

# Appendix A

## Detailed WBS Dictionary

**WBS Element: 1**

**WBS Level: 1**

**WBS Title: NSTX Upgrade Project**

**Definition:** The replacement of the entire Center Stack Assembly (CSA) and installation of a second Neutral Beam Injection (NBI) system on NSTX is planned to allow an improved understanding of the Spherical Torus (ST) magnetic confinement configuration which is needed to establish the physics basis for next-step ST facilities, broaden the scientific understanding of plasma confinement for ITER, and maintain U.S. world leadership in ST research capabilities. In particular, operation at higher magnetic field with reduced plasma collisionality is needed to extend the plasma physics understanding of the ST toward next-step ST facilities and ITER. Controllable fully-non-inductive current-drive will also contribute to assessing the ST as a potentially cost-effective path to fusion energy.

**WBS Element: 1.1**

**WBS Level: 2**

**WBS Title: Torus Systems**

**Definition:** The torus systems include all the systems and related elements within the boundary of the NSTX support structure. This WBS element includes the Plasma Facing Components (WBS 1.1), Vacuum Vessel & Support Structure (WBS 1.2), and Magnet Systems (WBS 1.3). The scope of the work contains engineering design, R&D, mockups, procurement activities, and component fabrication. Assembly of the Torus System is included in WBS 1.8.

**WBS Element: 1.1.0**

**WBS Level: 3**

**WBS Title: Project Integrated Model**

**Definition:** This WBS element includes development of a project integrated model and the associated analysis support of the overall NSTX Upgrade Project.

As a result of the NSTX Upgrade Project, the NSTX global models and analyses will need to be updated. This WBS element includes analytical support for global models and analysis not presently identified. The global model will provide the basis for updating the analysis to qualify components and identify areas of the tokamak requiring further analysis. Identified plasma scenarios and power supply current limit analyses will be run in the global model and current sets that require further analysis will be identified. These analyses also serve to check the results of more detailed analyses.

{Center Stack Upgrade (CSU) analytical Support (Job 1000)}

**WBS Title: Plasma Facing Components**

**Definition:** The plasma facing components (PFCs) include all the systems and related elements that serve to protect the vacuum vessel from the charged particles and radiation flux from the plasma. These include the plasma facing tiles and mounting components, passive stabilizers, inner wall protection, divertor area strike plates, and local I&C. This element consists of the engineering design, analysis, procurement activities and component fabrication.

The NSTX Upgrade Project will require new PFCs on the new Center Stack Casing (CSC) and the new Inboard divertor (IBD). This WBS element includes the design and analysis for both the CS and IBD PFCs, design modifications to the PFC tiles to accommodate surface diagnostics, including design of the tile mounting schemes and routing plans for diagnostic wires, generation of required documentation such as checked calculations, specifications and procedures, the procurement and installation of all PFC tiles and hardware on the CSC and IBD.

**{Center Stack Upgrade (CSU) PFCs (Job 1001)}**

In addition the NSTX Upgrade will require analysis of the passive plates for disruption and thermal loads. CDR level calculations were performed that addressed one of five disruptions. The remaining identified disruptions are to be completed during Preliminary Design. During Final design, analysis updates are expected as a result of preliminary design evolution. Modest hardware upgrades are anticipated as part of this task. Additions of accelerometers or other diagnostics to benchmark calculations with actual performance in NSTX are also anticipated. This analysis effort is included in this WBS element.

**{Passive Plate Analysis and Upgrade Activity (Job 1002)}**

With the exception of the modifications identified above, no additional modifications to the PFCs are anticipated.

**WBS Title: Vacuum Vessel and Support Structure**

**Definition:** The vacuum vessel & support structure (VVSS) consists of the vacuum chamber, not including the PFCs, all ports and vacuum boundary closures and the torus support structure which provides the overall supporting mechanism for the torus components to the test cell floor. This WBS element includes the engineering design, analysis, procurement activities and component fabrication.

The NSTX Upgrade Project will require that the existing VVSS be modified to accommodate the new center stack structure, including the umbrella structure and the new center stack support structure. This WBS element includes the analytical

and CAD design of the support structures associated with the Magnet upgrade activities. The scope includes; the Vacuum Vessel & Structural Support, the Outer TF Structures, the Outer PF Coil Structures, the Umbrella Structural Reinforcement, the CS Support Pedestal and miscellaneous Vacuum Vessel Structural Supports. It also includes the procurement and fabrication of these structures, but does not include installation costs. Installations costs are included in WBS 1.8. **{Vacuum Vessel & Support Structure (Job 1200)}**

**WBS Element: 1.1.3**

**WBS Level: 3**

**WBS Title: Magnet Systems**

**Definition:** The magnet system consists of the outer Poloidal Field (PF) coils (PF#2-5), the outer Toroidal Field (TF) coil legs, and the Center Stack Assembly (CSA). The CSA contains the inner TF coil legs, the TF coil joint (flex bus assembly), the OH solenoid, the shaping coils, and the center stack casing. This WBS element includes the design, analysis, prototypes (as required), procurement activities and fabrication of the magnet systems up to and including the magnet system coil buswork, but does not include installation costs. Installations costs are included in WBS 1.8

The NSTX Upgrade Project will require engineering, analysis, design procurement and fabrication of a new CSA, replacement of two outer TF coil legs, and a fabrication of a new TF coil joint

This WBS element provides CAD design support for the overall assembly drawings associated with the CSA upgrade. It also includes some time for space allocation studies associated with the magnet upgrades. CAD design support for individual components is included in the specific component jobs.

**{Center Stack Upgrade Project Design Support (Job 1300)}**

**{Center Stack Upgrade Magnet Systems for Conceptual and Prelim Design (Job 1310)}**

**WBS Element: 1.1.3.1**

**WBS Level: 4**

**WBS Title: Outer Poloidal Field Coils (PF #3-5)**

**Definition:** The outer Poloidal Field coils (PF 3-5) consist of 5 poloidal field coils PF 3 upper and lower, PF 4 upper and lower and PF 5 upper and lower. There are no changes to the outer PF coils as part of the NSTX Upgrade Project scope.

**WBS Element: 1.1.3.2**

**WBS Level: 4**

**WBS Title: Outer Toroidal Field Coils**

**Definition:** The outer Toroidal Field coils subsystem consists of the coil sections that make up the 12 TF outer legs. This WBS element includes the

design, analysis, prototypes (as required), procurement activities and fabrication. For the NSTX Upgrade Project two (2) new Outer TF coils will be fabricated to replace existing ones. This WBS element includes the fabrication of (2) new Outer TF coils to replace the existing leaking OTF#7 and OTF#11 that will be removed during the Neutral Beam port upgrade. This coil will then be used as a spare for future operations in NSTX. The scope includes the procurement of conductor, insulation material, aluminum castings and supports necessary to fabricate a new OTF coils. Coil fabrication will be performed by an outside vendor. This scope does not include costs associated with installation. Installations costs are included in WBS 1.8

**{Outer Toroidal Field Coil Repairs (Job 1301)}**

**WBS Element: 1.1.3.3**

**WBS Level: 4**

**WBS Title: Center Stack Assembly (CSA)**

Definition: The CSA consists of the inner TF coil legs, the OH solenoid, the inner PF shaping coils [PF1a, 1b and 1c], and the center stack casing. Also included in this WBS element are the TF coil joint (flex bus assembly) and the ceramic break assembly. The scope of this WBS element includes the design, analysis, prototypes (as required), procurement activities, fabrication and assembly of the Center Stack.

**WBS Element: 1.1.3.3.1**

**WBS Level: 5**

**WBS Title: Center Stack - TF Inner Legs/Bundle**

Definition: The TF inner leg subsystem consists of the new coil sections that will make up the TF inner bore and bundle. Also included in the scope of this WBS element is the TF coil joint (flex bus assembly) and testing of the new TF coil joint design.

For the NSTX Upgrade Project a new TF Inner Leg will be fabricated. This WBS element includes the design of the TF Bundle, the TF flex bus and flex bus supports and includes all analytical and CAD design efforts for these components. It also includes the early procurement of the TF conductor [80 lengths] and procurement of the TF flex bus and supports. It does not include the procurement/fabrication of the Inner TF bundle, which is included as part of the OH procurement in WBS 1.1.3.3.2.

**{Inner Toroidal Field Bundle (Job 1304)}**

. For the NSTX Upgrade Project a test stand to measure the required performance parameters on the new NSTX TF joint design will be designed and fabricated. Test parameter measurements and cyclic lifetime tests of the new TF joint materials will be performed and testing data will be compiled.

**{TF Joint Stand & Performance Test (Job 1303)}**

**WBS Element: 1.1.3.3.2**

**WBS Level: 5**



**WBS Title: Ohmic Heating Solenoid**

**Definition:** The ohmic heating solenoid subsystem consists of the new coils that will make up the center solenoid. This WBS element includes the design, analysis, prototypes (as required), procurement activities and fabrication.

For the NSTX Upgrade a new OH Solenoid will be fabricated. This WBS element includes the design & fabrication of a new OH solenoid and associated components including a Belleville washer spring assembly and support structures for the NSTX upgrades. It also includes all analytical & CAD design efforts. Includes advance procurement of the copper conductor and co-wound [glass/Kapton] insulation. Also includes the procurement of the Micro-therm insulation, conductive paint.

Includes the in-house fabrication for the combined OH and TF bundle assembly.

A single vendor will fabricate both components.

**{Ohmic Heating Solenoid (Job 1305)}**

**WBS Element: 1.1.3.3.3**

**WBS Level: 5**

**WBS Title: Inner Poloidal Field Coils**

**Definition:** The inner poloidal/shaping coils subsystem consists of the new coils that will make up the poloidal field coils 1A, 1B and 1C. This WBS element includes the design, analysis, prototypes (as required), procurement activities and fabrication.

For the NSTX Upgrade three new sets of inner poloidal field coils will be installed. This WBS element includes the design and procurement of the Inner poloidal field coils and supports which includes all analytical and CAD design efforts for these components. It includes the early procurement of the PF conductor and co-wound [Glass/Kapton] insulation.

**{Inner Poloidal Field Coils (Job 1306)}**

**WBS Element: 1.1.3.3.4**

**WBS Level: 5**

**WBS Title: Center Stack Casing and Assembly**

**Definition:** This WBS element includes the design and fabrication of the Center Stack casing and ceramic break assembly for the upgraded Center Stack as well as the assembly of the new Center Stack.

The Center Stack Casing effort includes analysis and CAD design for the casing components; the procurement of the Inconel tubing, forgings, bellows and organ pipes; the fabrication of Center Stack support legs; the procurement/fabrication of a new ceramic break assembly; the in-house assembly of the casing components; and mounting of the PF1A and PF1B structure/coils to the casing.

**{CS Casing (Job 1307)}**

The Center Stack Assembly effort involves all activities associated with the assembly of the Center Stack and includes design modifications and upgrade of the coil assembly stand; procedures for assembling the Center Stack and for installation; assembly of the Center Stack components including the OH/TF coil supports, mounting of the OH Solenoid surface diagnostics and thermal blanket, inconel casing and inner PF coils and setup and tear down of the Center Stack assembly area.

**{Center Stack Assembly (Job 1302)}**

**WBS Element: 1.2**

**WBS Level: 2**

**WBS Title: Plasma Heating and Current Drive Systems**

**Definition:** The heating and current drive systems include all the auxiliary plasma heating and current drive systems. This WBS element includes the High Harmonic Fast Wave (HHFW) Current Drive System, the Coaxial Helicity Injection (CHI) Current Drive System, the Electron Cyclotron Heating (ECH) System, and the Neutral Beam Injection (NBI) System. Only ECH (WBS 1.2.3) and Neutral Beam Injection (WBS 1.2.4) are impacted by the NSTX Upgrade Project. The scope of the work contains engineering design, R&D, mockups, procurement activities, component fabrication, installation, and System Testing. Installation of the WBS 2 systems is included in the individual WBS 2, level 3 elements.

**WBS Element: 1.2.1**

**WBS Level: 3**

**WBS Title: High Harmonic Fast Wave (HHFW)**

**Definition:** The High Harmonic Fast Wave System provides radio frequency (RF) energy to the plasma for the purpose of plasma heating and current drive. The components of such a system include generators, transmission lines, tuning systems, antennas and their associated diagnostic and control systems. The system includes components inside the vacuum vessel (antennas and feed-throughs) in the test cell (transmission and tuning components) and in the RF power rooms (AC/DC power conversion system, RF generators, switches and loads). There are no changes to the HHFW System as part of the NSTX Upgrade Project.

**WBS Element: 1.2.2**

**WBS Level: 3**

**WBS Title: Coaxial Helicity Injection (CHI) Current Drive**

**Definition:** The Coaxial Helicity Injection System is to provide helicity injection to aid startup and provide edge current profile control. The main hardware elements required fall under other WBS's. These include a ceramic break in the vacuum vessel (WBS 1.1.3) the poloidal coil system (WBS 1.1.3) and a power supply (WBS 1.5). In this WBS element the task is to assure that the various components of the system are compatible with helicity injection and that the Central I&C required is provided. There are no changes to the CHI System as part of the NSTX Upgrade Project.

**WBS Element: 1.2.3**

**WBS Level: 3**

**WBS Title: Electron Cyclotron Heating (ECH)**

**Definition:** The Electron Cyclotron Heating System provides breakdown and startup assist through an electron cyclotron heating system. The system will be composed of an AC/DC power conversion system, gyrotron source, transmission system, vacuum window and launcher. Any ECH specific diagnostics will be included and interfaced to Central I&C.

This scope of the WBS element for the NSTX Upgrade covers the ECH and other antenna systems, and miscellaneous diagnostics and components attached to the vessel which will be affected by the increases in EM and thermal loading. Disruption loads on the ECH waveguide will be evaluated for the Center Stack Upgrade Fields and field transients. Discussions with heating system experts regarding the performance of the ECH system for the higher Center Stack Upgrade fields indicate that no modification to the resonant frequency or other operational characteristic for the system will require upgrade. Only disruption qualification is planned. No previous qualification has been identified, so the resources include creation of a new calculation – not a review of an existing calculation as is the case for ICRH.

**{Electron Cyclotron Heating (Job 2300)}**

**WBS Element: 1.2.4**

**WBS Level: 3**

**WBS Title: Neutral Beam Injection (NBI)**

**Definition:** The Neutral Beam Injection System Upgrade provides a second Neutral Beam as part of the NSTX Upgrade Project. The second NBI is identical to the one already installed on NSTX. An existing TFTR beam will be decontaminated, refurbished, and installed on NSTX. This WBS element includes the NBI source refurbishment; the TFTR beamline decontamination, refurbishment and relocation to the NSTX Test Cell; the 2<sup>nd</sup> NBI Services; the NBI armor modifications; the 2<sup>nd</sup> NBI Power, Controls and Instrumentation; the 2<sup>nd</sup> NBI Duct and vacuum vessel modifications; and the NSTX Test Cell equipment removals and relocations necessary to accommodate the 2<sup>nd</sup> NBI. Vacuum Pumping System Modifications necessary to accommodate the 2<sup>nd</sup> NBI are included in WBS element 1.3. NBI Management and Health Physics support are included in element WBS 1.7.

**WBS Element: 1.2.4.2**

**WBS Level: 4**

**WBS Title: NBI Source Refurbishment**

**Definition:** This WBS element includes the activities to refurbish three neutral beam ion sources for the 2<sup>nd</sup> Neutral beamline, as currently being performed for the installed Neutral beamline 1.

**{Source Refurbishment (Job 2420)}**

**WBS Element: 1.2.4.3**

**WBS Level: 4**

**WBS Title: NSTX Beamline 2 Decontamination**

**Definition:** This WBS element includes the disassembly and decontamination activities of a TFTR Neutral Beam beamline in preparation for beamline refurbishment and reuse as an NSTX upgrade.

**{NSTX Beamline 2 Decontamination (Job 2430)}**

**WBS Element: 1.2.4.4**

**WBS Level: 4**

**WBS Title: NBI Beamline Refurbishment and Relocation**

**Definition:** This WBS element includes refurbishment of a TFTR NBI and its relocation to the NSTX test cell.

Included in this WBS element are the activities necessary to refurbish a TFTR Neutral Beam beamline for use on NSTX. This scope includes replacing the ion dump and calorimeter bellows as required and refurbishment of the seals, thermocouple wiring, and bellows (cal and spool) as needed.

**{NSTX Beamline 2 Refurbishment (Job 2440)}**

Also included in this WBS element are the efforts necessary to relocate a TFTR neutral beam line and ancillary equipment into the NSTX test cell. This includes High Voltage Enclosures (HVEs) and the complete beam box and components.

**{NSTX Beamline 2 Relocation (Job 2425)}**

**WBS Element: 1.2.4.5**

**WBS Level: 4**

**WBS Title: NSTX Beamline 2 Services**

**Definition:** This WBS element includes the efforts to provide services to the new neutral beam beamline and ancillary equipment in NSTX test cell. These services include water, cryogenic systems, gas supplies, and vacuum lines.

**{NSTX Beamline 2 Services (Job 2450)}**

**WBS Element: 1.2.4.6**

**WBS Level: 4**

**WBS Title: NBI Armor**

**Definition:** This WBS element includes the design, fabrication, and installation of upgraded and relocated neutral beam armor including cooling and instrumentation work.

**{NBI Armor (Job 2460)}**

**WBS Element: 1.2.4.7**

**WBS Level: 4**

**WBS Title: NBI Beamline 2 Power and Controls**

**Definition:** This WBS element includes providing power, controls and instrumentation for the 2<sup>nd</sup> Neutral beamline.

Included in this WBS element is providing power for the NBI beamline 2. NB2 is planned to be powered from the TFTR NB4 A, B, & C line ups. The electrical equipment in these line ups will be reactivated. The TFTR NB4 HVEs will be relocated to the NSTX Test Cell as part of WBS element 1.2.4.4. New triax cables will be installed with terminations from the Modregs to the HVEs. New Decel coaxial cables will be installed from the Decel supplies to the Sources. The Arc, Filament, Magnet, and the 208 feeds, to HVEs cables, will be spliced in the TFTR Test Cell basement to new cabling designed and installed from the TFTR Basement to the NSTX Test Cell. The fiber cables also will be spliced with additional lengths recovered from other TFTR line ups. The AC auxiliaries and Grounding for the NB2 will be designed and installed.

**{NBI Power System (Job 2470)}**

Also included in this WBS element are the controls and instrumentation for the NB2. The work covers PLC, programming, control racks, new thermocouples, TC scanner, miscellaneous controls, and control cabling. The work also includes the gradient grid upgrade. System integration and testing will also be performed as part of this effort.

**{NBI Controls & Instrumentation (Job 2475)}**

**WBS Element: 1.2.4.8****WBS Level: 4****WBS Title: NSTX Beamline 2 Duct & vacuum Vessel Modifications**

**Definition:** This WBS element includes the design, and fabrication of all components connecting the Neutral Beam Box to NSTX, and the connecting ductwork and modifications to NSTX Vacuum Vessel to accommodate the second beamline.

**{NSTX NB2 Duct & VV Mods (Job 2480)}**

**WBS Element: 1.2.4.9****WBS Level: 4****WBS Title: NSTX Test Cell Equipment Removals/Relocations**

**Definition:** This WBS element covers moving of racks and diagnostics to clear space in the NSTX Test Cell (NTC) for the second Neutral Beamline. Racks to be removed and re-installed in a new location are #419, 431-435, 440-445, 447-449, 488. Racks 456 and 489 will be removed and excess. This scope also includes the fabrication and installation of five sections of platform at elevation 118' on the west side of the NTC to accommodate the racks being re-installed in the NTC. Racks #441-445 will be relocated to the Gallery east of the NTC. Diagnostics to be removed are those from the midplanes of Bay J and Bay K as well as those on the present pump duct. The diagnostics from Bay J will be re-installed ~5"

outboard of their present position. IR windows and the Transmission Grating Spectrometer will be relocated to the new NB duct. Ion gages, filaments and the RGA will be relocated to the new pump duct under the NB2 duct. SPRED and LOWEUS will be relocated to Bay L. The Thomson Scattering Beam Dump Window will be relocated to between Bays K and L.

