

NATIONAL COMPACT STELLARATOR PROJECT

Engineering Change Proposal (ECP)

COVER PAGE

(TO BE COMPLETED BY SYSTEMS ENGINEERING SUPPORT MANAGER)

Originator: Phil Heitzenroeder

Date: July 7, 2005

ECP No: 033 Rev 1

ECP Title: MCWF Technical Requirements Revision

Required Reviewers

Required Reviewers for this ECP:

Dave Williamson, Wayne Reiersen, Brad Nelson, Ron Strykowski, Judy Malsbury, Frank Malinowski, Jerry Levine, Larry Sutton, Bob Simmons

ECP Approval Level

Expedited ECP? ☐ Yes ☒ No

Change Level: 2 Federal Project Director

Approving Official: 2 Federal Project Director

Actions

- (1) Revise MCWF CSPEC (NCSX-CSPEC-141-03) by July 15th.
- (2) Revise MCWF SOW (NCSX-SOW-141-02) by July 15th.
- (3) Incorporate ECN-4994 changes by June 15, 2005 (completed under Rev 0 of this ECP)
- (4) Issue Approved RFD-14-003 by June 15, 2005 (completed under Rev 0 of this ECP)
- (5) Issue contract modification to EIO by July 15th specifying NCSX-CSPEC-141-03-Rev. 8
- (6) Update cost and schedule baseline by July 30th

APPROVALS

(TO BE COMPLETED BY APPROVING OFFICIALS)

Change Level	Approving Official	Approval?	Signature
3	NCSX Project Manager	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
3a (Expedited ECP)	NCSX Engineering Manager	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2	NCSX Federal Project Director	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
1	Associate Director OFES	<input type="checkbox"/> Yes <input type="checkbox"/> No	
0	Deputy Secretary of Energy	<input type="checkbox"/> Yes <input type="checkbox"/> No	

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PART I *(TO BE COMPLETED BY ORIGINATOR)*

Originator: Phil Heitzenroeder

Date: July 7, 2005

Overview of Change

Type of of ECP: ☐ EXPEDITED ☒ STANDARD

Type of Change: ☒ TECHNICAL ☒ COST ☐ SCHEDULE ☐ EDITORIAL

(Check all that Apply)

Reason for Change:

Revision 0 - Clarifications of technical requirements, clarification of delivery requirements in SOW, revision of several drawings to reflect redesigned lead block, and approval of a Request for Deviation on material testing. This ECP was approved in mid-June as a Class 3 ECP since no impact on the cost or schedule baselines. However, subsequent discussions with EIO revealed additional concerns and revisions needed. Accordingly, this Revision 1 incorporates the results of the discussions with EIO.

Revision 1 - this revision incorporates the following major changes (attached version of CSPEC and SOW include all the revisions):

- (1) PPPL added a requirement to heat treat each MCWF casting to ensure adequate stress relief
- (2) PPPL clarified surface finish requirements and weld repair requirements.
- (3) Other miscellaneous changes to CSPEC made.

Impacted WBS Elements: WBS 141

Impacts of Change (Briefly Describe):

Revision 0 - This ECP dealt entirely with technical changes to requirements that had no impact on performance, cost, or schedule.

Revision 1:

- (1) There are not cost or schedule impacts associated with the change in surface finish and weld repair requirements. These changes are more clarifications and agreements reached with EIO on clarifications.
- (2) Cost impact to add the requirement of heat treating each MCWF casting is \$28.8K and should not impact EIO delivery schedule. Heat treatment was already a requirement to develop the strength required. What is added is a final, lower temperature stress relieving cycle under heat treatment to relax the residual stress in the weld repair area. It is this additional requirement that resulted in a cost increase.

Net impact is a required drawdown of contingency of \$37.9K from \$12,242K to \$12,204K

Assessment of Other Options: None

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List Attachments, Impacted Documents, etc.

- Budget reconciliation sheet (ECP-031 to ECP-033 and ECP-034)
- CSPEC (NCSX-CSPEC-141-03-08) – Currently in signature cycle
- SOW (NCSX-SOW-141-02-04) – approved
- ECN-4994 impacting drawings SE141-114, SE141-115, and SE141-116
- RFD-14-003

Detailed Description of Change:

