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Extent of Condition Review of the NSTX-U Project

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The National Spherical Torus eXperiment Upgrade (NSTX-U) is an experimental research facility funded by the U.S. Department of Energy (DOE) Fusion Energy Sciences (FES) that is operating at the Princeton Plasma Physics Laboratory (PPPL). NSTX-U (http://nstx-u.pppl.gov/home) is the centerpiece of the U.S. ST research program. After commencing operation in 1999 in its original configuration, the NSTX device operated successfully for a period of 10 years and served as a proof-of-principle demonstration of the low-aspect-ratio ST concept.

An upgrade initiative commenced in early 2009, aimed at improving the understanding of the ST configuration and establishing the physics basis for next-step ST facilities. In particular, operation at higher magnetic field with reduced plasma collisionality is targeted by the upgrade. Controllable fully non-inductive current-drive will also contribute to assessment of the ST as a potentially cost-effective path to fusion energy.

Per the United States Department of Energy (DOE) order DOE O 413.3B the Critical Decision 0 (CD-0) Mission Need for the NSTX Upgrade Project was approved February 2009. The CD-4 Project Completion milestone, achievement of 1st plasma, was accomplished in August 2015.

During the early phases of commissioning and operation, a series of technical problems were encountered, the last of which involved the failure of one of the poloidal field coils due to a turn-to-turn fault. This failure necessitated a shutdown of the NSTX-U device in July 2016. Soon after this event the DOE directed PPPL to conduct an Extent of Condition (EoC) review to "identify all design, construction, and operational issues". And to "Prepare a corrective action plan (CAP) to include cost, schedule, scope, and technical specifications of action."

In response to this directive, PPPL organized a dedicated Recovery Project team with Responsible Engineers linked to 11 subdivisions of the project scope. For each of those subdivisions, plus another covering the overall project scope and requirements, special Design Verification and Validation Reviews (DVVRs) are being convened to flesh out any gaps or issues in the design basis or as-built configuration of the device and its supporting infrastructure. The results from these DVVRs will feed into the CAP. Each line item in the CAP will address the issue, its consequence, the cost/schedule to mitigate, and the post-mitigation condition. The information in the CAP will then feed into high-level programmatic decisions concerning the path forward.

This paper describes the background leading to the EoC directive, the DVVR process, and the CAP process.

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