**{NTC Equipment Removals/Relocations (Job 2490)}**

**WBS Element: 1.2.4.0**

**WBS Level: 4**

**WBS Title: Vacuum Pumping System**

**Definition:** The Vacuum Pumping System provides the source and distribution of all vacuum pumping to NSTX. This includes the roughing pumps as well as the turbo pumps and any backing pumps to:

- Provide the initial high vacuum environment with minimum impurities for plasma formation;
- Evacuate the spent plasma constituents at the end of each pulse prior to the next plasma pulse;
- Remove impurities liberated during bakeout and/or discharge cleaning of the vacuum vessel interior; and
- Provide instrumentation and a Residual Gas Analyzer.

This WBS element also includes the controllers for all pumps. The relocation of racks and control equipment is covered under WBS 1.2.4.9

In order to accommodate the installation of the 2<sup>nd</sup> NBI on NSTX the existing Vacuum Pumping System will be modified. This WBS element includes the design, fabrication, and installation of a new vessel pumping system and includes new pump ducts off of the Neutral Beamline 2 duct, mechanical and electrical isolation of the system, vacuum diagnostic relocation, magnetic.

**{NSTX NB2 TVPS (Job 2485)}**

**WBS Element: 1.3**

**WBS Level: 2**

**WBS Title: Auxiliary Systems**

**Definition:** This WBS element includes the Coolant Systems, the Bakeout Heating System, Gas Delivery System and the Glow Discharge Cleaning System. The scope of the work contains engineering design, procurement activities, component fabrication, and System Testing. Installation of the WBS 3 systems is included in the individual WBS 3, level 3 elements.

**WBS Element: 1.3.2**

**WBS Level: 3**

**WBS Title: Coolant Systems**

**Definition:** The Coolant System provides cooling water to remove heat generated from NSTX

systems during experimental operations. The systems include the:

- TF/PF bus and coil cooling water system;
- Center stack cooling water system;
- Component cooling water system; and the
- Ohmic heating cooling water system.

These systems will provide cooling water for normal operations and discharge cleaning of the vacuum vessel. This WBS includes engineering design, analysis, procurement activities, component fabrication and installation to the coil, bus and component cooling manifolds at the torus.

The new Center Stack on NSTX will require modifications to the existing coolant system. This WBS element will provide water cooling services to the new Center Stack and ancillary equipment in the NSTX test cell.

**{Water System Coolant Modifications for CSU (Job 3200)}**

**WBS Element: 1.3.3**

**WBS Level: 3**

**WBS Title: Bakeout Heating System**

**Definition:** The bakeout heating system's function is to bake out the vacuum vessel and center stack in vacuum components at high temperature while keeping the outer vacuum vessel wall and ports within cooler design temperature limits. The system includes a pressurized hot water system to maintain the vessel wall temperature, a high pressure hot helium system to heat the in-vessel components, and a power supply for resistively heating the center stack walls. The controls and interlocks for safe operation of this system are included. This WBS element includes the engineering design, analysis, procurement activities and component fabrication.

This WBS element includes the purchase of a new more powerful power supply, to replace the existing one, to be used for electrical heating of the vessel. It is proposed to buy a 0-8V, 8000 amps for the application. Suitable cable leads will be fabricated and necessary interlocks

**{NSTX CSU Bakeout System Mods (Job 3300)}**

**WBS Element: 1.3.4**

**WBS Level: 3**

**WBS Title: Gas Delivery Systems**

**Definition:** The Gas Delivery Systems provides storage and delivery of gases to and from NSTX systems during experimental operations. These systems provide:

- Storage of on-site inventories of gases for use in NSTX plasma physics and future neutral beam experiments;
- Delivery of prescribed quantities of gases at prescribed purity levels and



flow rates;

- Delivery of gases continuously or in pulses of prescribed shape and duration; and
- Evacuation of delivery lines and components required for delivery.

This WBS includes engineering design, analysis, procurement activities, component fabrication and installation to the coil, bus and component cooling manifolds at the torus. The relocation of racks, control equipment and external delivery system is covered under WBS 1.2.4.9.

This WBS element includes the design, fabrication and installation, and test of up to four center stack fueling lines and modifications of the gas delivery assemblies.

**{Gas delivery system modifications (Job 3400)}**

**WBS Element: 1.3.5**

**WBS Level: 3**

**WBS Title: Glow Discharge Cleaning System**

**Definition:** The Glow Discharge Cleaning (GDC) System establishes and controls the GDC process in NSTX. GDC is a mode of vacuum conditioning in which the vacuum vessel internal surfaces are cleaned by the bombardment of ions formed during the glow process. This WBS includes engineering design, analysis, procurement activities, component fabrication and installation of the GDC system. The relocation of racks and control equipment is covered under WBS 1.2.4.9. There are no changes to the Glow Discharge Cleaning system as part of the NSTX Upgrade Project.

**WBS Element: 1.4**

**WBS Level: 2**

**WBS Title: Plasma Diagnostics**

**Definition:** The Plasma Diagnostics provide information on discharge parameters to characterize NSTX plasmas and guide its operation for optimized performance. The near term emphasis will be on detailed measurements of plasma profiles, using equipment presently available at PPPL. The long term objective will be to provide input for advanced plasma control systems, using new concepts and systems developed by the national NSTX team.

**WBS Element: 1.4.1**

**WBS Level: 3**

**WBS Title: Plasma Diagnostics**

**Definition:** The Plasma Diagnostics provide information on discharge parameters to characterize NSTX plasmas and guide its operation for optimized performance. The diagnostic subsystems included in this WBS are:

- Magnetic measurement diagnostics;
- Current density profile diagnostics;

- Laser and microwave diagnostics;
- Visible and total radiation diagnostics;
- Ultra violet and x-ray diagnostics;
- Particle measurement diagnostics;
- Divertor diagnostics; and
- Plasma Edge and vacuum diagnostics.

The NSTX Center Stack Upgrade will require new magnetic diagnostics to be installed. This WBS element includes the design and fabrications of Center Stack magnetic diagnostics to replace units removed with the old Center Stack. Installation of these diagnostics is included in WBS element 1.1.3.3.4.

#### **{Center Stack Upgrade Diagnostics (Job 4100)}**

The increased diameter of the Center Stack Upgrade requires changes to the laser beam path, which requires a new laser input vessel penetration, and plugging of the existing penetration. Increasing the nozzle diameter of the L port to accommodate an external laser dump, furnishing a vacuum boundary for the extension tube. Modifications are to anticipate a third laser in the future and a new penetration for a FIDA diagnostic above and slightly offset from Bay L. The laser input location may require a special design of the PF coil support column between Bays F and G.

#### **Center Stack Diagnostic Job 4500**

**WBS Element: 1.5**

**WBS Level: 2**

**WBS Title: Power Systems**

**Definition:** The Power Systems WBS element includes the engineering, design, prototyping, procurement and installation of all the systems and related elements that provide conditioned electrical power and energy to the NSTX systems. It includes the AC Power Systems, the AC/DC Convertors, the DC Systems, the Control and Protection System, and System Design and Integration as well as the coil bus runs..

**WBS Element: 1.5.1**

**WBS Level: 3**

**WBS Title: AC Power Systems**

**Definition:** The scope of the AC Power Systems WBS element is to provide the supply and distribution of all AC power to NSTX. This includes all the experimental and auxiliary loads.

## AC/DC Converters

: The scope of the AC/DC Converters WBS element is to reactivate existing AC/DC Converters that have not been used since the shutdown of TFTR for use by NSTX.

## DC Systems

The scope of the DC Systems WBS element is to receive AC input power and deliver controlled DC output power to the NSTX coil systems. This includes power cabling changes, DC Reactor changes, associated raceway changes, and changes required in the Power Cable Termination Structure (PCTS) inside the NSTX Test Cell.

## Power Systems Integration and Testing

This WBS element covers general power systems activities including interaction with the designers of other WBS elements, design review support and procedure preparations as well as the administrative and supervisory efforts for the NSTX Power Systems.

**{NSTX Center Stack Upgrade Power Systems (Job 5000)}**

**WBS Element: 1.5.2**

**WBS Level: 3**

**WBS Title: Control and Protection System**

Definition: The scope of the Control and Protection System WBS element is to control and protect the power loop components for all magnet circuits. This includes the design of hardwired interlock system, kirk-keys, real time controls, the PC Link, Firing Generator, and Fault Detector changes, measurement of signals, changes to existing coil protection devices and design of a new digital coil *protection system. The Center stack upgrade entails the TF feed to be 1kV, 129.8kA for 7.45 seconds every 2400 seconds. Design shall be such that the pulse period can be reduced to 1200 seconds. This requires complete redesign of the TF power system. Replacement of the fault detector (FD) and the Firing generator (FG) is required for fast and reliable response to fault conditions. The FD and FG are not included in the project work scope but part of the NSTX Program power supply reliability future upgrade. The HCS will be upgraded with a PLC. The OH power supply is designed to have the capability of 6kV, +/-24kA; OH CLRs will be replaced with calculated optimum requirements. A Digital Coil Protection (DCP) System will be designed and implemented. A Digital Coil Protection (DCP) System will be designed and implemented.*

**{NSTX Digital Coil Protection System (Job 5200)}**

**WBS Element: 1.5.3**

**WBS Level: 3**

**WBS Title: Coil Bus Runs**

Definition: This WBS element includes the design and fabrication of the coil bus runs/supports between the NSTX coils and the FCPC cable terminations located in the NSTX test cell.

**{Coil Bus Runs (Job 5501)}**

**WBS Element: 1.6**

**WBS Level: 2**

**WBS Title: Central Instrumentation and Controls (I&C)**

Definition: This upgrade will be capable of producing plasmas on the order of 6.5 seconds; to-date they are less than two seconds. For dozens of CAMAC and PC-based data acquisition systems this will require an upgrade, and, in some cases, replacement. The real-time plasma control system will require an upgrade to accommodate additional input/output signals, control loops, and a longer control period. The networks and analysis pool computers will need to be upgraded to achieve reasonable performance for time-sensitive functions. Some test cell racks will be relocated; there will be a modest effort required to route the control, timing, and communication cabling and qualify the systems.

**{Central I&C and Data Acquisition (Job 6100)}**

**WBS Element: 1.7**

**WBS Level: 2**

**WBS Title: Project Support & Integration**

Definition: Project support and integration includes the non-hardware related subsystems such as overall Project Management and Administration, Project Physics as well as Integrated Systems Testing support.

**WBS Element: 1.7.1**

**WBS Level: 3**

**WBS Title: Project Management and Integration**

Definition: The project management and integration WBS element consists of all the activities necessary to plan, monitor, integrate and control, and report on the progress of the NSTX Upgrade Project which includes technical, business, and administrative planning and support; organizing, directing, coordinating, controlling, reviewing and approving project actions.

**WBS Element: 1.7.1.1**

**WBS Level: 4**

**WBS Title: Project Management & Integration**

This WBS element includes overall management; a Project Manager, Deputy Project Manager, and Project Controls support to manage, monitor, integrate, control, and report on the progress on the NSTX Upgrade. Also included in this WBS element is System Engineering support and support for updating of the General Arrangement Drawings for the NSTX Test Cell as well as funds for independent reviewers as necessary.

**{Project Management and Integration (Job 7100)}**

**WBS Element: 1.7.1.2**

**WBS Level: 4**

**WBS Title: Center Stack Upgrade Management**

**Definition:** Level of Effort job to cover the oversight of Center Stack Upgrade work which includes a Manager, Project Engineering support and support and to cover Center Stack engineer's time to prepare for and participate in project cost and schedule reviews.

**{NSTX CSU Project Management (Job 7200)}**

**WBS Element: 1.7.1.3**

**WBS Level: 4**

**WBS Title: Neutral Beam Upgrade Management**

**Definition:** Level of Effort job to cover the oversight of the 2<sup>nd</sup> Neutral Beam Upgrade work which includes a Manager, Engineering support and support and to cover Neutral Beam engineer's time to prepare for and participate in project cost and schedule reviews.

**{NBI Project Support & Integration (Job 7300)}**

**WBS Element: 1.7.1.4**

**WBS Level: 4**

**WBS Title: Health Physics Support**

**Definition:** This WBS element includes the effort necessary for continuous health physics (HP) support for the Neutral beamline decontamination, refurbishment, and relocation to the NTC as well as the HP support for equipment removal and relocations being accomplished under WBS 1.2.4.

**{Health Physics Technical Support (Job 7400)}**

**WBS Element: 1.7.1.5**

**WBS Level: 4**

**WBS Title: Direct Allocations (Job 7710)**

**Definition:** This WBS element includes the costs to cover Laboratory Engineering and Scientific Computing and Environmental Services that are allocated to all Laboratory projects based on their funding levels. Also included in this WBS element are the home office Health Physics efforts necessary to support the collection of radiological analyses of various environmental samples and bioassay samples, and the collection of analyses of data on the gamma radiation spectra of radioactive material at PPPL that are allocated to all Laboratory projects based on their usage of Health Physics staff.

**{NSTX Upgrade Direct Allocations (Job 7710)}**

**WBS Element: 1.7.2**

**WBS Level: 3**

**WBS Title: Project Physics**

**Definition:** Project Physics includes the definition of requirements necessary to meet the overall NSTX mission and supporting objectives, physics analysis supporting the project's design and construction activities, and definition of R&D needs. In addition it includes the provision of hardware and software required for plasma control.

Project Physics is not included in the scope of the Upgrade Project.

**WBS Element: 1.7.3**

**WBS Level: 3**

**WBS Title: Integrated Systems Tests**

**Definition:** This element includes all of the activities associated with the support of development of all necessary procedures and documents to support the integrated tests, and to support performance of the pre-operational integrated system tests culminating in first plasma.

The WBS element includes Convening the NSTX Activity Certification Committee (ACC) for comprehensive review the upgrades. Prepare and make presentation to the PPPL ES&H Executive Safety Board for issuance of appropriate Safety Certificate parameters for operation of NSTX with new enhanced operating capabilities; preparation of documentation (procedures) for safely integrating the upgrades for operations within NSTX safe operating parameters; working with NSTX Operations Group for the successful integration of the upgrades.

{Integrated Systems Test (Job 7900)}

**WBS Element: 1.8**

**WBS Level: 2**

**WBS Title: Site Preparation and Assembly**

**Definition:** Site preparation and torus assembly includes modifications to the existing NSTX Test Cell components and subsystems and the assembly and installation of all Torus Systems (WBS 1.1). Modifications to other PPPL facilities, components, and subsystems outside the NSTX Test Cell and the assembly and installation of non-torus components and subsystems are included in the individual components and subsystems.

**WBS Element: 1.8.1**

**WBS Level: 3**

**WBS Title: Site Preparation**

**Definition:** This WBS element includes construction of the NSTX machine platform and the modifications to the NSTX Test Cell. There are no activities in this WBS element as part of the NSTX Upgrade Project. NTC equipment removals, relocations and

platform modifications necessary to support installation of the 2<sup>nd</sup> NBI are included in WBS element 1.2.4.2.

**WBS Element: 1.8.2**

**WBS Level: 3**

**WBS Title: Torus Assembly and Construction**

Definition: Torus Assembly and construction includes the assembly and installation of the NSTX torus, coils systems and all associated supports including construction management. This WBS element includes removal of equipment for clearance and accessibility, moving existing coils, modifying existing supports mounted on the vacuum vessel and installing a new external coil support structure.

{ Installation of the Coil Support System (Job 8200 LOE tasks & 8210 discrete tasks) }

Also included in this WBS element is the removal of the existing Center Stack and installation of the NSTX Upgraded Center Stack, followed by closing up the vacuum vessel, pumping down, leak checking, bakeout and machine area scrubs to be ready for Integrated System Testing.

{ CS Removal & Re-Installation/Pumpdown/Bakeout (Job 8250) }



# Appendix B

## Detailed Technical Performance Achieved

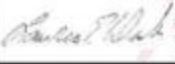


### NSTXU Project Scope Completion Verification




In addition to satisfying the project KPP's identified in the Project Execution Plan (PEP), both PPPL and DOE agreed to a format for verifying that all scope called out in the Work Breakdown Structure (WBS as shown in the PEP) has been delivered.




The methodology that was adopted required each of the Control Account Managers (CAMs) to review their WBS dictionaries and verify that their project scope had been delivered at the control account level or indicate what work remained to be delivered and when it would be completed. In addition, the CAMs verified that the WBS Dictionary was accurate, or indicated what changes would be necessary to reconcile the dictionary and the scope of work delivered.


The forms, called Project Closeout Acknowledgement (PCA) forms, were filled out by the CAMs and countersigned by their responsible line manager (RLM). Each PCA was then reviewed and approved by the NSTXU project manager.

Review of this documentation indicates that the project scope has been delivered.


<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1000	Title: Center Stack Upgrade (CSU) analytical Support		
WBS: 1.1.0	Control Account Manager (CAM): L. Dudek		
<b>Scope Description;</b> <p>This WBS element includes development of a project integrated model and the associated analysis support of the overall NSTX Upgrade Project.</p> <p>As a result of the NSTX Upgrade Project, the NSTX global models and analyses was updated. This WBS element included analytical support for global models and analysis not presently identified. The global model provides the basis for updating the analysis to qualify components and identify areas of the tokamak requiring further analysis. Identified plasma scenarios and power supply current limit analyses were run in the global model and current sets that required further analysis were identified. These analyses also serve to check the results of more detailed analyses.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgement	Name	Signature	Date
Control Account Manager (CAM)	Larry Dudek	 <div style="font-size: small; margin-top: 5px;">             Digitally signed by Lawrence E. Dudek              Date: 2015.04.13 16:16:15 -0400           </div>	
Responsible Line Manager (RLM)	Larry Dudek	 <div style="font-size: small; margin-top: 5px;">             Digitally signed by Lawrence E. Dudek              Date: 2015.04.13 16:16:32 -0400           </div>	
Project Manager	Ron Strykowski	 <div style="font-size: small; margin-top: 5px;">             Digitally signed by Ron Strykowski              DN: cn=Ron Strykowski, ou=PPPL, email=ronstrykowski@pppl.gov, o=US              Date: 2015.04.14 07:33:43 -0400           </div>	

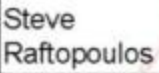


<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1001	Title: {Center Stack Upgrade (CSU) PFCs		
WBS: 1.1.1	Control Account Manager (CAM): K.Tresemmer		
<b>Scope Description;</b>  <p>The plasma facing components (PFCs) include all the systems and related elements that serve to protect the vacuum vessel from the charged particles and radiation flux from the plasma. These include the plasma facing tiles and mounting components, passive stabilizers, inner wall protection, divertor area strike plates, and local I&amp;C. This element consists of the engineering design, analysis, procurement activities and component fabrication.</p> <p>The NSTX Upgrade Project required new PFCs on the new Center Stack Casing (CSC) and the new Inboard divertor (IBD). This WBS element includes the design and analysis for both the CS and IBD PFCs, design modifications to the PFC tiles to accommodate surface diagnostics, including design of the tile mounting schemes and routing plans for diagnostic wires, generation of required documentation such as checked calculations, specifications and procedures, the procurement and installation of all PFC tiles and hardware on the CSC and IBD.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b>  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b>  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No (Describe additions and/or exclusions below)  <p>Additional scope covering the upgrade and installation of the Row 1 Outboard Divertor Tiles was added in response to analyses which suggested that it was possible to run plasma scenarios where the strike point hit the side of the PF1C canister, a vacuum barrier. The subsequent design changes to both the Inboard and Outboard Row 1 tiles were needed to provide thermal shadowing of this affected zone. This work was completed along with the rest of the 1001 WBS scope.</p>			
Acknowledgement	Name	Signature	Date
Control Account Manager (CAM)	Kelsey Tresemmer	Kelsey Tresemmer  <small>Digitally signed by Kelsey Tresemmer DN: cn=Kelsey Tresemmer, o=PPPL, ou=Engineering, email=ktresemmer@pppl.gov, c=US Date: 2015.04.13 14:30:54 -0400</small>	
Responsible Line Manager (RLM)	Larry Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.13 16:13:26 -04'00'</small>	
Project Manager	Ron Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o= ou=PPPL, email=ronstryk@pppl.gov, c=US Date: 2015.04.14 07:34:21 -0400</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1002		Title: Passive Plate Analysis and Upgrade Activity	
WBS: 1.1.1		Control Account Manager (CAM): N.Atnafu	
<b>Scope Description;</b>  <p>The NSTX Upgrade required analysis of the passive plates for disruption and thermal loads. CDR level calculations were performed that addressed one of five disruptions. The remaining identified disruptions were completed during Preliminary &amp; Final Design. Modest hardware upgrades are anticipated as part of this task. Additions of accelerometers or other diagnostics to benchmark calculations with actual performance in NSTX were provided. This analysis effort is included in this WBS element.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgement	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	Neway Atnafu	Neway Atnafu  <small>Digitally signed by Neway Atnafu DN: cn=Neway Atnafu, o=PPPL, ou=Plasma Physics Lab, email=atnafu@pppl.gov, c=US Date: 2015.04.15 09:01:06 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	Larry Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.17 09:35:01 -0400</small>	
<b>Project Manager</b>	Ron Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, ou=Plasma Physics Lab, email=ronstryk@pppl.gov, c=US Date: 2015.04.21 09:03:41 -0400</small>	