- Changes to CSPEC:
 - Added ASTM A751-01, “Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products,” to Section 2.1.1. This ASTM Spec is used to define the casting chemistry determination method used by MetalTek (and standard industry practice).
 - Revised Section 3.1.1.1: Added note about alloy composition ranges – this note cautioning that although the alloy is based on that developed for the prototype, it differs inasmuch as the range of chemistry is now specified. This was requested by EIO, presumably as a note to their personnel. Clarifies that Table 3-1 is for the casting chemistry. Table 3-2 was added which gives the chemical constituents of the weld wire.
 - Table 3-1: The % Si was changed from 0.5% to 0.7% max. The previous requirement of 0.5% was shown to be too restrictive. PPPL’s metallurgical consultant, Dick Reed, advised that there should be no problem with the higher Si (0.7%) spec. This was supported by actual mechanical tests performed on specimens (shims) made with the higher Si content. These specimens met both the mechanical properties and magnetic permeability requirements;
 - Revised Table 3-3: Changed yield from 34 ksi (234.4 MPa) to 30 ksi (206.8 Mpa). This refers to RT yield. Was 29ksi for for prototype and was subsequently increased. However, the higher 34 ksi value was found to be difficult to achieve consistently with actual attached specimens that received representative thermal processing ;
 - Revised Section 3.1.1.4 to change surface finish requirements. Relaxed finish requirements to <250 microinch in non-critical areas. This is anticipated to possibly provide some schedule relief.
 - The visual examination requirements of Section 3.1.1.6.1 were revised to eliminate the need to do a higher level of visual examination in the foundry of areas which will then be machined in subsequent steps. This change removed unnecessarily restrictive language that could be misinterpreted – does not result in any change to the level of inspection required;
 - Revised Section 3.2.3.1 to clarify stress relieving processes. Stress relieving is now specified for all castings as a final operation after all weld “upgrades” have been completed. This will reduce the risk of distortions due to residual stresses in welds and the risk that machining rates will be impacted by non-uniformity of metal properties that could occur without stress relieving;
 - Revised Sections 3.2.3.2.2.2 and 3.2.3.2.2.3 concerning weld repair to address weld repairs due to machining errors – this was not foreseen in the original spec;

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Continuation Sheet:

- **Changes to CSPEC (continued):**
 - In Section 4.2.1, the requirements for chemical analysis was clarified ; we want to know analysis of material for *each ladle* rather than a *single average value*, since we cannot be sure of how the material from the three ladles will mix. Consequently, we now clearly say analysis of the material for each ladle is required.
 - Revised Section 4.2.2: Deleted the requirement for both transverse and longitudinal test specimens. The need for performing testing on specimens from both the transverse and longitudinal directions was questioned from first a practical, and then a need basis. The practical aspect was that significantly larger attached specimens would be needed. However the need question was the determining consideration. Unlike a plate which can have directionality induced by the rolling process, castings do not have directionality to their grain structure. This lack of directionality in the casting is supported by our fracture results which showed no directional sensitivity. Consequently, this requirement has been deleted;
 - To make sure that it is absolutely clear that we expect yield strength, E, ultimate strength, elongation, and Charpy V-notch results from all three zones, the statement : "...for the three zones specified in Section 4.2.2 for each casting..." was added to Sections 4.2.2.1, 4.2.2.2, and 4.2.2.3. This was added for emphasis – the vendor missed this in pouring C1 casting;
 - Section 4.2.2.4 has been revised to clarify the quantity requirements, their origin, and the need to engrave or stamp so that their location is preserved for the additional test material to be supplied with each casting and for each zone;
 - Revised Section 4.2.2.5: Clarified wording for weld filler properties requirements; and
 - Revised Table 6-1 and Table 6-2 to reflect latest approved models and drawings and approved RFDs.
- **Changes to SOW:**
 - Revision 3 - Section 5.4.3 revised to clarify dimensional inspection file format and contents.
 - Revision 4 – Section 5.5 revised to clarify retention requirements of CAD/CAM files.
- **Changes to Drawings (per ECN-4994):**
 - Drawings SE141-114, SE141-115, and SE141-116 were revised due to the redesign of the lead blocks. As a result it was necessary to change the slot length from 6.38-in to 7.5-in and the slot width from 1.5-in to 1.5625-in. The location and dimensions of four tee base tapped holes w/ spotface were also changed to conform to the new design. The mounting pad dimensioning scheme was revised, resulting in a slight change in the pad height for the Type-A and –B winding forms.
- **Approval of RFD-14-003**
 - Section 4.2.2 required that material be tested in the transverse and longitudinal directions. This is performed when testing wrought materials, but is typically not performed in cast materials as it offers no significant information. The primary reason is that in cast materials, the grain structure is uniform and has no directionality. This deviation was approved and the commitment was made to delete this requirement from the CSPEC (Rev 8).