3.2.1 heading, clarified fabrication step on fabricating blank flanges, and deleted fabrication step to weld wire into two spool pieces. Also deleted Section 3.2.2 in its entirety. • Section 3.3 – added new subparagraph that addresses measurement frequency requirements and fiducials. • Section 3.4 – deleted Section 3.4.3 in its entirety.
3	October 4, 2004	Revised the following sections: <ul style="list-style-type: none"> • Section 1.2 - modified scope to reflect addition of a witness hold point to permit observation of the first of the flange welds. • Section 2.2 – correct typo. • Section 3.6.2 – clarified bi-weekly reports can be e-mailed. • Section 3.6.3 – revised section on the Technical Reports required.

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1 INTRODUCTION

1.1 Purpose

The purpose of this statement of work is to provide components and the description and requirements for a test program to demonstrate the NCSX Vacuum Vessel field weld joint.

1.2 Scope

The components needed for this test are to be supplied by a subcontractor to PPPL. They include a slanted spool piece and two mating end pieces and are made of Inconel 625. The spool piece will have oval flanges welded to each end and each end piece will also have a mating flange welded to them. PPPL desires a witness hold point to observe the first of these flange welds. The final flange to flange welds will be performed at PPPL.

1.3 Background and Goals

The NCSX Vacuum Vessel (VV) will be assembled using spool pieces welded to end flanges of the VV field period assemblies. This test program is intended to fabricate and assemble full size components which will simulate the VV weld joint and its assembly.

The goals of this test program are to:

- Determine the viability of the current VV joint design;
- Qualify weld procedures; and
- Determine the amount of weld distortion which can be expected during assembly of the actual components.

2 APPLICABLE DOCUMENTS

2.1 Statement of Work and Drawings

This Statement of Work (SOW) is intended to provide the recommended fabrication procedures and requirements for fabricating the components in the provided drawings.

Likewise, the prototype VV field weld joint assembly drawings that will be used to demonstrate the viability of the vacuum vessel field weld joint are available. The drawings are contained in a zip file that includes identical files in three formats: Adobe Acrobat (pdf) drawing files; Pro/Engineer assembly, part, format and drawing files; and an assembly STEP file.

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Table 2-1 below lists all the applicable drawings.

Table 2-1 Drawings

Drawing Number	Drawing Type	Revision Number
se1203-001r1.pdf	pdf	1
se1203-002r1.pdf	pdf	1
se1203-003r1.pdf	pdf	1
se1203-004r1.pdf	pdf	1
se1203-005r1.pdf	pdf	1
se1203-006r1.pdf	pdf	1
se1203-007r1.pdf	pdf	1
se1203-011r1.pdf	pdf	1
se1203-015r1.pdf	pdf	1
se1203-016r1.pdf	pdf	1
se1203-017r1.pdf	pdf	1
se1203-001-r1.asm	asm	1
se1203-002-r1.asm	asm	1
se1203-003-r1.asm	asm	1
se1203-004-r1.asm	asm	1
se1203-005-r1.asm	asm	1
se1203-006-r1.asm	asm	1
se1203-007-r1.asm	asm	1
se1203-001-4-r1.prt	prt	1
se1203-011-r1.prt	prt	1
se1203-012-r1.prt	prt	1
se1203-015-r1.prt	prt	1
se1203-016-r1.prt	prt	1
se1203-017-r1.prt	prt	1
se1203-011-r1_asm.stp	stp	1

2.2 Availability of Documents

General information on this and other pending or current manufacturing contracts can be found on the NCSX Manufacturing Web at:

http://ncsx.pppl.gov/NCSX_MFG/

Specific access to the Field Joint SOW and drawings is available via a hot link button from the above Manufacturing Web. The SOW and drawings are contained in a subfolder entitled, "Prototype_VV_Field_Joint."

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3 REQUIREMENTS

3.1 General

The supplier shall fabricate and assemble the components specified in the referenced drawings per Section 2.2. Metrology and final inspections shall be performed in accordance with Section 3.3 and 3.4. Program management and control tasks shall be accomplished in accordance with Section 3.5.