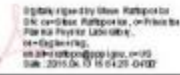

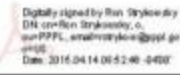
<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1200		Title: Vacuum Vessel & Support Structure	
WBS: 1.1.2		Control Account Manager (CAM): M. Smith	
<b>Scope Description;</b> <p>The vacuum vessel &amp; support structure (VVSS) consists of the vacuum chamber, not including the PFCs, all ports and vacuum boundary closures and the torus support structure which provides the overall supporting mechanism for the torus components to the test cell floor. This WBS element includes the engineering design, analysis, procurement activities and component fabrication.</p> <p>The NSTX Upgrade Project required that the existing VVSS be modified to accommodate the new center stack structure, including the umbrella structure and the new center stack support structure. This WBS element includes the analytical and CAD design of the support structures associated with the Magnet upgrade activities. The scope includes; the Vacuum Vessel &amp; Structural Support, the Outer TF Structures, the Outer PF Coil Structures, the Umbrella Structural Reinforcement, the CS Support Pedestal and miscellaneous Vacuum Vessel Structural Supports. It also includes the procurement and fabrication of these structures, but does not include installation costs. Installations costs are included in WBS 1.8 CA 8200.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
<p>Note: generally speaking, the description above is correct. However, structure / upgrades needed to the VV due to the 2nd neutral beam was not within the scope of CA 1200 but included in WBS 1.2 CA 2480. Also, structure / upgrades to the VV and/or diagnostic ports due to specific diagnostics was not within the scope of CA 1200 but included in WBS 1.4 CA 4500.</p>			
Acknowledgement	Name	Signature	Date
Control Account Manager (CAM)	Mark Smith	Mark Smith <small>Digitally signed by Mark Smith DN: cn=Mark Smith, o=PPPL, ou=amsmrmbh@pppl.gov, c=US Date: 2015.04.21 10:09:35 -0400</small>	
Responsible Line Manager (RLM)	Larry Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.21 10:26:35 -0400</small>	
Project Manager	Ron Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, email=ronstrykowski@pppl.gov, c=US Date: 2015.04.21 10:24:14 -0400</small>	




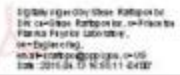

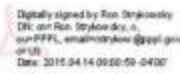
<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1300 & 1310		Title: Upgrade Project Design Support (Job 1300)	
WBS: 1.1.3		Control Account Manager (CAM): S. Raftopoulos	
<b>Scope Description;</b> <p>This WBS element provided CAD design support and engineering supervision for the overall assembly associated with the CSA upgrade. It also included time for space allocation studies associated with the magnet upgrades. CAD design support for individual components is included in the specific component jobs.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S. Raftopoulos	Steve Raftopoulos <small>Digitally signed by Steve Raftopoulos DN: cn=Steve Raftopoulos, o=Florida Plasma Physics Laboratory, ou=US gov nsl, c=US Date: 2015.04.14 08:25:22 -0400</small>	
Responsible Line Manager (RLM)	L. Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.14 08:25:22 -0400</small>	
Project Manager	R. Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: ou=Ron Strykowski, o= ou=PPPL, email=ron.strykowski@pppl.gov, c=US Date: 2015.04.14 08:51:20 -0400</small>	

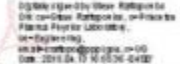

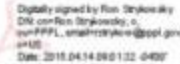
NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
Control Account: 9417-****-1301		Title: Outer Toroidal Field Coil Repairs (Job 1301)	
WBS: 1.1.3.2		Control Account Manager (CAM): S. Raftopoulos	
<p><b>Scope Description;</b></p> <p>The outer Toroidal Field coils subsystem consists of the coil sections that make up the 12 TF outer legs. This WBS element included the design, analysis, prototypes (as required), procurement activities and fabrication. This WBS element included the fabrication of (2) new Outer TF coils to replace the existing leaking OTF#7 and OTF#11 that were removed during the Neutral Beam port upgrade. These coils will then be used as a spare for future operations in NSTX. The scope included the procurement of conductor, insulation material, aluminum castings and supports necessary to fabricate a new OTF coils. Coil fabrication was performed by an outside vendor. This scope does not include costs associated with installation. Installations costs are included in WBS 1.8</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S. Raftopoulos	 <div style="font-size: small; color: red; margin-top: 5px;">             Digitally signed by Steve Raftopoulos              DN: cn=Steve Raftopoulos, o=Princeton              Plasma Physics Lab, ou=Digital ID,              email=sraftop@princeton.edu,              c=US              Date: 2015.04.15 11:04:21 -0400           </div>	
Responsible Line Manager (RLM)	L. Dudek	 <div style="font-size: small; color: red; margin-top: 5px;">             Digitally signed by              Lawrence E. Dudek              Date: 2015.04.14              08:25:09 -0400           </div>	
Project Manager	R. Strykowski	 <div style="font-size: small; color: red; margin-top: 5px;">             Digitally signed by Ron Strykowski              DN: cn=Ron Strykowski, o=              PFFPL, email=stryk@princeton.edu,              c=US              Date: 2015.04.14 08:52:08 -0400           </div>	

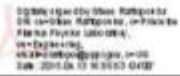

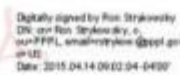


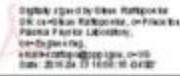

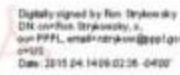
<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9417-****-1302</b>		<b>Title: Center Stack Assembly (Job 1302)</b>	
<b>WBS:1.1.3.3.4</b>		<b>Control Account Manager (CAM): S. Raftopoulos</b>	
<b>Scope Description;</b> <p>The Center Stack Assembly effort involved the activities associated with the assembly of the Center Stack and included design modifications and upgrade of the coil assembly stand; procedures for assembling the Center Stack and for installation; assembly of the Center Stack components including the OH/TF coil supports, mounting of the OH Solenoid surface diagnostics and thermal blanket, Inconel casing and inner PF coils and setup and tear down of the Center Stack assembly area.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No (Describe when the work will be completed)</b>			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No (Describe additions and/or exclusions below)</b>			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	S.Raftopoulos	Steve Raftopoulos 	
<b>Responsible Line Manager (RLM)</b>	L.Dudek	 Digitally signed by Lawrence E. Dudek Date: 2015.04.14 09:24:52 -0400	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski 	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1303		Title: TF Joint Stand & Performance Test (Job 1303)	
WBS:1.1.3.3.1		Control Account Manager (CAM): S. Raftopoulos	
<b>Scope Description;</b> <p>For the NSTX Upgrade Project a test stand to measure the required performance parameters on the new NSTX TF joint design was designed and fabricated. Test parameter measurements and cyclic lifetime tests of the new TF joint materials were performed and testing data was compiled. Results were used for the design of centerstack components.</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S.Raftopoulos	Steve Raftopoulos <small>Digitally signed by Steve Raftopoulos DN: cn=Steve Raftopoulos, o=PPPL, ou=PPPL, email=raftop@pppl.gov, c=US Date: 2015.04.14 09:24:39 -0400</small>	
Responsible Line Manager (RLM)	L.Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.14 09:24:39 -0400</small>	
Project Manager	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, ou=PPPL, email=ronstryk@pppl.gov, c=US Date: 2015.04.14 09:00:12 -0400</small>	




<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1304		Title: Inner Toroidal Field Bundle (Job 1304)	
WBS: 1.1.3.3.1		Control Account Manager (CAM): S. Raftopoulos	
<b>Scope Description;</b> <p>For the NSTX Upgrade Project a new TF Inner Leg was fabricated. This WBS element includes the design of the TF Bundle, the TF flex bus and flex bus supports and included all analytical and CAD design efforts for these components. It also included the procurement of the TF conductor [80 lengths] and procurement of the TF flex bus and supports. It does not include the procurement/fabrication of the OH, which is included as part of the OH procurement in WBS 1.1.3.3.2.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	S.Raftopoulos	Steve Raftopoulos 	
<b>Responsible Line Manager (RLM)</b>	L.Dudek		
<b>Project Manager</b>	R.Strykowski	Ron Strykowski 	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1305		Title: Ohmic Heating Solenoid (Job 1305)	
WBS: 1.1.3.3.2		Control Account Manager (CAM): S. Raftopoulos	
<b>Scope Description;</b>  For the NSTX Upgrade a new OH Solenoid was fabricated. This WBS element included the design & fabrication of a new OH solenoid and associated components including a Belleville washer spring assembly and support structures for the NSTX upgrades. It also included all analytical & CAD design efforts. Includes advance procurement of the copper conductor and co-wound [glass/Kapton] insulation. Also includes the procurement of the Micro-therm insulation, conductive paint. Includes the in-house fabrication for the combined OH and TF bundle assembly.			
Is all work scope for this control account complete per the control account plan? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
Does the WBS dictionary accurately represent the work completed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S.Raftopoulos	Steve Raftopoulos 	
Responsible Line Manager (RLM)	L.Dudek	 Digitally signed by Lawrence E. Dudek Date: 2015.04.14 08:24:00 -0400	
Project Manager	R.Strykowski	Ron Strykowski 	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1306		Title: Inner Poloidal Field Coils (Job 1306)	
WBS: 1.1.3.3.3		Control Account Manager (CAM): S. Raftopoulos	
<p><b>Scope Description;</b></p> <p>The inner poloidal/shaping coils subsystem consists of the new coils that will make up the poloidal field coils 1A, 1B and 1C. This WBS element includes the design, analysis, procurement activities and fabrication.</p> <p>For the NSTX Upgrade three new sets of inner poloidal field coils were fabricated and installed. This WBS element includes the design and procurement of the Inner poloidal field coils and supports which includes all analytical and CAD design efforts for these components. It includes the early procurement of the PF conductor and co-wound [Glass/Kapton] insulation.</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	S.Raftopoulos	Steve Raftopoulos 	
<b>Responsible Line Manager (RLM)</b>	L.Dudek	 Digitally signed by Lawrence E. Dudek Date: 2015.04.14 08:22:12 -0400	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski 	


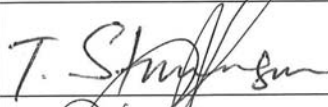

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-1307		Title: CS Casing (Job 1307)	
WBS: 1.1.3.3.4		Control Account Manager (CAM): S. Raftopoulos	
<b>Scope Description;</b> <p>This WBS element includes the design and fabrication of the Center Stack casing and ceramic break assembly for the upgraded Center Stack as well as the assembly of the new Center Stack. The Center Stack Casing effort includes analysis and CAD design for the casing components; the procurement of the Inconel tubing, forgings, bellows and organ pipes; the fabrication of Center Stack support legs; the procurement/fabrication of a new ceramic break assembly; the in-house assembly of the casing components; and mounting of the PF1A and PF1B structure/coils to the casing.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S.Raftopoulos	Steve Raftopoulos 	
Responsible Line Manager (RLM)	L.Dudek	 Digitally signed by Lawrence E. Dudek Date: 2015.04.14 08:21:54 -04'00'	
Project Manager	R.Strykowski	Ron Strykowski 	


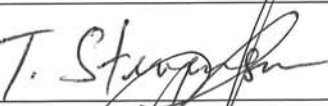




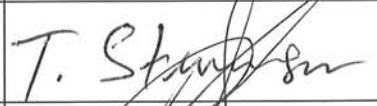

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account:</b> 9418-****-2300		<b>Title:</b> Electron Cyclotron Heating (Job 2300)	
<b>WBS:</b> 1.2.3		<b>Control Account Manager (CAM):</b> T. Stevenson	
<b>Scope Description;</b> <p>This scope of the WBS element for the NSTX Upgrade covers the ECH and other antenna systems, and miscellaneous diagnostics and components attached to the vessel which will be affected by the increases in EM and thermal loading. Disruption loads on the ECH waveguide were evaluated for the Center Stack Upgrade Fields and field transients. Only disruption qualification calculations were performed.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	T. Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	T. Stevenson		3/19/15
<b>Project Manager</b>	R. Strykowski		3/19/15









NSTX Upgrade Project			
Project Closeout Acknowledgement			
CD-4			
Control Account: 9418-****-2420		Title: 2 <sup>nd</sup> NBI Source Refurbishment (Job 2420)	
WBS: 1.2.4.2		Control Account Manager (CAM): M.Cropper	
<p><b>Scope Description;</b></p> <p>This WBS element included the activities to refurbish three neutral beam ion sources for the 2nd Neutral beamline, as currently being performed for the installed Neutral beamline 1.</p>			
<p><b>Is all work scope for this control account complete per the control account plan?</b></p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe when the work will be completed)</p> <p>Due to TF fault 7/20/2011, existing sources were available so no new sources needed refurbishment.</p>			
<p><b>Does the WBS dictionary accurately represent the work completed?</b></p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	M.Cropper	Mark B. Cropper <small>Digitally signed by Mark B. Cropper DN: cn=Mark B. Cropper, o=Princeton Plasma Physics Lab, ou=Neutral Beams, email=mcropper@pppl.gov, c=US Date: 2015.07.21 12:09:28 -0400</small>	
Responsible Line Manager (RLM)	T.Stevenson	Timothy N. Stevenson <small>Digitally signed by Timothy N. Stevenson DN: cn=Timothy N. Stevenson, o=PPPL, ou=ENGR, email=tstevenson@pppl.gov, c=US Date: 2015.07.23 16:02:02 -0500</small>	
Project Manager	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, email=rstryk@pppl.gov, c=US Date: 2015.07.27 12:50:13 -0400</small>	

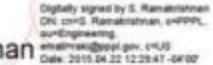

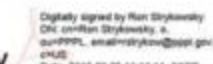
<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9418-****-2425</b>		<b>Title: NSTX Beamline 2 Relocation (Job 2425)</b>	
<b>WBS: 1.2.4.4</b>		<b>Control Account Manager (CAM): T. Stevenson</b>	
<b>Scope Description;</b> Also included in WBS element 1.2.4.4 are the efforts necessary to relocate a TFTR neutral beam line and ancillary equipment into the NSTX test cell. This includes High Voltage Enclosures (HVEs) and the complete beam box and components.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	T.Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	T.Stevenson		3/19/15
<b>Project Manager</b>	R.Strykowski		3/19/15

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9418-****-2430</b>		<b>Title: NSTX Beamline 2 Decontamination (Job 2430)</b>	
<b>WBS:1.2.4.3</b>		<b>Control Account Manager (CAM): T. Stevenson</b>	
<b>Scope Description;</b>  <p>This WBS element included the disassembly and decontamination of a TFTR Neutral Beam beamline in preparation for beamline refurbishment and reuse as an NSTX upgrade.</p>			
<p><b>Is all work scope for this control account complete per the control account plan?</b></p> <p><input checked="" type="checkbox"/> Yes      <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p><b>Does the WBS dictionary accurately represent the work completed?</b></p> <p><input checked="" type="checkbox"/> Yes      <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
<b>Acknowledgements</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Control Account Manager (CAM)</b>	T.Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	T.Stevenson		3/19/15
<b>Project Manager</b>	R.Strykowski		3/19/15

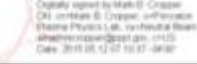

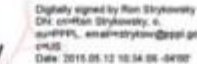
<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9418-****-2440</b>		<b>Title: NSTX Beamline 2 Refurbishment &amp; Relocation(Job 2440)</b>	
<b>WBS: 1.2.4.4</b>		<b>Control Account Manager (CAM): T. Stevenson</b>	
<b>Scope Description;</b> <p>This WBS element included refurbishment of a TFTR NBI and its relocation to the NSTX test cell.</p> <p>Included in this WBS element are the activities necessary to refurbish a TFTR Neutral Beam beamline for use on NSTX. This scope included replacing the ion dump and calorimeter bellows and refurbishment of the seals, thermocouple wiring, and bellows (cal and spool).</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No (Describe when the work will be completed)</b>			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No (Describe additions and/or exclusions below)</b>			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	T.Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	T.Stevenson		3/19/15
<b>Project Manager</b>	R.Strykowski		3/19/15




NSTX Upgrade Project			
Project Closeout Acknowledgement			
CD-4			
Control Account: 9418-***-2450		Title: NSTX Beamline 2 Services (Job 2450)	
WBS: 1.2.4.5		Control Account Manager (CAM): M.Cropper	
<p><b>Scope Description;</b></p> <p>This WBS element included the efforts to provide services to the new neutral beam beamline and ancillary equipment in NSTX test cell. These services include water, cryogenic systems, gas supplies, and vacuum lines.</p>			
<p><b>Is all work scope for this control account complete per the control account plan?</b></p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p><b>Does the WBS dictionary accurately represent the work completed?</b></p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	M.Cropper	Mark B. Cropper  <small>Digitally signed by Mark B. Cropper DN: cn=Mark B. Cropper, o=Princeton Plasma Physics Lab, ou=Neutral Beams, email=mcropper@pppl.gov, c=US Date: 2015.07.23 12:11:16 -0400</small>	
Responsible Line Manager (RLM)	T.Stevenson	Timothy N. Stevenson  <small>Digitally signed by Timothy N. Stevenson DN: cn=Timothy N. Stevenson, o=PPPL, ou=ENGR, email=tstevenson@pppl.gov, c=US Date: 2015.07.23 16:03:52 -0500</small>	
Project Manager	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o, ou=PPPL, email=rstrykow@pppl.gov, c=US Date: 2015.07.23 12:56:44 -0400</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9418-****-2460		Title: NBI Armor (Job 2460)	
WBS: 1.2.4.6		Control Account Manager (CAM): K. Tresemer	
<b>Scope Description;</b> This WBS element included the design, fabrication, and installation of upgraded and relocated neutral beam armor including cooling and instrumentation work.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	K.Tresemer	Kelsey Tresemer  <small>Digitally signed by Kelsey Tresemer DN: cn=Kelsey Tresemer, o=PPPL, ou=Engineering, email=ktreseme@pppl.gov, c=US Date: 2015.04.21 15:14:29 -04'00'</small>	
<b>Responsible Line Manager (RLM)</b>	T.Stevenson	Timothy N. Stevenson  <small>Digitally signed by Timothy N. Stevenson DN: cn=Timothy N. Stevenson, o=PPPL, ou=ENR, email=stevenson@pppl.gov, c=US Date: 2015.04.21 16:12:29 -04'00'</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, ou=PPPL, email=ronstryk@pppl.gov, c=US Date: 2015.08.05 13:41:01 -04'00'</small>	

NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
Control Account: 9418-****-2470		Title: NBI Power System (Job 2470)	
WBS: 1.2.4.7		Control Account Manager (CAM): S. Ramakrishnan	
<b>Scope Description;</b> <p>Included in this WBS element is providing power for the NBI beamline 2. NB2 is planned is powered from the TFTR NB4 A, B, &amp; C line ups. The electrical equipment in these line ups was reactivated. The TFTR NB4 HVEs were relocated to the NSTX Test Cell as part of WBS element 1.2.4.4. New triax cables were installed with terminations from the Modregs to the HVEs. New Decel coaxial cables were installed from the Decel supplies to the Sources. The Arc, Filament, Magnet, and the 208 feeds, to HVEs cables, were spliced in the TFTR Test Cell basement to new cabling designed and installed from the TFTR Basement to the NSTX Test Cell. The fiber cables also were spliced with additional lengths recovered from other TFTR line ups. The AC auxiliaries and Grounding for the NB2 were designed and installed.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S. Ramakrishnan	 S. Ramakrishnan	04/12/15
Responsible Line Manager (RLM)	T. Stevenson	 Timothy N. Stevenson	
Project Manager	R. Strykowski	 Ron Strykowski	







