

DESIGN REVIEW DOCUMENTATION – RESULTS – No: 1.1.3.4 #

Title: PF1A & 1B Upper Bus Bar and Bus Support

CAT: ☒ A1 ☐ A2 ☐ A3 ☐

Type of Review: ☐ Peer ☐ CDR ☐ PDR ☒ FDR

Cognizant Individual: D. Cai **Date of Review:** March 6, 2020

Review Board Members:

Please see attached report.

Chairperson R. Ellis

RE Magnets

T A (Mech)

TA (Analysis)

TA (Mfg)

QA

ESH

Regulatory Compliance

Invited Attendees:

Other Attendees:

Items Reviewed:

Appropriate requirements identified

Development plans and schedules

Reg. compliance incl. USI/USID and NEPA

Disposition of CHITS from previous reviews

Calculations (all listed are signed and filed)

Cost objectives

Other review objectives addressed

Sat.

Unsat.

Comments or n/a if not applicable



SUMMARY OF RESULTS:

Disposition: [check one]

Acceptable

☒ **Acceptable pending resolution of concerns-** CHITS identified above must be resolved prior to installation.

☐ **Incomplete** - Additional design work is required prior to another design review.

☐ **Unsuccessful** – Corrective actions must be taken and another review process must be initiated.

Design Review Chair Person **Date:**

Cognizant Individual Acceptance **Date:**

Distribution: Review Board Members, Operations Center, Responsible Engineer (RE), Cognizant Individuals, Project Manager, Project Director, relevant Technical Authorities (TAs), Chief Engineer (CE), Fire Protection Engineer, Attendees, QA, ES&H, Security, Requesting & Performing Dept. Head

PF1A&1B Upper Bus Bar and Bus Support Final Design Review

March 6, 2020

Attendees

R. Ellis*, chair and Chief Engineer; J. Mitchell*, CAD Design; M. Safabakhsh*, Manufacturing TA; S. Sheckman; C. Rana; R. Hawryluk; A. Indelicato (DoE); N. Gerrish*, ES&H; P. Dugan; D. Cai; A. Castaneda*, QA; D. Bishop; J. Dellas, Power Systems TA; G. Swider; Y. Zhai; S. Raftopoulos*, Magnets RE; W. Que; D. Loesser*, VVIH RE and Mechanical TA; M. Kalish*, Magnets COG, remote connection; M. Smith*, VVIH SME, remote connection; P. Titus*, Analysis TA; A. Brooks; W. Gattoni; J. Galayda; S. Gerhardt*, Systems Integration and Research Operation

*review committee member

Summary

The Final Design Review of the PF1A&1B Upper Bus Bars – the last one in a series of reviews of Bus Bars – was held on March 6, 2020. It covered the upper PF1A and PF1B bus bars and associated support structures. Analyses were presented, showing acceptable stresses in the bus bars and supports, acceptable contact pressure at the coil/bus bar connections, and that the configuration of the bus bars and supports did not introduce forces into the coil leads that would alter their design assumptions.

Dang Cai presented the design of the bus bars and supports, and summarized the results of the analyses. He also presented a manufacturing study, and cost and schedule information.

There were five chits, of which one was rejected. None of the chits will require a fundamental alteration of the design.

The review was judged to be satisfactory, pending resolution of concerns.

TO: D. CAI

FROM: Y. ZHAI

SUBJECT: CHARGE FOR PF1A&1B UPPER BUS BAR AND BUS SUPPORT FINAL DESIGN REVIEW – Rev. 1

1 Introduction

The NSTX-U Recovery Project completed a final design review (FDR) for the inner PF replacement coils on March 30, 2018 that included significant design improvement to the coil terminal supports. The project also completed two preliminary design reviews (PDR-I & PDR-II) on the inner PF Bus on February 28, 2019, on bakeout Bus, the PF4 Bus support and remaining Bus scope on October 14 2019 respectively. The FDR I held on February 7, 2020 and FDR II held on February 19, 2020 covered the BUS work scope including

- Inner PF 1C coil bus bars and bus support structures
- The PF4 hard and flex bus and supports
- PF1B water cooled power cable connection from vessel to PCTS
- The TF extension connection field fit-up
- The OH coax hard bus field fit-up
- Inner PF 1A and 1B lower coil bus bars and bus support structures
- The bakeout bus and bus supports

This FDR III shall present the final design of remaining BUS work scope including

- Inner PF1A and 1B upper coil bus bars and bus support structures

The flex cable support at the far end of the coil bus bars will also be evaluated to ensure sufficient structural integrity for the PF Bus bar system. The design review methodology will conform to the latest version of ENG-033 (Rev. 8), based on A1 risk classification.