3.2 Fabrication Steps

The following description provides a suggested procedure for fabrication the components in the referenced drawings. Should the Supplier elect to substitute alternate methods, prior approval of the NCSX Project is required. The suggested fabrication steps follow:

- Roll and seam weld 3/8” Inconel 625 plate into a 34.5” diameter cylinder.
- Cut two vessel end pieces and a spool piece from the cylinder using a method which does not result in distortion of the components.
- Face off the end surfaces of the components, as required, to achieve required flatness before welding to the blank flanges.
- Cut 4 blank flanges from 1” Inconel 625 stock using appropriate non-distorting methods. Flanges may be fabricated in sections and assembled by welding rather than a single cut from a large plate.
- Weld blank flanges to each end of the spool piece and to the mating faces of the end pieces
- Final machine the spool piece assembly and the two end piece assemblies.
- Cut and machine four seal plates.
- Weld sealplates on spool and end piece flanges.
- Clean the components per procedures supplied by the Project.

3.3 Metrology

The completed end pieces and spool piece shall be measured by the Supplier on a CMM machine or other appropriate device to map the contour of the components. The goal will be to repeat the measurements on the completed welded joint and determine the amount and location of the weld distortion. Sufficient data, must be taken to permit modeling of the contours on ProE; particular attention being given to regions around the joint welds. A metrology plan will be provided by the Project.

At a minimum, measurements shall be taken every inch along the length of the flanges and in a two inch grid on the body of the components. A minimum of three (3) fiducials on each end flange shall be permanently installed to establish a reference system to be used for dimensional inspection. The goal shall be to permit replication of Supplier measurements by the Laboratory. The fiducials may be mounts for removable tooling balls or some other system proposed by the Supplier. The nature, location, and installation of these fiducials shall be submitted by the Supplier for approval by the Laboratory.

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3.4 Inspections and Measurements

The Supplier shall perform and document the following inspections and measurements to demonstrate that the produced spool piece and end pieces meet NCSX Project requirements documented on the referenced drawings. PPPL shall be notified of the date of these inspections and afforded the opportunity to witness the inspections and measurements at its option. The results of these inspections and measurements shall be documented and submitted to the NCSX Project.

All welds shall be inspected for conformance to the code and acceptance criteria on the drawings.

Dimensional verification shall be performed (ref. paragraph 3.3) to verify conformance to all drawing dimensions and tolerances.

3.5 Program Management Requirements

3.5.1 QA Requirements

3.5.1.1 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 supplier's premises and those of the Supplier's subcontractors during the performance of the subcontract for purposes of inspection, surveillance, audit, and/or obtaining any required information as may be necessary to assure that items and services are being furnished in accordance with specified requirements. Such visits shall be coordinated with the Supplier's personnel to minimize interference with the normal operations of said premises. The Supplier shall make available records and documentation necessary for this function and shall provide all reasonable facilities and assistance for 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 Supplier's right to withhold information concerning proprietary processes. The Supplier agrees to insert the paragraph above in each lower-tier procurement issued hereunder.

3.5.1.2 Supplier's Responsibility for Conformance

Neither PPPL review and/or approval of supplier documents, nor PPPL inspection of supplier items or services, shall relieve the Supplier of responsibility for full compliance with the requirements of the contract. The Supplier is responsible for assuring that all requirements and restrictions are imposed on any sub-tier suppliers.

3.5.1.3 Non-conformances and Deviations

Nonconforming items shall be positively identified, and, where possible, segregated to prevent use. PPPL must be notified of non-conformances with one (1) business day of their discovery. The Supplier shall document each non-conformance, identifying the extent and location of the non-conformance and shall propose a disposition. The written concurrence of PPPL is required prior to implementing the disposition. The Supplier's system shall provide not only for the timely resolution of non-conformances, but also for

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analysis of non-conformances to determine root causes and implementation of appropriate and effective corrective actions.

3.5.1.4 Supplier's Quality Assurance Program

The Supplier shall maintain an effective Quality Assurance Program to assure that the Supplier's work meets the required quality and is performed in accordance with contractual requirements. The Supplier'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 requirements, and obtain satisfactory resolution of conflicts involving quality.

3.5.1.5 Inspection and Test Procedures

Inspections and tests shall be performed in accordance with written procedures referencing criteria for acceptance or rejection. Adequate records shall be maintained and available for PPPL reviews.

3.5.1.6 Control of Special Processes

Subcontractor shall use trained and qualified personnel and qualified written procedures in accordance with specified requirements for the performance of certain special processes, including but not limited to, brazing, welding, heat treatment, nondestructive examination, etc. Copies of special process procedures shall be available for review by Princeton and submitted to Princeton for review and approval if requested.