<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account:</b> 9418-****-2475		<b>Title:</b> NBI Controls & Instrumentation (Job 2475)	
<b>WBS:1.2.4.7</b>		<b>Control Account Manager (CAM):</b> M. Cropper	
<b>Scope Description;</b> <p>Also included in WBS element 1.2.4.7 are the controls and instrumentation for the NB2. The work covers PLC, programming, control racks, new thermocouples, TC scanner, miscellaneous controls, and control cabling. The work also includes the gradient grid upgrade. System integration and testing will also be performed as part of this effort.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No (Describe when the work will be completed)</b>			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> <b>Yes</b> <input type="checkbox"/> <b>No (Describe additions and/or exclusions below)</b>			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	M.Cropper	Mark B. Cropper  <small>Digitally signed by Mark B. Cropper DN: cn=Mark B. Cropper, o=PPPL, ou=Physics, st=PA, cn=Mark B. Cropper, email=markcropper@pppl.gov, c=US Date: 2015.05.12 17:10:47 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	T.Stevenson	Timothy N. Stevenson  <small>Digitally signed by Timothy N. Stevenson DN: cn=Timothy N. Stevenson, o=PPPL, ou=Physics, st=PA, cn=Timothy N. Stevenson, email=timstevenson@pppl.gov, c=US Date: 2015.05.12 10:34:55 -0400</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, ou=Physics, st=PA, cn=Ron Strykowski, email=ronstrykowski@pppl.gov, c=US Date: 2015.05.12 10:34:55 -0400</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9418-****-2480</b>		<b>Title: NSTX NB2 Duct &amp; VV Mods (Job 2480)</b>	
<b>WBS: 1.2.4.8</b>		<b>Control Account Manager (CAM): T. Stevenson</b>	
<b>Scope Description;</b> <p>This WBS element included the design, and fabrication of all components connecting the Neutral Beam Box to NSTX, and the connecting ductwork and modifications to NSTX Vacuum Vessel to accommodate the second beamline.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	T.Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	T.Stevenson		3/19/15
<b>Project Manager</b>	R.Strykowski		3/19/15

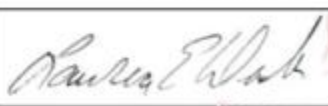
NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
Control Account: 9418-****-2485		Title: NSTX NB2 TVPS (Job 2485)	
WBS:1.2.4.0		Control Account Manager (CAM): W. Blanchard	
<p><b>Scope Description;</b></p> <p>In order to accommodate the installation of the 2nd NBI on NSTX the Vacuum Pumping System was modified. This WBS element included the design, fabrication, and installation of a new vessel pumping system and includes new pump ducts off of the Neutral Beamline 2 duct, mechanical and electrical isolation of the system, vacuum diagnostic relocation, magnetic.</p> <p>This WBS element also includes the controllers for all pumps. The relocation of racks and control equipment is covered under WBS 1.2.4.9</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	W.Blanchard	W. Blanchard <small>Digitally signed by W. Blanchard DN: cn=W. Blanchard, o=PPPL, ou=Engineering, email=wblancha@pppl.gov, c=US Date: 2015.03.24 13:58:34 -0400</small>	
Responsible Line Manager (RLM)	T. Stevenson	Timothy N. Stevenson <small>Digitally signed by Timothy N. Stevenson DN: cn=Timothy N. Stevenson, o=PPPL, ou=HMI, email=stevenson@pppl.gov, c=US Date: 2015.04.22 09:01:17 -0500</small>	
Project Manager	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, ou=Engineering, email=ronstryk@pppl.gov, c=US Date: 2015.04.20 15:48:48 -0400</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account:</b> 9418-****-2490		<b>Title:</b> NTC Equipment Removals/Relocations (Job 2490)	
<b>WBS:</b> 1.2.4.9		<b>Control Account Manager (CAM):</b> E. Perry	
<b>Scope Description;</b> <p>This WBS element covers moving of racks and diagnostics to clear space in the NSTX Test Cell (NTC) for the second Neutral Beamline. Racks to be removed and re-installed in a new location are #419, 431-435, 440-445, 447-449, 488. Racks 456 and 489 will be removed and excess. This scope also includes the fabrication and installation of five sections of platform at elevation 118' on the west side of the NTC to accommodate the racks being re-installed in the NTC. Racks #441-445 will be relocated to the Gallery east of the NTC. Diagnostics to be removed are those from the midplanes of Bay J and Bay K as well as those on the present pump duct. The diagnostics from Bay J will be re-installed ~5" outboard of their present position. IR windows and the Transmission Grating Spectrometer will be relocated to the new NB duct. Ion gages, filaments and the RGA will be relocated to the new pump duct under the NB2 duct. SPRED and LOWEUS will be relocated to Bay L. The Thomson Scattering Beam Dump Window will be relocated to between Bays K and L.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No (Describe when the work will be completed)  SPRED and LOWEUS re-installation deleted from scope.			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No (Describe additions and/or exclusions below)  SPRED and LOWEUS re-installation deleted from scope.			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	E.Perry	Erik D. Perry <small>Digitally signed by Erik D. Perry DN: cn=Erik D. Perry, o. gov, email=eperry@pppl.gov, c=US Date: 2015.05.06 10:13:12 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	T. Stevenson	Timothy N. Stevenson <small>Digitally signed by Timothy N. Stevenson DN: cn=Timothy N. Stevenson, o=PPPL, ou=PPPL, email=tnstevenson@pppl.gov, c=US Date: 2015.07.22 10:12:01 -0400</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o. gov, email=rstrykowski@pppl.gov, c=US Date: 2015.07.22 10:17:13 -0400</small>	


<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-3200		Title: Water System Coolant Modifications for CSU (Job 3200)	
WBS: 1.3.2		Control Account Manager (CAM): N. Atnafu	
<p><b>Scope Description;</b>            The Coolant System provides cooling water to remove heat generated from NSTX systems during experimental operations. The systems include the:</p> <ul style="list-style-type: none"> <li>• TF/PF bus and coil cooling water system;</li> <li>• Center stack cooling water system;</li> <li>• Component cooling water system; and the</li> <li>• Ohmic heating cooling water system.</li> </ul> <p>These systems will provide cooling water for normal operations and discharge cleaning of the vacuum vessel. This WBS includes engineering design, analysis, procurement activities, component fabrication and installation to the coil, bus and component cooling manifolds at the torus.</p> <p>The new Center Stack on NSTX required modifications to the existing coolant system. This WBS element provides water cooling services to the new Center Stack and ancillary equipment in the NSTX test cell.</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	N. Atnafu	Neway Atnafu  <small>Digitally signed by Neway Atnafu DN: cn=Neway Atnafu, o=Princeton Plasma Physics Lab, ou=PPPL, email=atnafu@pppl.gov, c=US Date: 2015.04.15 09:52:19 -0400</small>	
Responsible Line Manager (RLM)	L. Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.17 09:34:33 -0400</small>	
Project Manager	R. Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o= ou=PPPL, email=ronstrykowski@pppl.gov, c=US Date: 2015.04.21 09:04:20 -0400</small>	


NSTX Upgrade Project			
Project Closeout Acknowledgement			
CD-4			
<b>Control Account:</b> 9417-****-3300	<b>Title:</b> NSTX CSU Bakeout System Mods (Job 3300)		
<b>WBS:</b> 1.3.3	<b>Control Account Manager (CAM):</b> S. Ramakrishnan		
<b>Scope Description;</b> <p>This WBS element includes the purchase of a new power supply/supplies, to replace the existing one, to be used for electrical heating of the vessel. It is proposed to buy two 0-8V, 0-4000 amps supplies for the application. The supplies will then be connected in parallel to get 0-8000A. Suitable cable leads will be fabricated and necessary interlocks will be incorporated.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below) The description can be amended as stated in the Scope			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	S. Ramakrishnan	S. Ramakrishnan <small>Digitally signed by S. Ramakrishnan DN: cn=S. Ramakrishnan, o=PPPL, ou=Engineering, email=sr@pppl.gov, c=US Date: 2015.07.24 11:09:07 -0400</small>	07/24/15
<b>Responsible Line Manager (RLM)</b>	L. Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.07.28 16:07:05 -0400</small>	
<b>Project Manager</b>	R. Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o, ou=PPPL, email=rstrykowski@pppl.gov, c=US Date: 2015.07.29 08:11:34 -0400</small>	






NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
Control Account: 9417-****-3400	Title: Gas delivery system modifications (Job 3400)		
WBS: 1.3.4	Control Account Manager (CAM): W.Blanchard		
<b>Scope Description;</b>  This WBS included engineering design, analysis, procurement activities, component fabrication, installation and test of up to four center stack fueling lines and modifications of the gas delivery assemblies. The relocation of racks, control equipment and external delivery system is covered under WBS 1.2.4.9.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	W.Blanchard	W. Blanchard <small>Digitally signed by W. Blanchard            DN: cn=W. Blanchard, o=PPPL,            email=wblanchard@pppl.gov,            c=US            Date: 2015.07.27 11:22:46 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	LDudek	 <small>Digitally signed by Lawrence E. Dudek            Date: 2015.07.28 16:05:50 -04'00'</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski            DN: cn=Ron Strykowski, o,            ou=PPPL,            email=rstrykow@pppl.gov, c=US            Date: 2015.07.29 08:12:29 -04'00'</small>	



<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-4100		Title: Stack Upgrade Diagnostics (Job 4100)	
WBS: 1.4.1		Control Account Manager (CAM): R. Kaita	
<b>Scope Description;</b> <p>The Plasma Diagnostics provide information on discharge parameters to characterize NSTX plasmas and guide its operation for optimized performance. The diagnostic subsystems included in this WBS are; Magnetic measurement diagnostics, Current density profile diagnostics, Laser and microwave diagnostics, Visible and total radiation diagnostics, Ultra violet and x-ray diagnostics, Particle measurement diagnostics, Divertor diagnostics, and Plasma Edge and vacuum diagnostics.</p> <p>The NSTX Center Stack Upgrade required new magnetic diagnostics that were installed. This WBS element included the design and fabrication of Center Stack magnetic diagnostics which replaced units removed with the old Center Stack. Installation of these diagnostics is included in WBS element 1.1.3.3.4.</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes     <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	R.Kaita	<b>Robert Kaita</b> <small>Digitally signed by Robert Kaita            DN: cn=Robert Kaita, o=Princeton Plasma Physics Laboratory, ou=Princeton, st=New Jersey, c=US, email=robertk@pppl.gov, date=2015.04.21 17:51:51</small>	
Responsible Line Manager (RLM)	L.Dudek	 <small>Digitally signed by Lawrence E. Dudek            Date: 2015.04.02 10:19:29 -04'00'</small>	
Project Manager	R.Strykowski	<b>Ron Strykowski</b> <small>Digitally signed by Ron Strykowski            DN: cn=Ron Strykowski, o=PPPL, email=ronstrykowski@pppl.gov, ou=PPPL, date=2015.04.02 10:22:24 -04'00'</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-4500		Title: MPTS VV Modification Job 4500	
WBS: 1.4.1		Control Account Manager (CAM): G. Labik	
<b>Scope Description;</b> <p>The increased diameter of the Center Stack Upgrade required changes to the MPTS laser beam path, which required a new laser input vessel penetration, and plugging of the existing penetration, increasing the nozzle diameter of the L port to accommodate an external laser dump, furnishing a vacuum boundary for the extension tube. Modifications were made are to anticipate a third laser in the future and a new penetration for a FIDA diagnostic above and slightly offset from Bay L. The laser input location required a special design of the PF coil support column between Bays F and G.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No (Describe additions and/or exclusions below) <p>The work scope expanded to include installing additional diagnostic vacuum interfaces :</p> <ol style="list-style-type: none"> <li>1. Two ports for IR cameras to view the NB carbon tiles and the RF antennas.</li> <li>2. Background CHERS and Future tangential views.</li> <li>3. High K Scattering.</li> <li>4. Fusion Products Probe.</li> <li>5. FIRE TIP or other Tangential View.</li> <li>6. 6 Wire vacuum feedthroughs for magnetics inside the vacuum vessel.</li> </ol> <p>7. Rerouted the RWM coils for Bays JK and AL</p> <p>8. Funded the impact of multi physics loading of vacuum vessel to design the Bay L upgrade using a combination of Ansys and Maxwell software. The combined software was used to design other vessel changes and additions .</p>			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	G. Labik	George Labik <small>Digitally signed by George Labik DN: cn=George Labik, o=US, email=glabik@pppl.gov, c=US Date: 2015.03.19 08:20:44 -0500</small>	
<b>Responsible Line Manager (RLM)</b>	L Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.16 09:30:11 -0400</small>	
<b>Project Manager</b>	R. Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=US, email=PPPL_email=strykco@pppl.gov, c=US Date: 2015.04.16 09:43:53 -0400</small>	

NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
Control Account: 9417-****-5000		Title: NSTX Center Stack Upgrade Power Systems (Job 5000)	
WBS: 1.5.1		Control Account Manager (CAM): S. Ramakrishnan	
<b>Scope Description;</b> <p>AC Power Systems: The scope of the AC Power Systems was to provide the supply and distribution of all AC power to NSTX. This included all the experimental and auxiliary loads.</p> <p>AC/DC Converters: The scope of the AC/DC Converters was to reactivate existing AC/DC Converters that have not been used since the shutdown of TFTR for use by NSTX.</p> <p>DC Systems: The scope of the DC was to receive AC input power and deliver controlled DC output power to the NSTX coil systems. This included power cabling changes, DC Reactor changes, associated raceway changes, and changes required in the Power Cable Termination Structure (PCTS) inside the NSTX Test Cell.</p> <p>Power Systems Integration and Testing: This WBS element covers general power systems activities including interaction with the designers of other WBS elements, design review support and procedure preparations as well as the administrative and supervisory efforts for the NSTX Power Systems.</p>			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	S. Ramakrishnan	 <small>Digitally signed by S. Ramakrishnan DN: cn=S. Ramakrishnan, o=PPPL, ou=Engineering, email=sramak@pppl.gov, c=US Date: 2015.04.22 12:31:37 -0400</small>	04/10/15
Responsible Line Manager (RLM)	L. Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.22 13:34:11 -0400</small>	
Project Manager	R. Strykowski	 <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, ou=Engineering, email=rstryk@pppl.gov, c=US Date: 2015.07.23 10:12:01 -0400</small>	

**NSTX Upgrade Project  
Project Closeout Acknowledgement  
CD-4**

<b>Control Account: 9417-****-5200</b>	<b>Title: NSTX Digital Coil Protection System (Job 5200)</b>
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<b>WBS: 1.5.2</b>	<b>Control Account Manager (CAM): T. Stevenson</b>
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**Scope Description;**

The scope of the Control and Protection System WBS element is to control and protect the power loop components for all magnet circuits. This includes the design of hardwired interlock system, kirk-keys, real time controls, the PC Link, Firing Generator, and Fault Detector changes, measurement of signals, changes to existing coil protection devices.


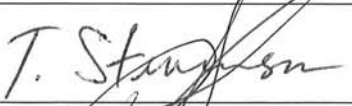

The scope of this job was to design, install, and test a new digital coil protection system (DCPS) on NSTXU.




**Is all work scope for this control account complete per the control account plan?**

☒ Yes      ☐ No (Describe when the work will be completed)




**Does the WBS dictionary accurately represent the work completed?**

☒ Yes      ☐ No (Describe additions and/or exclusions below)

Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	T.Stevenson		3/19/15
Responsible Line Manager (RLM)	T.Stevenson		3/19/15
Project Manager	R.Strykowski		3/19/15

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
Control Account: 9417-****-5501		Title: Coil Bus Runs (Job 5501)	
WBS: 1.5.3		Control Account Manager (CAM): N. Atnafu	
<b>Scope Description;</b> This WBS element included the design and fabrication of the coil bus runs/supports between the NSTX coils and the FCPC cable terminations located in the NSTX test cell.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	N.Atnafu	Neway Atnafu  <small>Digitally signed by Neway Atnafu DN: cn=Neway Atnafu, o=Fusion Plasma Physics Lab, ou=PPPL, email=atnafu@pppl.gov, c=US Date: 2015.04.15 09:04:44 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	L.Dudek	 <small>Digitally signed by Lawrence E. Dudek Date: 2015.04.17 09:33:41 -0400</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o= ou=PPPL, email=ronstryk@pppl.gov, c=US Date: 2015.04.21 09:04:54 -0400</small>	



NSTX Upgrade Project			
Project Closeout Acknowledgement			
CD-4			
Control Account: 9417-****-6100		Title: Central I&C and Data Acquisition (Job 6100)	
WBS: 1.6		Control Account Manager (CAM): P.Sichta	
<p>Scope Description;</p> <p>This upgrade will be capable of producing plasmas on the order of 6.5 seconds; to-date they are less than two seconds. For dozens of CAMAC and PC-based data acquisition systems this will require an upgrade, and, in some cases, replacement. The real-time plasma control system was upgraded to accommodate additional input/output signals, control loops, and a longer control period. The networks and analysis pool computers were upgraded to achieve reasonable performance for time-sensitive functions. Some test cell racks were relocated; there was a modest effort required to route the control, timing, and communication cabling and qualify the systems.</p>			
<p>Is all work scope for this control account complete per the control account plan?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe when the work will be completed)</p>			
<p>Does the WBS dictionary accurately represent the work completed?</p> <p><input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (Describe additions and/or exclusions below)</p>			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	P.Sichta	 <p>Digitally signed by Paul Sichta DN: cn=Paul Sichta, o=PPPL, email=psichta@pppl.gov, c=US Date: 2015.07.28 07:46:18 -0400</p>	
Responsible Line Manager (RLM)	L. Dudek	 <p>Digitally signed by Lawrence E. Dudek Date: 2015.07.28 07:33:27 -04'00'</p>	
Project Manager	R.Strykowski	 <p>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, email=rstrykow@pppl.gov, c=US Date: 2015.07.28 07:46:18 -0400</p>	



**NSTX Upgrade Project  
Project Closeout Acknowledgement  
CD-4**

<b>Control Account: 9417-****-7100</b>	<b>Title:</b> Project Management and Integration (Job 7100)
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<b>WBS:1.7.1.1</b>	<b>Control Account Manager (CAM): R.Strykowski</b>
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**Scope Description;**

**This WBS element includes overall management; a Project Manager, Deputy Project Manager, and Project Controls support to manage, monitor, integrate, control, and report on the progress on the NSTX Upgrade. Also included in this WBS element is System Engineering support and support for updating of the General Arrangement Drawings for the NSTX Test Cell as well as funds for independent reviewers as necessary.**

**Is all work scope for this control account complete per the control account plan?**

☐ Yes      ☒ No (Describe when the work will be completed)

Scope will be concluded upon;

1. Reconciliation of CD4 closeout review recommendations
2. Delivery of the final project closeout report
3. Final year end accounting adjustment verifications. Expected finish Sept 2015

**Does the WBS dictionary accurately represent the work completed?**

☒ Yes      ☐ No (Describe additions and/or exclusions below)

Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	R.Strykowski		
<b>Responsible Line Manager (RLM)</b>	Mike Williams		
<b>Project Manager</b>	M. Williams		

**NSTX Upgrade Project  
Project Closeout Acknowledgement  
CD-4**

<b>Control Account: 9417-****-7200</b>	<b>Title: NSTX CSU Project Management (Job 7200)</b>
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WBS: 1.7.1.2	<b>Control Account Manager (CAM): L.Dudek</b>
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**Scope Description;**

**Level of Effort job to cover the oversight of Center Stack Upgrade work which includes a Manager, Project Engineering support and support and to cover Center Stack engineer's time to prepare for and participate in project cost and schedule reviews.**

**Is all work scope for this control account complete per the control account plan?**

☐ Yes      ☒ No (Describe when the work will be completed)

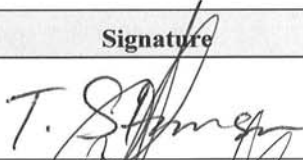


Scope will be concluded upon;