2 Purpose

The purpose of this final design review (FDR) is to review final design of the PF1A and 1B coil upper terminal support structure, PF1A&1B upper bus bars, and the bus support structures listed above.

3 Requirements

- General Requirements Document, NSTX-U-RQMT-GRD-001-03.
- System Requirements Document for Magnet Systems, NSTX-U-RQMT-SRD-002-02.
- NSTX Structural Design Criteria, NSTX-CRIT-0001-02.

4 Scope

The scope of this FDR includes PF1A & 1B upper coil terminal supports, PF1A & 1B upper coil bus bar and bus support. Cost and schedule will be covered, and review of the manufacturing and installation of the bus, power cable, and supports will also be included.

5 Methodology

The FDR shall be conducted in accordance with existing PPPL procedure ENG-033 "Design Verification," supplemented by the participation of the NSTX-U Project Engineer.

The following are the FDR objectives/deliverables (as applicable):

- Review and verify that the final design satisfies all requirements and is ready for implementation.
- Verify resolution of chits from previous reviews.
- Verify that detailed analyses, calculations, and tests are complete and documented including calculation checking.
- Review and verify that the final product can be manufactured, inspected, assembled, stored, delivered, and installed reliably, safely, and cost effectively.
- Review and verify that appropriate documentation is available for producing the final product (e.g. drawings, installation procedures).
- Review and verify that procurement issues have been identified and resolved.
- Review and verify that appropriate test plans for the final product have been established.
- Review and verify that identification and control of items has been addressed.
- Review and verify any SAD/ASE considerations have been resolved.
- Review and verify that human factors are appropriately addressed in the design.
- Formally convey the design output for approval via the Design Approval Form (ENG-033 - Attachment 6).

Review materials shall be presented to the Design Review Committee and Project Engineer for acceptance, and then distributed to the review committee one week in advance of the review.

6 Review Committee

The Design Review Committee shall be constituted as follows. In case any persons are absent, the review may proceed at the discretion of the Design Review Chair (DRC) and NSTX-U Project Engineer (PE).

Robert Ellis	Design Review Chair and Chief Engineer
John Dellas	Power System TA
Stefan Gerhardt	Systems Integration and Research Operation
Michael Kalish	COG, Magnets
ES&H	N. Gerrish or H. Wetzel
Doug Loesser	VV+IH RE & ME TA
QA Representative	F. Malinowski or A. Castaneda
Mark Smith	VV+IH, SME
Steve Raftopolous	RE, Magnets
Mojtaba Safabakhsh	Manufacturing TA
Peter Titus	Analysis TA
John Mitchell	CAD Design

7 Agenda

The review shall be accomplished over one half day, scheduled for March 6, 2020, with the following preliminary agenda:

6-Mar-20	NSTX-U PF1A&1B UPPER BUS WORK FDR		
	Agenda		
Start	Duration	Topic	Presenter
15:00	5	Introduction & Requirements	D. Cai
15:05	30	Design and analysis for PF1A&1B Upper BUS	D. Cai
15:35	5	Manufacturing and Installation Plan	D. Cai
15:40	10	Chit Disposition	DRC
15:50	Adjourn		

L. Hill	J. Mitchell
D. Loesser	R. Ellis
D. Cai	Y. Zhai
G. Swider	A. Brooks

cc: A. Castaneda W. Que
 J. Dellas S. Raftopolous
 P. Dugan C. Rana
 J. Fang M. Safabakhsh
 R. Hawryluk P. Titus
 S. Gerhardt S. Weidner - PU
 M. Kalish J. Winkelman
 J. King – DOE B. Sullivan – DOE
 A. Indelicato – DOE P. Johnson – DOE
 S. Rogan – DOE D. Niemenski - DOE
 F. Malinowski
 N. Gerrish J. Mitchell
 H. Wetzel
 S. Sheckman PPPL QA
 M. Smith NSTX-U File

PFIAIBU Bus FDR Attendance

Ellis

Mitchell

Safabakhsh

Sheckman

Raver

Hannyluk

Indelicato

Gerrish

Dugan

Car

Costaneda

Bishop

Dallas

Swider

Zhai

Reftopoulos

Que

Loesser

Kalish - remote

Smith - remote

Titus

Brooks

Gattoni

Galayda