3.5.1.7 Witness/Hold Points and Notification of Princeton in Advance

Princeton reserves the right to designate selected manufacturing, inspection and/or test operations as mandatory "witness" points. Subcontractor shall provide Princeton with three (3) working days notice in advance of such witness points. **Two such witness points will be welding of the first flange to spool piece or end piece and subcontractors verification of flange flatness.**

3.5.1.8 Equipment/Material Identification and Status

Material and equipment identification shall be maintained throughout the program and be traceable to the records. Status of acceptability shall be readily discernible through the Subcontractor's use of tags, stamps, serial numbers or other positive means.

3.5.1.9 Document Review, Approval and Control

The Subcontractor shall provide a system for distribution and control of approved documents and changes thereto. The system shall use procedures, which provide for review and approval of design documents (drawings, specifications, etc.), prior to issuance for use, and for approval and incorporation of changes in a formal and orderly manner. The system shall control obsolete documents to prevent inadvertent use.

3.5.1.10 Calibration of Test And Measuring Equipment

Inspections and tests shall be performed using properly calibrated measuring and test equipment. Subcontractor shall have in its possession the necessary equipment to perform the required inspections and tests. Calibration standards shall be traceable to the National

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Institute for Standards and Technology (NIST) or equivalent. Where such standards do not exist, the basis used for calibration shall be documented. Calibration standards shall not be used for shop inspections, but instead be protected against damage or degradations.

3.5.1.11 Release for Shipment Form

Subcontractor shall have a signed "Product Quality Certification and Shipping Release" Form to be provided by PPPL Quality Assurance Representative prior to PPPL acceptance of procured items or services for full or partial shipment.

3.5.1.12 Process History

Subcontractor shall provide to PPPL a Process History that includes a compilation of documents, detailing the objective evidence of the acceptability of the work performed. Subcontractor shall provide to PPPL three (3) "paper" copies or one "electronic" copy of the Process History, which includes a compilation of documents, detailing the objective evidence of the acceptability of the work performed. The Process History shall be complete and available at the time the Subcontractor requests Release for Shipment. The Process History shall include as a minimum, but not be limited to, material certifications and inspection and test reports. The Process History shall include as a minimum, but not be limited to, the following:

3.5.1.12.1 Material Certifications

The Subcontractor shall submit copies of inspection reports, test data, and/or certifications from Supplier/s, showing relevant chemical and mechanical properties of materials used, where applicable, as well as documents showing adherence to in-process requirements. Material certifications from sub-tier suppliers shall also be submitted.

3.5.1.12.2 Inspection Reports

Copies of the original reports of all required inspections and examinations, properly validated by authorized personnel.

3.5.1.12.3 Nonconformance Reports

Completed and approved copies of any nonconformance reports issued for this work.

3.5.1.12.4 PPPL Receiving Inspection

PPPL will perform Receiving Inspection on items supplied by Subcontractor. Discrepant items will be rejected and returned to Subcontractor or reworked by PPPL. Costs caused by rejects will be charged to Subcontractor.

3.5.2 Shipping Storage and Handling

The delivered items shall be prepared for shipment in such a manner as to ensure acceptance by common carrier for transportation at the lowest applicable rate and to afford protection from normal hazards of transportation. Subcontractor's name, shipper, purchase order number, contents and gross weight shall be marked on shipping containers.

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Subcontractor is responsible arranging shipment, and for the safe arrival of the delivered parts.

3.6 Deliverables

The Subcontractor is responsible for delivering to the following:

3.6.1 QA Documentation

All documentation listed in Sections 3.5.1.12 and 3.5.2

3.6.2 Weekly Reports

Brief e-mail bi-weekly status reports covering technical, administrative, and Quality activities and notable problems/issues shall be provided to PPPL's Technical and Administrative Representatives during the period of performance.

3.6.3 Technical Reports

Provide one (1) electronic copy in Adobe Acrobat (.pdf) format of the manufacturing methods for fabricating the Weld Test Joint components (ref. Section 3.2).

3.6.4 Vacuum Vessel Field Weld Joint Components

Provide completed end pieces and spool per this SOW. Packaging and shipping details shall be subject to prior PPPL approval.