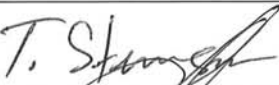

4. Reconciliation of CD4 closeout review recommendations
5. Delivery of the preliminary project closeout report

**Does the WBS dictionary accurately represent the work completed?**

☐ Yes      ☐ No (Describe additions and/or exclusions below)

Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	L.Dudek		
<b>Responsible Line Manager (RLM)</b>	R.Strykowski		
<b>Project Manager</b>	R.Strykowski		

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9418-****-7300</b>		<b>Title: NBI Project Support &amp; Integration (Job 7300)</b>	
<b>WBS: 1.7.1.3</b>		<b>Control Account Manager (CAM): T. Stevenson</b>	
<b>Scope Description;</b> Level of Effort job to cover the oversight of the 2nd Neutral Beam Upgrade work which includes a Manager, Engineering support and support and to cover Neutral Beam engineer's time to prepare for and participate in project cost and schedule reviews.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No (Describe when the work will be completed)			
Scope will be concluded upon; 1. Reconciliation of CD4 closeout review recommendations 2. Delivery of the preliminary project closeout report.			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
<b>Acknowledgements</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Control Account Manager (CAM)</b>	T.Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	R.Strykowski		3/19/15
<b>Project Manager</b>	R.Strykowski		3/19/15

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account: 9418-****-7400</b>		<b>Title: Health Physics Technical Support (Job 7400)</b>	
<b>WBS: 1.7.1.4</b>		<b>Control Account Manager (CAM): T. Stevenson</b>	
<b>Scope Description;</b> This WBS element includes the effort necessary for continuous health physics (HP) support for the Neutral beamline decontamination, refurbishment, and relocation to the NTC as well as the HP support for equipment removal and relocations being accomplished under WBS 1.2.4.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	T.Stevenson		3/19/15
<b>Responsible Line Manager (RLM)</b>	R.Strykowski		3/19/15
<b>Project Manager</b>	R.Strykowski		3/19/15

**NSTX Upgrade Project  
Project Closeout Acknowledgement  
CD-4**

<b>Control Account: 9417-****-7710</b>	<b>Title:</b> NSTX Upgrade Direct Allocations (Job 7710)
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<b>WBS:</b> 1.7.1.5	<b>Control Account Manager (CAM):</b> R.Strykowski
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**Scope Description;**

**This WBS element is a LOE overhead that includes the costs to cover Laboratory Engineering and Scientific Computing and Environmental Services that are allocated to all Laboratory projects based on their funding levels. Also included in this WBS element are the home office Health Physics efforts necessary to support the collection of radiological analyses of various environmental samples and bioassay samples, and the collection of analyses of data on the gamma radiation spectra of radioactive material at PPPL that are allocated to all Laboratory projects based on their usage of Health Physics staff.**

**Is all work scope for this control account complete per the control account plan?**




☒ **Yes**      ☐ **No (Describe when the work will be completed)**

6. Work scope complete but final adjusted cost not available until end of fiscal year.

**Does the WBS dictionary accurately represent the work completed?**

☒ **Yes**      ☐ **No (Describe additions and/or exclusions below)**

<b>Acknowledgements</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Control Account Manager (CAM)</b>	R.Strykowski		
<b>Responsible Line Manager (RLM)</b>	R.Strykowski		
<b>Project Manager</b>	M. Williams		




NSTX Upgrade Project			
Project Closeout Acknowledgement			
CD-4			
Control Account: 9417-****-7900		Title: Integrated Systems Test (Job 7900)	
WBS: 1.7.3		Control Account Manager (CAM): C.Gentile	
<b>Scope Description;</b> The WBS element includes Convening the NSTX Activity Certification Committee (ACC) for comprehensive review the upgrades. Prepare and make presentation to the PPPL ES&H Executive Safety Board for issuance of appropriate Safety Certificate parameters for operation of NSTX with new enhanced operating capabilities; preparation of documentation (procedures) for safely integrating the upgrades for operations within NSTX safe operating parameters; working with NSTX Operations Group for the successful integration of the upgrades.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	C.Gentile	Charles A. Gentile  <small>Digitally signed by Charles A. Gentile DN: cn=Charles A. Gentile, o=PPPL, email=cgentile@pppl.gov, c=US Date: 2015.08.11 13:40:44 -0400</small>	
Responsible Line Manager (RLM)	A.vonHalle	Alfred von Halle  <small>Digitally signed by Alfred von Halle DN: cn=Alfred von Halle, o=PPPL, email=avonhalle@pppl.gov, c=US Date: 2015.08.11 13:03:03 -0500</small>	
Project Manager	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, email=rstrykowski@pppl.gov, c=US Date: 2015.08.12 08:14:07 -0400</small>	



NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
Control Account: 9417-****-8200		Title: Installation of the Coil Support System (Job 8200 TASKS)	
WBS: 1.8.2		Control Account Manager (CAM): E. Perry	
<b>Scope Description;</b> Torus Assembly and construction. Includes the assembly and installation of the NSTX torus, coils systems and all associated supports including construction management. This WBS element includes removal of equipment for clearance and accessibility, moving existing coils, modifying existing supports mounted on the vacuum vessel and installing a new external coil support structure.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
Control Account Manager (CAM)	E.Perry	Erik D. Perry <small>Digitally signed by Erik D. Perry DN: cn=Erik D. Perry, o=ns, email=eperry@pppl.gov, c=US Date: 2015.05.06 10:20:38 -04'00'</small>	
Responsible Line Manager (RLM)	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=ns, ou=PPPL, email=ronstrykow@pppl.gov, c=US Date: 2015.07.22 10:07:31 -04'00'</small>	
Project Manager	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=ns, ou=PPPL, email=ronstrykow@pppl.gov, c=US Date: 2015.07.22 10:07:50 -04'00'</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account:</b> 9417-****-8210		<b>Title:</b> Installation of the Coil Support System (Job 8210 LOE)	
<b>WBS:</b> 1.8.2		<b>Control Account Manager (CAM):</b> E. Perry	
<b>Scope Description;</b> Field supervision and oversight for Torus Assembly and construction. Includes the assembly and installation of the NSTX torus, coils systems and all associated supports including construction management. This WBS element includes removal of equipment for clearance and accessibility, moving existing coils, modifying existing supports mounted on the vacuum vessel and installing a new external coil support structure.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	E.Perry	Erik D. Perry <small>Digitally signed by Erik D. Perry              DN: cn=Erik D. Perry, o=US, email=eperry@pppl.gov, c=US              Date: 2015.05.08 10:21:10 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski              DN: cn=Ron Strykowski, o=US, ou=PPPL, email=strykows@pppl.gov, c=US              Date: 2015.07.22 10:06:58 -0400</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski              DN: cn=Ron Strykowski, o=US, ou=PPPL, email=strykows@pppl.gov, c=US              Date: 2015.07.22 10:07:07 -0400</small>	

NSTX Upgrade Project Project Closeout Acknowledgement CD-4			
<b>Control Account: 9417-****-8250</b>		<b>Title: CS Removal&amp;Re-Install/Pumpdown/Bakeout (Job 8250)</b>	
<b>WBS: 1.8.2</b>		<b>Control Account Manager (CAM): E. Perry</b>	
<b>Scope Description;</b> Included in this WBS element is the removal of the existing Center Stack and installation of the NSTX Upgraded Center Stack, followed by closing up the vacuum vessel, pumping down, leak checking, bakeout and machine area scrubs to be ready for Integrated System Testing.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	E.Perry	Erik D. Perry <small>Digitally signed by Erik D. Perry            DN: cn=Erik D. Perry, o.ou,            email=eperry@pppl.gov, c=US            Date: 2015.05.06 10:21:45 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski            DN: cn=Ron Strykowski, o.ou=PPPL, email=ronstryk@pppl.gov, c=US            Date: 2015.07.22 10:05:31 -0400</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski <small>Digitally signed by Ron Strykowski            DN: cn=Ron Strykowski, o.ou=PPPL, email=ronstryk@pppl.gov, c=US            Date: 2015.07.22 10:05:40 -0400</small>	

<b>NSTX Upgrade Project</b> <b>Project Closeout Acknowledgement</b> <b>CD-4</b>			
<b>Control Account:</b> 9417-****-8251	<b>Title:</b> CS OH fault repairs (Job 8251)		
<b>WBS:</b> 1.8.2	<b>Control Account Manager (CAM):</b> E.Perry		
<b>Scope Description;</b> Included in this WBS element are the cost associated with the NSTXU arc fault repairs that are necessary to support CD-4.			
<b>Is all work scope for this control account complete per the control account plan?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe when the work will be completed)			
<b>Does the WBS dictionary accurately represent the work completed?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (Describe additions and/or exclusions below)			
Acknowledgements	Name	Signature	Date
<b>Control Account Manager (CAM)</b>	E.Perry	Erik D. Perry  <small>Digitally signed by Erik D. Perry DN: cn=Erik D. Perry, o=PPPL, email=eperry@pppl.gov, c=US Date: 2015.08.10 14:51:23 -0400</small>	
<b>Responsible Line Manager (RLM)</b>	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, email=rstrykow@pppl.gov, c=US Date: 2015.08.10 15:13:48 -0400</small>	
<b>Project Manager</b>	R.Strykowski	Ron Strykowski  <small>Digitally signed by Ron Strykowski DN: cn=Ron Strykowski, o=PPPL, email=rstrykow@pppl.gov, c=US Date: 2015.08.10 15:13:48 -0400</small>	

# Appendix C

## Major External Reviews

<b><u>Summary</u></b>
<b>Princeton University Advisory Committee = 11</b>
<b>DOE-OPA = 7</b>
<b>Other Management = 6</b>
<b><u>Technical Design Review = 10</u></b>
<b>Total =34</b>

<b><u>Detail List</u></b>
Project Management Review (Sept 2009)
Princeton University Advisory Committee Oct 2009
CDR Conceptual Design Review (Oct 28-29, 2009)
<b>DOE-OPA Review CD-1 Dec 2009</b>
Princeton University Advisory Committee May 2010
CSU Peer Review (April 29, 2010)
Project Mngt Advisory Committee Sept 2010
PDR Preliminary Design Review (June 23-24, 2010)
Princeton University Advisory Committee Oct 2010
<b>DOE-OPA Review CD-2 August 2010</b>
External Independent Review (October 2010)
EVMS GAP analysis March 2011
CSU Peer Review (May 18, 2011)
Princeton University Advisory Committee May 2011
DCPS PDR (June 2011)
FDR Final Design Review (June 2011)
TF Fault Review (Sept 7 2011)
EVMS Mock Interviews (Sept 12-13, 2011)
EVMS Cert Review Oct 2011
Princeton University Advisory Committee Oct 2011
<b>DOE-OPA Review CD-3 October 2011</b>
Princeton University Advisory Committee Apr 2012
DOE-OPA Review May 2012
Princeton University Advisory Committee Nov 2012
DOE-OPA Review Dec 2012
Princeton University Advisory Committee Apr 2013
CS Magnet Review by NML Sept 2013
DOE-OPA Review Oct 2013
Princeton University Advisory Committee Nov 2013
DOE-OPA Review Feb 2014
Princeton University Advisory Committee May 2014
Aquapour review (Sept 7 2014)
Princeton University Advisory Committee Nov 2014
Princeton University /PPPL Readiness for Operations (Dec 2014)
<b>DOE-OPA Review CD-4 May 2015</b>

<b><u>External Participant Institutions</u></b>	
DOE	17
GA	8
ORNL	7
BNL	7
ANL	1
Cal Tech	1
Consultant	3
Culham	1
Abuquerque	1
MIT	8
Fermi	1
ITER IO	1
LANL	1
LBNL	1
NML	1
Princeton Univer.	2
NIST	1
SLAC	3
TJNL	3
MAST	2
Univ Wisc	1
UKAEA	1
<b>22 Insitutions</b>	<b>72 Reviewers</b>

# Appendix D

## Summary of Project Injuries

Date	Organization	Type	Description
6/5/09	PPPL	DART	Twisted right knee when stepping on something uneven on TFTR Test Cell floor (lost time).
3/8/13	PPPL	Recordable	Right shoulder strain after bumping into equipment along with frequent periods of awkward posture while welding.
3/11/14	PPPL	DART	Right shoulder tendinitis after shifting position while working on NSTX machine (lost time).
6/11/14	PPPL	Recordable	Irritation of right elbow area. Worker performed a number of repetitive motion activities for the NSTX Upgrade.
1/25/15	PPPL	DART	Metatarsalgia (injury to ball of right foot) after working under the NSTX-U machine (lost time).



# Appendix E

## Project Risk Registry

NSTX Upgrade Project Risk & Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action, if Risk Occurs	Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost consider red
															Retired=	\$ 6,243
															Open=	\$ -
1305f	1305		OH bundle - poor VPI impregnation	Engineering of the fill locations and vents will be performed as part of developing the fabrication procedure.	Evaluate condition of coil - Local dry areas could be repaired, but larger failure would require cutting OH coil from TF and rebuilding	Apr-2014	Chrzanowski	Retired	U	Significant	Moderate	cost to rewind per primavera	1279	5 month schedule impact		\$ 1,279
1305g	1305		CH coil fails electrical tests	Include tests (meggar, hydro and hi-pot) at several points in the fabrication process so non-conformances can be identified and corrected as they occur.	If fault can not be repaired, Coil must be cut off and rebuilt	Apr-2014	Chrzanowski	Retired	U	Significant	Moderate	cost to rewind per primavera	1279	5 month schedule impact		\$ 1,279
8200e	8200		Passive Plate Tiles/hardware need upgrading: Possibly ~3500 tiles, 70000 in <sup>3</sup> , replacing with 2D CFC	Finalize disruption and thermal load analysis by FDR	Should replacement be necessary option to defer until later in ops by limiting machine parameters (no cost/schedule impact) or replace all affected PP and tiles during the planned outage (sign cost impact little schedule impact)	8/1/2011	Tresemer	Retired	U	Significant	Moderate		1000		field removal of PP upgrade attachments and re-installPP	1000
7100a	7100	Project Management and integration	EVMS implementation requires more project controls, support for training, etc than expected	Assign experienced engineers as CAMs. Minimize the number of CAMs. New PM office.	current usage included in BAC and EAC	Dec-2011	Strykowski	Retired	L	Marginal	likely	Project Manager's estimate	150		additional 1 tie for two years	\$ 500
1001d	1001	Centerstack Plasma Facing Components	Passive Plate Tiles/hardware need upgrading: Possibly ~2050 tiles	Design and fab 2D CFC		6/22/2011	Tresemer	Retired	U	Significant	Moderate		436			436
1305d	1305		TF full bundle - poor VPI impregnation	Engineering of the fill locations and vents will be performed as part of developing the fabrication procedure.	Evaluate condition of coil - Local dry areas could be repaired, but larger failure would require separating quadrants and re-assy and VPI of bundle 1304-5400	Sep-2014	Chrzanowski	Retired	U	Marginal	Low		250	8		\$ 250

## Appendix E (continued)

### Project Risk Registry

NSTX Upgrade Project Risk& Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Con-sequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost Considered
															Retired=	\$ 6,243
															Open=	\$ -
	1305	Damage to components	Inadvertent damage to centerstack assembly during movement or rigging	rigging and lifting procedures, safety discussions with staff	repair damage	Nov-2015	Chrzanowski/S trykowski	Retired	VU			PM's estimate 4 people one month plus oversight	209	4		\$ 209
1305b	1305		TF quadrant - poor VPI Impregnation	Engineering of the fill locations and vents will be performed as part of developing the fabrication procedure.	Evaluate condition of coil - Local dry areas could be repaired, but larger failure would require rebuilding TF quadrant 1304-1870	Mar-2013	Chrzanowski	Retired	U	Marginal	Low	manager's estimate	200	0	repeat fabrication tasks	\$ 200
1305c	1305		TF quadrant fails electrical tests	Include tests (meggar, hydro and hi-pot) at several points in the fabrication process so non-conformances can be identified and corrected as they occur.	If unable to repair short, rebuild quadrant 1304-1890	Mar-2013	Chrzanowski	Retired	U	Marginal	Low	manager's estimate	200	0	cost to cut off coil and repeat fabrication tasks	\$ 200
8250b	8250		Flex bus require more than two fit-ups / reworks prior to final installation	Repeat "remove rework, re-install"		Feb-2015	Perry	Retired	VL	Marginal	Low	Construction Manager's estimate	63 to 189	2 to 6	Same work previous done on NSTX	\$ 189
7100	7100	injury prompted stand down	serious injury causes 2-4 week shutdown	continued focus and diligence on safety at the daily WCCC mtg, 8:30 meetings, staff meeting etc.		Mar-2015	strykowski	Retired	u	Significant	Moderate			2 to 4		\$ 188
1304a	1304	Inner TF Bundle Design and Fabrication	Poor VPI of TF bundle ***x duplicate of 1305b***	Engineering of the fill locations and vents will be performed as part of developing the fabrication procedure.	If repairs cannot be made, rebuild coil 1304-1870	n/a	Chrzanowski	Retired	U	Marginal	Low	manager's estimate	165	0	repeat fabrication tasks	\$ 165
1304b	1304		TF coil fails electrical tests ***x duplicate of 1305c***	Include tests (meggar, hydro and hi-pot) at several points in the fabrication process so non-conformances can be identified and corrected as they occur.	If fault area cannot be repaired, rebuild coil 1304-1890	n/a	Chrzanowski	Retired	U	Marginal	Low	manager's estimate	165	0	repeat fabrication tasks	\$ 165

## Appendix E (continued)

### Project Risk Registry

NSTX Upgrade Project Risk& Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action, if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost considered
															Retired=	\$ 6,243
															Open=	\$ -
2490a	2490	Relocations to Support NB2 Installation	SPRED re-design and re-installation may require more effort than estimated due to the physical constraints in the area of bay L	Start design work immediately so potential schedule impact can be accommodated if necessary.		Apr-2014	Perry	Retired	U	Marginal	Low	manager's estimate	98 to 147	0	Past experience installing this diagnostic on NSTX	\$ 147
2490b	2490		LOWEUS re-design and re-installation may require more effort than estimated due to the physical constraints in the area of bay L	Start design work immediately so potential schedule impact can be accommodated if necessary.		Apr-2014	Perry	Retired	U	Marginal	Low	manager's estimate	98 to 147	0	Past experience installing this diagnostic on NSTX	\$ 147
	7100		Generic late vendor delivery	Award contracts early ASAP, followup vendor calls, timely receipt inspection		Apr-2014	strykowski	Retired	VU					4	\$130k/mo.	\$ 130
7200a	7200	Centerstack Management	Additional reviews	Increase scope as required	currently underrunning, No unexpected reviews remain	Sep-2013	Dudek	Retired	U	Marginal	Low	Manager's estimate	107		additional review every other year	\$ 107
	7100	project stretchout	CD-4 delayed due to non-project event (ie CRA findings, non project scope (MPTS, Neutron calibr etc)	conduct ACC and CRA reviews well in advance of the ISTP project scope (MPTS, Neutron calibr etc)	continue to communicate impacts to the project schedule at weekly rollover meetings.	CD-4	strykowski	Retired	L			Project manager's estimate	\$200k/mo	1 to 2 weeks		\$ 100
5100e	6100	Additional work scope	NSTX operations does not fund work scope as listed in WBS6100 PDR	Continued diligence to assure the program office funds req'd infrastructure improvements. Additional work scope for upgrade		Sep-2014	Sichta	Retired	L	Negligible	Low	Manager's estimate	100	0		\$ 100
2300a	2300	Miscellaneous small appendage reinforcement on vessel	Upgrade may increase EM loads to small items on vessel that may need reinforcement, e.g. shutters, ECH, brackets diagnostic supports.	Design reinforcements as problem areas are identified.	Reinforcements underway for passive plates and RF feed throughs	Sep-2011	Titus	Retired	VU	Marginal	Low	project manager's estimate	100			\$ 100
1304c	1304		Copper extrusion vendor has difficulty making full length conductors			5/1/2011	Chrzanowski	Retired	U	Marginal	Low	manager's estimate	100			100

## Appendix E (continued) Project Risk Registry

NSTX Upgrade Project Risk& Opportunity Registry, rev 26 3/20/2015																
CA Number	Job Title	Risk Description	Mitigation Plan	Corrective Action if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Con-sequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost consider red	
														Retired=	\$ 6,243	
														Open=	\$ -	
1305e	1305	TF full bundle fails electrical tests	Include tests (meggar, hydro and hi-pot) at several points in the fabrication process so non-conformances can be identified and corrected as they occur.	Repair electrical short 1304-5400	Sep-2014	Chrzanowski	Retired	U	Negligible	Low		75	8		\$ 75	
7300a	7300	NB2 Management	Additional reviews	Increase scope as required	2/2/2011	Stevenson	Retired	U	Negligible	Low	Manager's estimate	75		additional review every other year	75	
7700a	7700	HP Allocations	Volatility of overhead rates	ETC reflects revised cost		Strykowski	Retired	L	Negligible	Low	Project Manager's estimate	65	0	3% variation	\$ 65	
7700b	7700		Volatility of base estimates for the allocated cost centers	ETC reflects revised cost		Strykowski	Retired	L	Negligible	Low	Project Manager's estimate	65	0	3% variation	\$ 65	
1001c	1001	Centerstack Facing Components	Tiles require unforeseen machining	If schedule critical, and in-house machining will not suffice, seek external machining sources. Additional machining time added to WAF	Jun-2014	Tresemmer	Retired	L	Negligible	Low	prior experience on NSTX	15 to 60	1 to 4	3 machinists for 1 to 4 weeks	\$ 60	
1200a	1200	Centerstack Structural Supports	All interferences with existing equipment have not been identified	Field audit of interferences is included in estimate. audit included in base estimate	2/2/2011	Mangra	Retired	U			manager's experience	60	0	6 weeks of engineer and designer	60	
8250a	8250	Centerstack Removal and Re-installation / Pumpdown / Bakeout	Vacuum seals don't pass leakcheck	Lift centerstack out, rework seals, re-install centerstack	Feb-2015	Perry	Retired	VU	Negligible	Low	Construction Manager's estimate	28 to 56	1 to 2	Same work previous done on NSTX	\$ 56	
6100d	6100	Loss of key personnel	Loss of key personnel	hire replacement and assess schedule impact	Sep-2014	Sichta	Retired	VU	Significant	Low	Manager's estimate	10 to 50	9		\$ 50	
1306a	1306	Inner PF Coils Design and Fabrication	Poor impregnation	Engineering of the fill locations and vents will be performed as part of developing the fabrication procedure.	Jan-2014	Chrzanowski	Retired	U	Negligible	Low	manager's estimate	10 to 50	0	repeat fabrication tasks	\$ 50	

# Project Risk Registry

NSTX Upgrade Project Risk & Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action, if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost considered
															Retired=	\$ 6,243
															Open=	\$ -
1306b	1306	Inner PF Coils Design and Fabrication	Coil fails final acceptance tests.	Include tests (meggar, hydro and hi-pot) at several points in the fabrication process so non-conformances can be identified and corrected as they occur.	If coil cannot be repaired, a new coil will need to be wound. 1306-5050	Jan-2014	Chrzanowski	Retired	U	Negligible	Low	manager's estimate	50	0	repeat fabrication tasks	\$ 50
1301a	1301	Outer TF Coil Repairs	After press mold operation, numerous dry areas are found	Engineering of the fill locations and vents will be performed as part of developing the fabrication procedure.	Attempt local repair; if unsuccessful, rebuild coil 1301-0060	May-2013	Chrzanowski	Retired	U	Negligible	Low	manager's estimate	50	0	repeat existing tasks	\$ 50
1301b	1301		Coil does not pass final acceptance tests	Include tests (meggar, hydro and hi-pot) at several points in the fabrication process so non-conformances can be identified and corrected as they occur.	Attempt local repair; if unsuccessful, rebuild coil 1301-0060	May-2013	Chrzanowski	Retired	U	Negligible	Low	manager's estimate	50	0	repeat existing tasks	\$ 50
1303a	1303	TF Joint Test Stand and Testing	Significant change in TF design concept	Perform additional work		2/1/2011	Kozub	Retired	U	Negligible	Low	manager's estimate	10 to 50		past experience	50
1303b	1303		Increased number of redesigns/test cycles	Perform additional work		2/1/2011	Kozub	Retired	U	Negligible	Low	manager's estimate	10 to 50		past experience	50
7100	7100	core competencies to critical staff	critical skills lost (due to illness, VSP retirement etc)	Cross train and develop backup staff	reduced likely hood	Mar-2015	strykowski	Retired	VU	Significant	Moderate	schedule impact of 2 weeks on critical path		2		\$ 45
7710a	7710	Direct Allocations	Volatility of head rates	ETC reflects revised cost			Strykowski	Retired	L	Negligible	Low	Project Manager's estimate	65	0		\$ 43
7710b	7710		Volatility of base estimates for the allocated cost centers	ETC reflects revised cost			Strykowski	Retired	L	Negligible	Low	Project Manager's estimate	65	0		\$ 43
8250c	8250		Umbrella lids require more than two fit-ups / reworks prior to final installation	Repeat "remove, rework, re-install"		Feb-2015	Perry	Retired	VL	Negligible	Low	Construction Manager's estimate	14 to 42	1 to 2	Same work previous done on NSTX	\$ 42

## Project Risk Registry

Risk Registry\_r25 20150320.xls 3/20/2015 11:34 AM

## Project Risk Registry

Risk Registry r25 20150320.xls 3/20/2015 11:34 AM

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## Appendix E (continued)

### Project Risk Registry

NSTX Upgrade Project Risk & Opportunity Registry, rev 26 3/20/2015																
Number	GA	Job Title	Risk Description	Mitigation Plan	Corrective Action if Risk Occurs	Deadline to Reduce Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost considered
8200rs		Construction	Opportunity to factor in efficiencies into the up estimate factoring in input from viola, rafopoulos, and jos winston	Erk to do bottom-s in input from viola, rafopoulos, and jos winston	none	Oct-2011	Perry/Strykowski	retired	L	Significant		Based on at least 10% savings (strykowski)	0		Retired=	\$ 6,243
1305a		OH Coil Design and Fabrication	No vendor bids for OH/TF fabrication having bid process include both domestic and international PPPL to fab	Fabricate coil in-house (Suggest having bid process include both domestic and international PPPL to fab			Chrzanowski	Retired	U							0
2440a		Beamline Refurbishment	Further inspections may require additional parts and labor	Inspect all parts promptly so damaged ones can be identified early - all parts and labor now in job estimate		2/2/2011	Denault	Retired	U			project manager's estimate	50			0
2450b			Heat load may be too high	Remake He lines - not a concern		2/2/2011	Denault	Retired	U			project manager's estimate	50	0		0
2440b			Existing copper parts may be reusable (except for the dump)	Negative risk - reduce scope of job - job estimate now includes reduced scope		FY10 PDR	Denault	Retired	L			project manager's estimate	-234			0
7200b			Availability of key personnel: Chrzanowski, Mangra, Titus	Chrzanowski by Heizenroeder and Kalish; Mangra by Smith; Titus by Brooks and Heizenroeder - back-up persons identified for key personnel		FY10 PDR	Dudek	Retired								0
2450c			MPST Beam Dump Window re-design and re-installation may require more effort than estimated due to the physical constraints in the area of bay L	Preliminary design work started to layout MPSTs and included VV modifications and interfaces - job 4500 estimate included to provide larger Bay L port and MPST interfaces.		FY11 FDR	Jones	Retired	U			Engineering estimate included in NSTXU cost			Past experience designing and installing this diagnostic on NSTX	0
2460a		NB Armor	CFC tiles needed for thermal/structural reasons	Add requirement for redundant plasma control to eliminate need for CFC tiles - MPTs		FY10 PDR	Priniski	Retired	L							0

## Appendix E (continued)

### Project Risk Registry

NSTX Upgrade Project Risk & Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost considered
															Retired=	\$ 6,243
															Open=	\$ -
2480a	2480	NB2 Duct and VV Mods	Beam too close to bellows/duct	Include molybdenum shielding in estimate - Bay K port plug provides larger free aperture than BL Some Moly shield for bellows included in job.		FY10 PDR	Priniski	Retired	L			project manager's estimate	30 to 60	0	Past experience on NSTX	0
2480d	2480		Previous fabricators of rectangular bellows not available	Locate alternate vendors - RFQ with multiple vendors to access vendor and cost for PDR.		Issue requisition for bellows fabrication	Priniski	Retired	U			Project Manager's estimate	10 to 100			0
2480b	2480		Difficulty machining vessel	Double estimate for this portion of the job - several methods exist for cutting and job estimate was increased for least efficient process.		Vessel machining	Priniski	Retired	L			project manager's estimate	10 to 70	1 to 8	Past experience on NSTX	0
2480c	2480		J-K cap may not be able to be installed in one piece	Include removal of one TF outer leg (to facilitate access) in the baseline estimate - now in job			Priniski	Retired	U							0
2470b	2470		Old 100 micron fiber cables that are proposed to be used may not be in good condition	Test a prototype with a 62.5 micron cable fused to 100 micron cable - sufficient 100 micron cable located on-site		FY11 FDR	Ramakrishnan	Retired	U			project manager's estimate	50		Past experience in installing the NB1 line up for NSTX	0
2470a	2470	NB Power System	Old RCA tubes are being used and may need a tune-up	Use the 8 additional tubes from TFR - available			Ramakrishnan	Retired	U						Budgetary quotes received for Triax and other cables and used in estimates	0
6100a	6100	Central Instrumentation and Control	Volume of data from diagnostic camera systems exceed capability of network, storage, and backup systems	Install 10 Gb networks and enhance storage and backup systems		FY10 PDR	Sichia	Retired	U	Marginal	Low	Engineering estimate	30 to 200		Similar work at PPPL	0
6100b	6100		EPICS data acquisition takes too long	Include in the base job the upgrade of some data acquisition systems (CAMAC)		FY10 PDR	Sichia	Retired	VL	Marginal	Moderate	Engineering estimate	10 to 100		Similar work at PPPL	0

## Appendix E (continued)

### Project Risk Registry

NSTX Upgrade Project Risk & Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost considered
															Retired=	\$ 6,243
2300b	2300		Diagnostic waveguide has a present weakness that hasn't been seen in operation.	Reinforce		2/2/2011	Titus	Retired		Negligible	Low		0		Open=	\$ -
8200a	8200	Centerstack and Coil Structure Installation	Longer time to remove diagnostics for access	- incorporated into base plan			Viola	Retired	L							0
8200c	8200		remove LLD and replace with existing OD tiles	Perform disruption analysis on LLD or program decision on limiting operation. INCLUDE IN BASELINE			Viola	Retired	L			Manager's estimate	0			0
2450a		NB2 Services	Availability of V. Garzotto	Desandro / Denault could do this work-replacements available				Retired								0
1001e	1001	Centerstack Plasma Facing Components	May be able to use ATJ on CS VS instead of 2D CFC. Depends on fastening needs			6/22/2011	Tresemmer	Retired	U			Possible outcome of thermal analysis. Is unlikely.	-75			-75
7100b	7100		FY2014 overhead rates	Continue to ensure that outyear rates are conservative		Apr-2014	Stykowski	Retired	L			Project Manager's estimate	-1000	0		\$ (1,000)
2420			Ion sources Use existing 5 sources	factored into baseline via ecp-004			stykowski	Retired								\$ (1,000)
7100b	7100		FY2015 overhead rates	Continue to ensure that outyear rates are conservative		Apr-2014	Stykowski	open	L			Project Manager's estimate	tbd	0		
1001a	1001	Centerstack Plasma Facing Components	Tiles not delivered on time	1001-0066	If schedule critical, install tiles in vessel.	Jun-2014	Tresemmer	Retired	U			prior experience on NSTX	0	0		
1001b	1001	Centerstack Plasma Facing Components	Special diagnostics for tiles not received on time	4100-0066	If schedule critical, install tiles in vessel.	Jun-2014	Tresemmer	Retired	U			prior experience on NSTX	0	0		
CD0-a			Uncertain of ability to find a cost effective TF joint that works at higher fields	Perform extensive analysis (all operating scenarios) for new joint designs			Dudek	Retired								
CD0-b			Little room to re-enforce outer TF legs and umbrell structure to handle higher loads	Perform detailed design			Dudek	Retired								

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Appendix E (continued)

# Project Risk Registry

NSTX Upgrade Project Risk & Opportunity Registry, rev 26 3/20/2015																
Number	CA	Job Title	Risk Description	Mitigation Plan	Corrective Action if Risk Occurs	Deadline to Retire Risk or Absorb Impact	Owner	Current Status	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$K)	Critical Path Schedule Impact (weeks)	Cost and Schedule Impact Calculation Basis	Cost considered
CD0-c			The vacuum vessel may need to be reinforced to accommodate higher loads				Dudek	Retired							Retired=	\$ 6,243
CD0-d			Uncertain of level of effort required to decontaminate TFTR NB				Stevenson	Retired							Open=	\$ -
CD0-e			Uncertain of the commercial availability of high voltage switch-tubes				Stevenson	Retired								
CD0-f			Uncertain of the commercial availability of cabling and terminations for the 100kV accelerator system				Stevenson	Retired								
1001d	1001	Centerstack Plasma Facing Components	Outboard Divertor tile and hardware replacement may be required for extreme operating scenarios	Should replacement be necessary, defer until later in ops by limiting machine parameters (no cost/schedule impact)		8/2/2011	Tressemmer	Retired	VU			Retired. Existing OBD tiles will be used in place of the LLD.				

# Appendix F

## Engineering Change Proposal (ECP) log

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Draw Cum K	CBB K	Contingency Remaining K	ECP Status
1	1.7	7700	Combine CA 770 and 7710 into one CA (7710) Direct Allocations	4/25/2011	3 Project Manager			\$77,317	\$16,992	Approved
2	1.6	6100	Move the baseline start date for task 6100-0041 to 12 April 2012	6/8/2011	3 Project Manager			\$77,317	\$16,992	Approved
3	1.6	6100	Reduce man-hours on task 6100-001. Add this budget as M&S on task 6100-0049D.	9/10/2011	3 Project Manager			\$77,317	\$16,992	Approved
4	1.1 1.2 1.8	1304 8200 8210 2420 2490	1- CA 1304 change to TF procurement (cost/schedule) 2- CA 8200 re-structured and split into two CA's (8200/8210) 3- Remove four tasks from NB Source CA 2420 4- Task acceleration	11/10/2011	2 Federal Project Director	963	963	\$78,280	\$16,029	Approved
5	1.5	5501 5200 5000	Update the Work Breakdown Structure/Dictionary in the Project Execution Plan to ensure that a single Control Account does not occur at more than one WBS element	10/6/2011	3 Project Manager		963	\$78,280	\$16,029	Approved
6	1.7 1.8	7100 8200 8250	Various changes to Control Accounts 7100 (move labor), 8200/8250 (delete WPs and convert to PPs)	11/21/2011	3 Project Manager	-3	960	\$78,277	\$16,032	Approved
7	1.5	5000	Convert task 531-005 held in Planning Package to discrete tasks	11/30/2011	3 Project Manager		960	\$78,277	\$16,032	Approved
8	1.8	8200 8210	Move budget/task (8200-0017A) for purchase of two welding machines from oversight job (8210) to field work job (8200). Change EVT to % Complete.	12/2/2011	3 Project Manager		960	\$78,277	\$16,032	Approved
9	1.3	3300	Control Account 3300: Convert WP 3300-125 EVT from Planning Package to % complete.	12/13/2011	3 Project Manager		960	\$78,277	\$16,032	Approved
10	1.5	5000	Convert EVT for activity 531-013 to % complete	1/13/2012	3 Project Manager		960	\$78,277	\$16,032	Approved
11	1.1	1002	Control Account 1002. Add scope (cost/schedule) as shown on attached WAF to support reinforcement of passive plates. Change CA 1002 CAM to Neway Atnafu.	1/23/2012	2 Federal Project Director	178	1138	\$78,455	\$15,854	Approved
12	1.1 1.2	1304 1305 2480	Delete several unnecessary activities from CA 1304 Inner TF Bundle. Add several activities (cost/schedule) to CA 1305 to accommodate sandblast and prime of OH conductor. Reduce budget on task 2480-0057.	2/7/2012	2 Federal Project Director	-11	1127	\$78,444	\$15,865	Approved
13	1.8	8200 8210	Move task 8200-0017 from Control Account 8210 to Control Account 8200.	12/19/2011	3 Project Manager		1127	\$78,444	\$15,865	Approved
14	1.2	2485	Change the EVT for task 2485-0044A to C (% complete)	1/9/2012	3 Project Manager		1127	\$78,444	\$15,865	Approved
15	1.1	1305	Add activities (cost/schedule) to accomplish Aquapour test recommended at FDR	2/22/2012	2 Federal Project Director	31	1158	\$78,475	\$15,834	Approved
16	1.2	2300	Engineering and Analysis work to support adding compliance to the HHFW antennas. New CAM = Bob Ellis		2 Federal Project Director		1158	\$78,475	\$15,834	OPS Scope
17	1.2	2425	Neway Atnafu will replace Martin Denault as the Control Account Manager for Control Account 2425 BL Relocation.	1/24/2012	3 Project Manager		1158	\$78,475	\$15,834	Approved

**Appendix F (continued)**  
Engineering Change Proposal (ECP) log

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Draw Cum K	CBB K	Contingency Remaining K	ECP Status
18	1.2	2450	Resource change for several activities in Control Account 2450, and a change to the start dates for several LOE tasks.	1/26/2012	3 Project Manager	-10	1148	\$78,465	\$15,844	Approved
19	1.1 1.8	1301 8200	Move tasks for drilling additional holes in outer TF flags (tasks 1301-0300 and 1301-0310) from Control Account 1301 to Control Account 8200	2/21/2012	3 Project Manager		1148	\$78,465	\$15,844	Approved
20	1.2	2425	Change the start and finish dates for the three LOE tasks.	2/21/2012	3 Project Manager	-6	1142	\$78,459	\$15,850	Approved
21	1.2	2425	Replanning of work scope in Control Account 2425 to better fit project timing. Should equate to a slight budget reduction.	3/12/2012	3 Project Manager	-51	1091	\$78,408	\$15,901	Approved
22	1.5	5200	Re-planning of Control Account 5200 for Digital Coil Protection	5/1/2012	2 Federal Project Director	27	1118	\$78,435	\$15,874	Approved
23	1.2	2440	Transfer responsibility of Control Account Manager (CAM) from Martin Denault to Mark Cropper for Control Account 2440 2nd NBI Beamline	2/24/2012	3 Project Manager		1118	\$78,435	\$15,874	Approved
24	1.1	1307	Replace task 1307-2030 Fabricate CS Casing with five (5) new tasks consistent with contract award	3/28/2012	2 Federal Project Director	409	1527	\$78,844	\$15,465	Approved
25	1.2 1.8	2475 8200	In Control Account 2475 add steps to the schedule for EPICS timing and Control Interface. In Control Account 8200: Delete task 8200-0102C	4/2/2012	2 Federal Project Director	122	1649	\$78,966	\$15,343	Approved
26	1.1 1.7 1.8	1001 7100 8250	Change M&S budget on tasks 1001-0066 and 1001-0066F in Control Account 1001. Also this ECP increases FY2012 resources for Control Account 7100 (Project Management & Integration). Delete redundant tasks from Control Acct. 8250.	3/21/2012	2 Federal Project Director	210	1859	\$79,176	\$15,133	Approved
27	1.1 1.8	5000 1302 1304 1305 1307 8200	Update (replanning) of Control Accounts 1302, 1304, 1305, 1307 including additional tasks and updated resources. Delete Planning Package 8200-PP01A; work not required.	5/1/2012	2 Federal Project Director	22	1881	\$79,198	\$15,111	Approved
28	1.7	7300	In Control Account 7300 - Delete task 7300-13 Support of OPA Review	3/27/2012	3 Project Manager	-86	1795	\$79,112	\$15,197	Approved
29	Milestone PEP		In PEP: Re-define Level II milestone change ref "Friction stir weld coil leads..." In Project Schedule: Re-define activity 1070 to read:RECEIVE FIRST DELIVERY MACHINED INNER TF CONDUCTOR - 30 JUN 2012	4/3/2012	2 Federal Project Director		1795	\$79,112	\$15,197	Approved
30	1.7	7300	In Control Account 7300 (NB2 Management) delete activity 7300-22.	5/2/2012	2 Federal Project Director	-86	1709	\$79,026	\$15,283	Approved
31	1.2 1.1	2490 1002 2440	CA: 1002 Add drafting support CA: 2440 Delete tasks for exit spool piece CA: 2490 Add drafting support and tasks for locating TMP rack on 119' platform	5/23/2012	2 Federal Project Director	-165	1544	\$78,861	\$15,448	Approved

**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Cum K	CBB K	Contingency Remaining K	ECP Status
32			Not used				1544	\$78,861	\$15,448	
33	1.1 1.7	1000 7710	In Control Account 1000 increase the Title III Analysis Support task (LOE) to 900 man hours/FY. This equates to 75 hrs/mo from June 2012 through September 2014. Reduce FY12 and FY13 HP Allocation task in Control Account 7710.	6/14/2012	2 Federal Project Director	258	1803	\$79,120	\$15,189	Approved
34	1.1	1304	Change the EVT for several tasks in CA 1304 from 0-100 to % complete. The thought was that milestone payments would be made; however, accruals have been taken based on completion of work and we want to ensure we earn the appropriate value.	6/8/2012	3 Project Manager		1803	\$79,120	\$15,189	Approved
35	1.1	1305	In Control Account 1305 task 1304-1510 had baseline dates of 2Oct12 through 19Sept13. With the early start of fabrication this task requires date changes to Start: 1May2012 through Finish: 31Aug2012.	6/21/2012	2 Federal Project Director	-2	1801	\$79,118	\$15,191	Approved
36	1.1	1304	In Control Account 1304 Subcontract S011001 was amended to have Major Tool straighten some of the conductors. This task added an additional \$66,260.00 to the contract. This change will add this additional cost in task 1304-1000.	6/21/2012	2 Federal Project Director	66	1867	\$79,184	\$15,125	Approved
37	1.1	1001	Protective measures for the PF-1C coil canister.	7/20/2012	2 Federal Project Director	464	2332	\$79,649	\$14,660	Approved
38			Not Used		3 Project Manager		2332	\$79,649	\$14,660	Not yet submitted for Approval
39	1.1	1300 1301 1305 4100	Additional budget to jobs in CA's 1300, 1301 and 1305. Resources are needed for these tasks that were not previously budgeted.	6/26/2012	2 Federal Project Director	689	3021	\$80,338	\$13,971	Approved
40	1.4	6100	Physics (Stefan) identified new workscope for Diagnostics. This ECP represents the portion of that which Central I&C can service.				3021	\$80,338	\$13,971	OPS Scope
41	1.5	5000	PF1 feed changes		2 Federal Project Director		3021	\$80,338	\$13,971	OPS Scope
42	1.8	8210	Reschedule and re-budget task 8200-0012D "Reinstallation Oversight".	7/3/2012	2 Federal Project Director	159	3180	\$80,497	\$13,812	Approved
43	1.8 1.2	8200 2490	Additional tasks for Control Accounts 8200 and 2490. Delete 3 tasks from CA 2490.	7/30/2012	2 Federal Project Director	178	3358	\$80,675	\$13,634	Approved
44	1.2	2425	The HVAC duct over the door between the TFTR and NSTX Test Cells was removed to allow the move of the second neutral beam into the NTC. When this duct is permanently re-installed it should be mounted higher on the wall so it will not interfere with future use of this doorway.	7/16/2012	2 Federal Project Director		3358	\$80,675	\$13,634	Not yet submitted for Approval



**Appendix F (continued)**  
Engineering Change Proposal (ECP) log

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Draw Cum K	CBB K	Contingency Remaining K	ECP Status
45	1.1	1300 1301 1302 1304 1305 1306 1307	Re-estimating of remaining Center Stack Work	8/15/2012	2 Federal Project Director	1466	4824	\$82,141	\$12,168	Approved
46	1.1	1001	Delete tasks 1001-0078 and 1001-0082 in Control Account 1001. These two tasks are redundant.	7/24/2012	2 Federal Project Director	-43	4782	\$82,099	\$12,210	Approved
47	1.1 1.2 1.3	2450 2480 3200	Change Control Account Manager (CAM) for several jobs: 2450: from Denault to Neway Atnafu 2480: from Denault to Bill Blanchard 3200: from Denault to Neway Atnafu	8/8/2012	3 Project Manager		4782	\$82,099	\$12,210	Approved
48	1.1	1200	Updated estimated costs are more than original budget for several tasks. Request additional budget.	8/20/2012	2 Federal Project Director	169	4951	\$82,268	\$12,041	Approved
49	1.5	5501 1200	Additional scope (cost/schedule) for Control Account 5501 analysis tasks and additional oversight/documentation time for Control Account 1200	10/5/2012	2 Federal Project Director	497	5448	\$82,765	\$11,544	Approved
50	1.6	6100	Add additional budget to oversight task 6100-0000	9/4/2012	2 Federal Project Director	38	5486	\$82,803	\$11,506	Approved
51	1.1	1305	Add activity 1305-0003 to re-design and manufacture flanges for the TF Quadrant Mold that will allow for complete closure and sealing of the mold	7/19/2012	2 Federal Project Director	10	5496	\$82,813	\$11,496	Approved
52	1.2	2480	Convert Planning Package 2480-0076 to discrete activities	8/28/2012	3 Project Manager		5496	\$82,813	\$11,496	Approved
53	1.2	2440	Delete tasks 2440-0014 and 2440-0024 from Control Account 2440	9/19/2012	2 Federal Project Director	-125	5371	\$82,688	\$11,621	Approved
54	1.2	2490	Delete tasks 24910470 and 24910480 from Control Account 2490	9/24/2012	2 Federal Project Director	-36	5335	\$82,652	\$11,657	Approved
55	1.4	4500	Add scope for analysis/design/fabrication/installation of tFIDA	12/4/2012	2 Federal Project Director	192	5527	\$82,844	\$11,465	Approved
56	1.2	2440 2475	Delete unnecessary task from Control Account 2440. In Control Account 2475 add steps to the schedule for LCC & Low Voltage Power Supply refurbishment. In Control Account 2475 add steps to the schedule for Display Software up-grade.	10/19/2012	2 Federal Project Director	59	5586	\$82,903	\$11,406	Approved
57	1.8	8200	Install 6 small ports on NSTX Vacuum Vessel	12/4/2012	2 Federal Project Director	97	5683	\$83,000	\$11,309	Approved
58	1.2 1.1	2460 1001	For Control Account 1001 the contract for the machining for Batch 1 of the PFCs came in under budget by ~\$90K. For Control Account 2460 there is an increase in job scope	12/4/2012	2 Federal Project Director	-31	5651	\$82,968	\$11,341	Approved

**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Draw Cum K	CBB K	Contingency Remaining K	ECP Status
59	1.1	1001	Move BL start date for task 1001-0066F to 12/3/2012 while task is being re-planned.	11/12/2012	3 Project Manager		5651	\$82,968	\$11,341	Approved
60	1.2	2450	The baseline budget for Control Account 2450 is not sufficient to perform the remaining work scope. This ECP will be used to cover the difference between the cost estimate for the remaining work and the original budget.	1/24/2013	2 Federal Project Director	221	5872	\$83,189	\$11,120	Approved
61	1.1	1305 1304	Add tasks to cover additional work on TF quadrant mold and to perform an in-line braze test (OH). Change BL dates on two other tasks.	12/17/2012	2 Federal Project Director	14	5886	\$83,203	\$11,106	Approved
62	1.8 1.7	8200 8210 7300 7200	For Control Account 8200/8210 - add re-work of parts received from other WBS elements. Delete two tasks from Management Job 7300 and one task from Management Job 7200.	12/20/2012	2 Federal Project Director	240	6126	\$83,443	\$10,866	Approved
63	1.5	5200	Change BL start and finish dates on the Water PLC portion of the DCPS (5200) job.	12/10/2012	2 Federal Project Director	2	6128	\$83,445	\$10,864	Approved
64	1.5	5501	Control Account 5501 has been assigned to a new CAM. The CAM has overhauled the schedule which requires additional budget. All tasks that are currently "in-progress" will be stopped as of the end of February 2013 and the new schedule will be used moving forward.	3/29/2013	2 Federal Project Director	319	6448	\$83,765	\$10,544	Not yet submitted for Approval
65	1.5	5501	Change Control Account Manager (CAM) on Control Account 5501 Coil Bus Runs to Neway Atnafu	12/20/2012	3 Project Manager		6448	\$83,765	\$10,544	Approved
66	1.1	1002	Passive plate re-inforcement	1/24/2013	2 Federal Project Director	197	6644	\$83,961	\$10,348	Approved
67	1.2	2490	Remove several activities from Control Account 2490 which are no longer required since the SPRED diagnostic will not be re-installed	1/31/2013	2 Federal Project Director	-60	6584	\$83,901	\$10,408	Approved
68	1.1	1302 1305 1306	Correct baseline dates for various future Critical Path activities to make them consistent with the baseline schedule and milestones. Also, replan activity 1306-5050 for the PF coil procurement.	1/17/2013	2 Federal Project Director	18	6602	\$83,919	\$10,390	Approved
69	1.1	1001	Reduce total budget on task 1001-0066F to \$142,000 (a reduction of \$146,064.80)	1/17/2013	2 Federal Project Director	-146	6456	\$83,773	\$10,536	Approved
70	1.1	1305	Move baseline dates for task 1305-2620 "Fab and deliver OH Mold" (this is a zero cost change)	1/28/2013	3 Project Manager		6456	\$83,773	\$10,536	Approved
71	1.7	7400 7710	Reduction of 10% in remaining HP support activities and HP direct allocations due to reduced need	1/31/2013	2 Federal Project Director	-133	6322	\$83,639	\$10,670	Approved
72	1.2	2450	Control Account Manager restructuring of job post CAM change. No increase in budget.	3/5/2013	2 Federal Project Director	0	6322	\$83,639	\$10,670	Approved

**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Cum K	CBB K	Contingency Remaining K	ECP Status
73		1304	NOT USED				6322	\$83,639	\$10,670	
74	1.2	2480	S-FLIP Port Installation and Reinforcement	3/1/2013	2 Federal Project Director	165	6487	\$83,804	\$10,505	Approved
75	1.1	1200	NOT USED				6487	\$83,804	\$10,505	
76	1.1	1001	Adjust the baseline dates of various future tasks in job 1001 CS Plasma Facing Components (small cost increase due to tasks pushed into FY14)	3/21/2013	2 Federal Project Director	3	6490	\$83,807	\$10,502	Approved
77	1.8	8200	In Control Account 8200 add additional scope for installation of umbrella arch reinforcements which is not included in the existing estimate.	3/19/2013	2 Federal Project Director	74	6564	\$83,881	\$10,428	Approved
78	1.1	1300 1305	Updated resources added for Control Account 1305 to cover the VPI's through the full TF. Added resources for Commissioning of the OH Winding Station. Additional resources added to the LOE job 1300 to cover Engineering Support and Drafting/Title III support.	3/22/2013	2 Federal Project Director	476	7040	\$84,357	\$9,952	Approved
79	1.1	1200	In Control Account 1200. The bolted connection between the lower lid and the pedestal require re-design and analysis.	4/19/2013	2 Federal Project Director	8	7048	\$84,365	\$9,944	Approved
80	1.8	8250	Delete Planning Package 8250-PP01A "CS Analysis Update". This scope is not needed in this Control Account.	4/25/2013	2 Federal Project Director	-49	6999	\$84,316	\$9,993	Approved
81	1.1	1306	Delete current task 1306-5050A for the PF Coil Procurement and replace with new task 1306-5050B which shows the current contract price/schedule.	4/26/2013	2 Federal Project Director	-19	6980	\$84,297	\$10,012	Approved
82	1.1	1300	Budgeted time required for Control Account 1300 task 1300-0012 Engineering Support needs to be increased 300 hrs. per month through Sept. 2013.	5/9/2013	2 Federal Project Director	388	7368	\$84,685	\$9,624	Approved
83			NOT USED			21	7389	\$84,706	\$9,603	
84	1.2	2450	The winning bid for the NBI Pipeline construction contract was \$668,210. This is more than the \$500,000 originally estimated by \$168,210. Plus, due to safety concern for this complex construction activity, 1 PPPL personnel is decided to monitor and assist the contractor activities at all times, in addition to the supervision by Technical Rep, QC and ES&H.	5/15/2013	2 Federal Project Director	223	7612	\$84,929	\$9,380	Approved
85	1.8 1.2 1.1	1302 2490 8200 8250	Additional tasks required in Control Account 8250 required for the re-assembly of the Centerstack and Installation into NSTX. These tasks are off-set by several tasks being deleted in Control Accounts 1302, 2490 and 8200.	6/3/2013	2 Federal Project Director	1	7614	\$84,931	\$9,378	Approved
86	1.5	5200	This ECP is a re-planning of the remaining tasks for Control Account 5200. The remaining tasks represent a reduction in cost to complete the DCPS work scope.	5/30/2013	2 Federal Project Director	-162	7452	\$84,769	\$9,540	Approved
87	1.2	2480	Delete unnecessary tasks from Control Account 2480. Add new steps for the fabrication, testing, and assembly of the Transition Duct.	6/3/2013	2 Federal Project Director	-23	7429	\$84,746	\$9,563	Approved

**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Cum K	CBB K	Contingency Remaining K	ECP Status
88	1.1	1200	In Control Account 1200: Require high strength hardware for all Umbrella Upper/Lower Lid Connections requiring and increase in M&S for these tasks.	6/18/2013	2 Federal Project Director		7429	\$84,746	\$9,563	Approved
89	1.1	1305	In job 1305 add two additional tasks. 1) Additional OH conductor 2) Provide dehumidifier for CS HiBay	6/18/2013	2 Federal Project Director	31	7460	\$84,777	\$9,532	Approved
90	1.7	7200	Additional additional task to Control Account 7200 to cover the estimated costs of attending the SOFE Conference	6/26/2013	2 Federal Project Director	142	7602	\$84,919	\$9,390	Approved
91	1.3	3300	Control Account 3300: Purchase additional bakeout system power supplies/accessories	9/13/2013	2 Federal Project Director	81	7683	\$85,000	\$9,309	Approved
92	1.5	5200	Control Account 5200 requires additional scope to support: 1) Computer Division Support Activities, 2) Additional Computer Division project oversight, 3) Evaluation of additional scope requirements, and 4) Additional software design.	7/31/2013	2 Federal Project Director	45	7728	\$85,045	\$9,264	Approved
93	1.2	2425 2450	Change the Control Account Manager for Control Accounts 2425 and 2450 from Neway Atnafu to Mark Cropper	7/23/2013	3 Project Manager		7728	\$85,045	\$9,264	Approved
94	1.5	5501	Increased budget need on several activities in Control Account 5501 as a result of a bottom up estimate. The estimate was completed after the design maturity has increased which has given a clearer picture of the man-power and procurement needs for the Control Account future activities.	8/21/2013	2 Federal Project Director	146	7874	\$85,191	\$9,118	Approved
95	1.1	1002	PCHERS passive plate design/fabrication	9/3/2013	2 Federal Project Director	357	8231	\$85,548	\$8,761	Approved
96	1.2	2470	For Control Account 2470 a budget increase is necessary due to sub-contract quotes being more than budgeted cost for activity 247000750 "Installation of 2nd NBI Raceway".	8/21/2013	2 Federal Project Director	157	8388	\$85,705	\$8,604	Approved
97	1.1	1300	Add additional budget to Control Account 1300 to extend LOE Engineering Support	9/30/2013	2 Federal Project Director	264	8652	\$85,969	\$8,340	Approved
98			NOT USED				8652	\$85,969	\$8,340	
99	1.1	1305	The results of a bottom-up estimate and job review for Control Account 1305 added additional scope/budget per attached .pdf.	9/30/2013	2 Federal Project Director	187	8840	\$86,157	\$8,152	Approved
100	1.4	4501	Fabricate, install, and test a two turn RWM coil encompassing Bays A & L.	11/22/2013	1 Director Office of Science	154	8994	\$86,311	\$7,998	Approved
101	1.8	8250	Additional scope required in Control Account 8250 to prepare/install spacers for the Outer TF flex joints. This work will require the fabrication of 72 unique spacers to connect the OTF flex joints.	11/4/2013	2 Federal Project Director	263	9256	\$86,573	\$7,736	Approved
102	1.6	6100	In control account 6100 add an additional \$13,050 to activity 6100-0049D for an upgraded LEMOPANEL to resource 41 (M&S).	11/14/2013	2 Federal Project Director	17	9274	\$86,591	\$7,718	Approved

**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Cum K	CBB K	Contingency Remaining K	ECP Status
103	1.1	1305	Add additional task in Control Account 1305 for three (3) additional five gallon kits of CTD 425 are expected to be needed for the VPI of the OH coil	12/2/2013	2 Federal Project Director	31	9304	\$86,621	\$7,688	Approved
104	1.1	1300	Control Account 1300 requires additional Engineering support through May 2014. This ECP adds additional Engineering/Design Support through May 2014.	12/18/2013	2 Federal Project Director	152	9456	\$86,773	\$7,536	Approved
105	1.1	1305	In Control Account 1305 add tasks previously identified to baseline. These are tasks identified by the CAM that occur after the OH VPI. They have been shown in the current schedule and EAC for some time.	12/18/2013	2 Federal Project Director	47	9503	\$86,820	\$7,489	Approved
106	1.1	1200	Control Account 1200 requires additional labor to complete documentation.	1/2/2014	2 Federal Project Director	15	9518	\$86,835	\$7,474	Approved
107	1.6	6100	In Control Account 6100 it appears as though an error was made when entering information into Primavera from the WAF and the second digit of the budgeted hours was clipped for activity 6100-0073A. A spreadsheet and screenshot from WAF is attached. This ECP corrects the budgeted hours (increased cost).	1/2/2014	2 Federal Project Director	20	9538	\$86,855	\$7,454	Approved
108			NOT USED				9538	\$86,855	\$7,454	
109	1.5	5200	DCPS (Control Account 5200) additional scope: Prepare/Install DCPS computer, Halmar Signal Conditioner interface box, Temp. conn. panel, RTC interface chassis, IT and Management Support.	3/11/2014	2 Federal Project Director	286	9824	\$87,141	\$7,168	Approved
110	1.3	3200	A review of Control Account 3200 (Cooling Water) indicated a budget need. The current unstarted activities will be deleted and replaced by the activities shown on the attached WAF.	3/31/2014	2 Federal Project Director	174	9998	\$87,315	\$6,994	Approved
111	1.8	8200	In Control Account 8200 delete activity 8200-0110 "Adjust PF Coils". Due to the nature of how work was performed this activity is no longer required to be performed. Add an additional task to Control Account 8200 to remove gaps around the TFOL AI block interface using epoxy. Increase cost due to man hours for this field work.	4/7/2014	2 Federal Project Director	8	10006	\$87,323	\$6,986	Approved
112	1.2 1.7	2490 7100	Move the baseline start and finish dates for several tasks. In 7100 for ORA Support, and in 2490 move the installation tasks for the reinstall of the IR Camera(s), LOWEUS, and Transmission Grating Spectrometer due unclear path forward.	4/4/2014	3 Project Manager		10006	\$87,323	\$6,986	Approved
113	1.1	1304	In Control Account 1304 delete activity 1304-1154 "Fab/Deliver supports for OTF jumpers" and replace with new activity capturing the updated cost/schedule for the fabrication and delivery of these parts.	4/7/2014	2 Federal Project Director	212	10218	\$87,535	\$6,774	Approved

**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Cum K	CBB K	Contingency Remaining K	ECP Status
114	Milestone		Revise PEP Level II milestone "Complete fab & test inner TF/OH coil assembly" from JUNE 2014 TO JULY 2014.	4/30/2014	2 Federal Project Director		10218	\$87,535	\$6,774	Approved
115	1.1	1300	In Control Account 1300 add additional EA/EM oversight resources for overseeing of the Centerstack fabrication through July 2014.	5/2/2014	2 Federal Project Director	189	10407	\$87,724	\$6,585	Approved
116	1.1	1306	In Control Account 1306 the subcontract for the fabrication of the three (3) sets of PF coils has been changed to provide and additional \$40K (equitable adjustment) plus an additional \$20K for the on-time completion of the remaining four (4) coils.	5/8/2014	2 Federal Project Director	120	10527	\$87,844	\$6,465	Approved
117	1.1	1304 8250	In control Account 1304 Purchase Order PE013500 has been issued for another set of outer TF connectors (lead extensions). In Control Account 8250 tasks 8250-157, 8250-161, 8250-165, and 8250-169 have been replaced by the shorter bakeout activity 8250-165A.	6/11/2014	2 Federal Project Director	124	10651	\$87,968	\$6,341	Approved
118	1.1	1300	Add new activity in Control Account 1300 to provide Engineering Support through Sept 30, 2014 to support the CS fabrication activities	7/21/2014	2 Federal Project Director	110	10761	\$88,078	\$6,231	Approved
119	1.6	6100	The current work now includes additional M&S for a genuine real-time control computer, new higher-performance input/output boards, and a complete restructuring of the software architecture to achieve better reliability, improved performance, lower maintenance and future enhancement costs, and integration of DCPS. In addition, it includes a consultant to help recover from the loss of our experienced power supply engineer, who was fluent in both power engineering and specifying software requirements.	9/2/2014	2 Federal Project Director	260	11021	\$88,338	\$5,971	Approved
120			NOT USED		2 Federal Project Director		11021	\$88,338	\$5,971	Not yet submitted for Approval
121	1.8	8210 8250 8200	In Control Account 8200 delete activity 8200-0124 "Re-install RF pipes". Crane availability and space availability precludes completion before CD-4. Add Misc. M&S activity to support field work. In Control Account 8250 add activity 8250-1371A "Install OTF flag supports". These activities were not identified in BL. In Control Account 8210 add activity 8210-0013A Installation oversight extends LOE through January for oversight.	8/26/2014	2 Federal Project Director	29	11050	\$88,367	\$5,942	Approved
122	1.7	7900	In Control Account 7900 delete activity 7900-110 Prepare NBI2 & CS ISTP Test Procedures. Existing procedures being used or modified. This activity is unnecessary.	8/26/2014	2 Federal Project Director	-22	11028	\$88,345	\$5,964	Approved

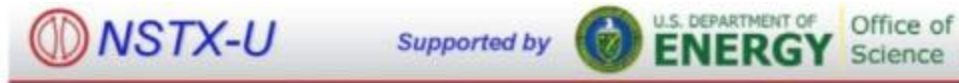
**Appendix F (continued)**  
**Engineering Change Proposal (ECP) log**

ECP No.	Impacted WBS Elements	Control Accounts	ECP Title	Approval Date	Change Level	Contingency Draw K	Contingency Draw Cum K	CBB K	Contingency Remaining K	ECP Status
123	1.7	7100	In Control Account 7100 move BL start/finish dates for activity CS7000052 "ORA Support" to Start: 12/8/2014 Finish 12/12/2014.	8/26/2014	3 Project Manager		11028	\$88,345	\$5,964	Approved
124	1.1	1002	In Control Account 1002 delete activities associated with preparing/installing new Passive Plates in machine. Installation will cause negative impact on first plasma and will not be required during the first year of operations.	9/5/2014	2 Federal Project Director	-71	10957	\$88,274	\$6,035	Approved
125			NOT USED				10957	\$88,274	\$6,035	
126	1.2 1.8	2490 8200	All remaining scope in CA 9417-****-2490 and 8200 that are not required to support the CD-4 KPP's shall be charged to CA 1150-****-X890. The following exceptions are required for CD-4: Restore Gas Inj. system, Pressure Gauges, Shutter/TIV Actuators, TF/OH/PF3/PF5 Rogowski Coils, ECH Preionization System	9/5/2014	2 Federal Project Director	-334	10623	\$87,940	\$6,369	Approved
127	1.7	7200	In Control Account 7200 CSU Management add LOE task for oversight through January 2015.	9/12/2014	2 Federal Project Director	37	10660	\$87,977	\$6,332	Approved
128	1.7	7300	In Control Account 7300 NB2 Management add LOE task for oversight through December 2014.		3 Project Manager	31	10691	\$88,008	\$6,301	Not yet submitted for Approval
129	1.7	7100	In Control Account 7100 delete activity CS7000052 "ORA support". This activity will not be required.	8/26/2014	2 Federal Project Director	-111	10580	\$87,897	\$6,412	Approved
130	1.1	1302 1305	Move activities: 1305-8800A, 1305-8800B, 1305-8800G, 1305-8800H from Control Account 1305 to 1302. These activities are for the U/L crown installs and the bulkhead fittings which were put in the wrong Control Account in a previous ECP.	9/5/2014	3 Project Manager		10580	\$87,897	\$6,412	Approved
131	1.7	7100	In Control Account 7100 add LOE hours to support Project Management activities through February 2015.	9/15/2014	2 Federal Project Director	403	10982	\$88,299	\$6,010	Approved
132	1.1	1302	In Control Account 1302 delete activity 1302-1600 "Tear down assembly area". This activity to be performed by NSTXU Operations. Job 1302 may be closed as a result.	11/6/2014	2 Federal Project Director	-55	10928	\$88,245	\$6,064	Approved
133	1.8	8250	Add the following activities in 8250: 1. Re-machining of TF lead extensions per request of Engineering 2. Health Physics coverage for 8250 tasks	11/6/2014	2 Federal Project Director	344	11272	\$88,589	\$5,720	Approved
134	1.6	6100	The cancellation of the (WBS5) FCPC Fault Detector project has cancelled (WBS6) planned CAMAC retirement, so this ECP will supplement the remaining CAMAC memory.	11/24/2014	2 Federal Project Director	28	11299	\$88,616	\$5,693	Approved
135	1.2	2475	Delete the following activities that are not required for NSTXU CD-4 2475-0170D Update Display Software \$55,651.20 2475-0136 Protective Plate Interlocks (I/P Pryometer/Cam) \$37,033.20 2475-0138 NBOS Station - Installation \$29,931.20	3/30/2015	2 Federal Project Director	-123	11177	\$88,494	\$5,815	Approved
136	1.7 1.8	8250 7100	Add planning packages to cover scope required to recover from NSTXU arc event. A planning package of \$100K for Control Account 7100 and \$500K for Control Account 8250.	5/28/2015	2 Federal Project Director	600	11777	\$89,094	\$5,215	Approved



# Appendix G

## Transition to Operations Plan



### Transition to Research on NSTX-U

Coll of Wm & Mary  
Columbia U  
CompX  
General Atomics  
PTU  
Johns Hopkins U  
LANL  
LLNL  
Lockstar  
MIT  
Lehigh U  
Nova Photonics  
ORNL  
PPPL  
Princeton U  
Purdue U  
SNL  
Therak Tank, Inc.  
UC Davis  
UC Irvine  
UCLA  
UCSD  
U Colorado  
U Illinois  
U Maryland  
U Rochester  
U Tennessee  
U Tulsa  
U Washington  
U Wisconsin  
X Science LLC

**Stefan Gerhardt**  
Research Staff  
Head of Experimental Research Operations

**NSTX-U CD-4 Closeout**  
**B-318**  
**September 2<sup>nd</sup>, 2015**



Culham Sci Ctr  
York U  
Chubu U  
Fukui U  
Hiroshima U  
Hyogo U  
Kyoto U  
Kyushu U  
Kyushu Tokai U  
NAPS  
Nagoya U  
U Tokyo  
JAEA  
Inst for Rust Res, Kiev  
Joffe Inst  
TRIUMF  
Chondok Natl U  
NFRB  
KAUST  
POSTECH  
Seoul Natl U  
ASIPP  
CERN  
POKIST DIPP  
ENEA, Frascati  
CEA, Cadarache  
IPP, Jülich  
IPP, Garching  
ASCR, Czech Rep


### Outline

- NSTX-U scientific goals
- NSTX-U CD-4 plasma results
- NSTX-U organization
- Outline of the first experimental campaign

# Appendix G

## Transition to Operations Plan (continued)

### Outline

- NSTX-U scientific goals 
- NSTX-U CD-4 plasma results
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 NSTX-U

CD-4 Class-Out - Transition to Operations, S. Gerhardt (9/2019)

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### Five Year Plan Described Five Highest Priority Research Goals

#### Present Upgrade

#### Future Upgrade (See Backup Slides)

- Demonstrate 100% non-inductive sustainment at performance that extrapolates to  $\geq 1\text{MW/m}^2$  neutron wall loading in FNSF**
  - 2<sup>nd</sup> neutral beam, higher TF
  - Cryopump (future upgrade), NCC (future upgrade)
- Access reduced  $\nu^*$  and high- $\beta$  combined with ability to vary  $q$  and rotation to dramatically extend ST physics understanding**
  - 2<sup>nd</sup> neutral beam, higher TF, higher  $I_p$
  - Cryopump (future upgrade), NCC (future upgrade)
- Develop and understand non-inductive start-up and ramp-up (overdrive) to project to ST-FNSF with small/no solenoid**
  - 2<sup>nd</sup> neutral beam, higher TF
  - ECH (future upgrade)
- Develop and utilize high-flux-expansion "snowflake" divertor and radiative detachment for mitigating very high heat fluxes**
  - Expanded PF-1 coil set, new divertor gas injectors
- Begin to assess high-Z PFCs + liquid lithium to develop high-duty-factor integrated PMI solutions for next-steps**
  - Metal PFCs and flowing lithium systems (future upgrades)

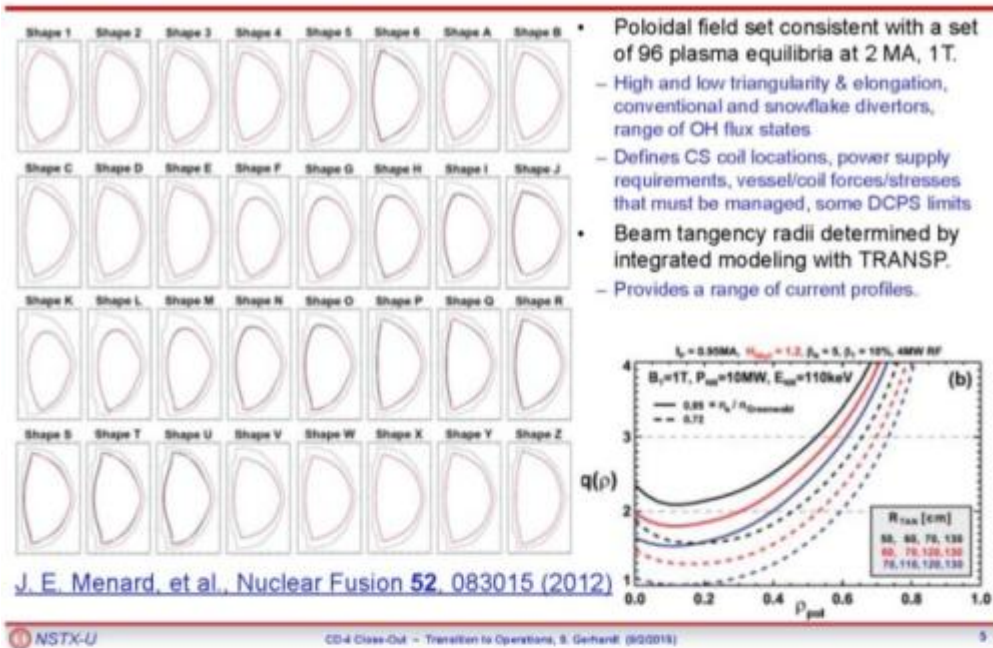
 NSTX-U

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# Appendix G

## Transition to Operations Plan (continued)

### Engineering Design Driven By Physics Considerations




## Long-Term Research Agenda For NSTX-U is Defined in the 5-Year Plan

- Available on the web at:
- <http://nstx-u.pppl.gov/five-year-plan/five-year-plan-2014-18>
- 11 Chapters, written by the entire NSTX-U team, describing
  - the research goals
  - future upgrades to the facility
- Reviewed over three days in May 2013.
- Accepted by DoE.

## Appendix G

### Transition to Operations Plan (continued)

#### Outline

- 
- NSTX-U scientific goals
  - NSTX-U CD-4 plasma results 
  - NSTX-U organization
  - Outline of the first experimental campaign

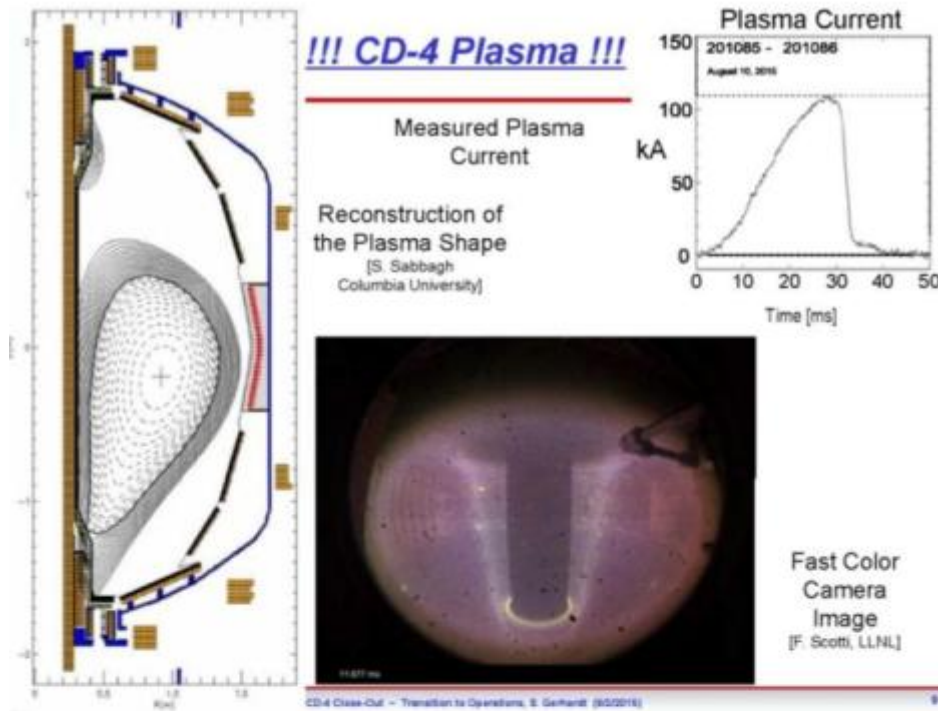
#### CD-4 Run-Up

- 
- **[8/3/2015]** ES&H Executive Board accepted the ACC recommendation to restart the facility.
  - **[8/4/2015]** Begin the coil system Integrated Systems Test Procedure (ISTP-001)
    - [8/4/2015] Complete Coil High-Pots
    - [8/5/2015-8/7/2015] Single Coil Test Shots
    - [8/10/2015] Combined Field Test Shots
  - **[8/10/2015]** Begin plasma operations under XMP-100.
    - Achieve 100 kA of plasma current
  - **[8/11/2015 & 8/12/2015]** Continued operation on XMP-130.
    - Achieve ~140 kA, improve plasma positioning.

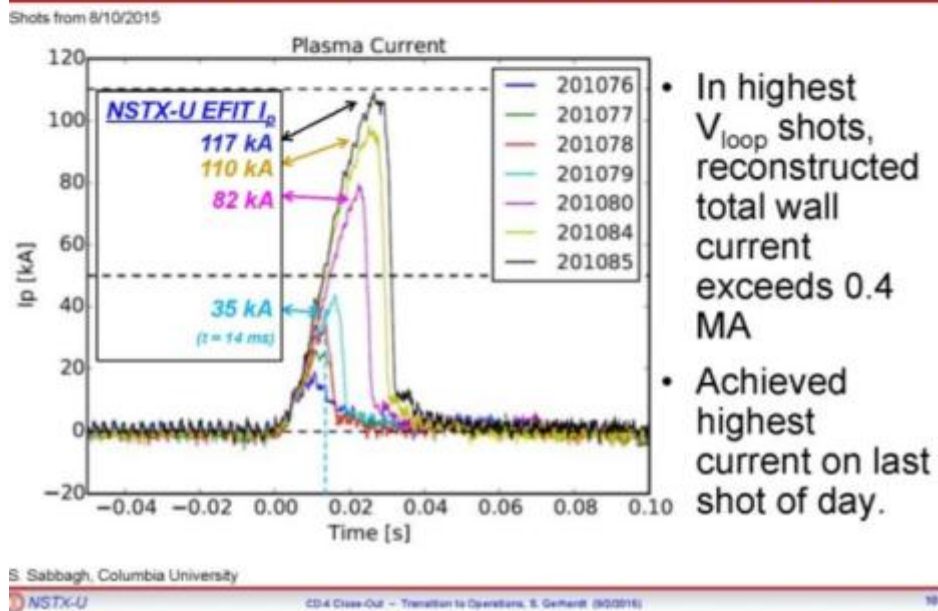


## Appendix G

### Transition to Operations Plan (continued)



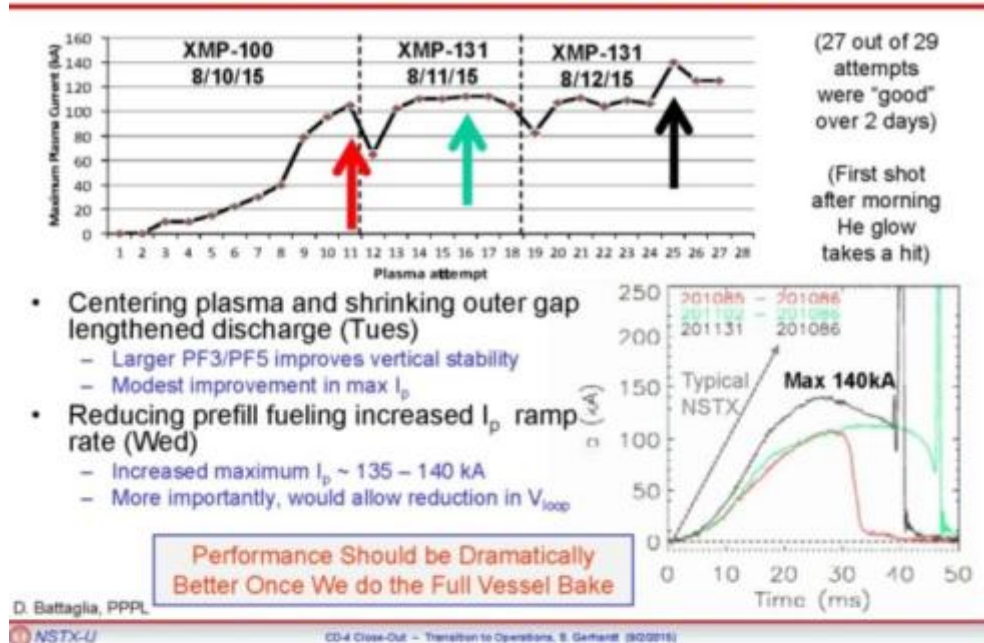
**Measured, compensated plasma current compares well to NSTX-U EFIT reconstructed current on CD-4 day.**



# Appendix G

## Transition to Operations Plan (continued)

### Continued Improvement in Plasma Current and Duration in Sixteen Plasma Shots over 1.5 Days



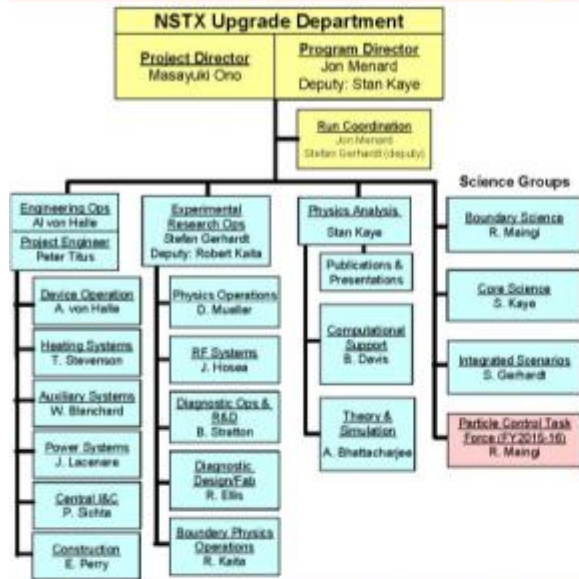
## Outline

- NSTX-U scientific goals
- NSTX-U CD-4 plasma results
- NSTX-U organization ←
- Outline of the first experimental campaign

## Appendix G

### Transition to Operations Plan (continued)

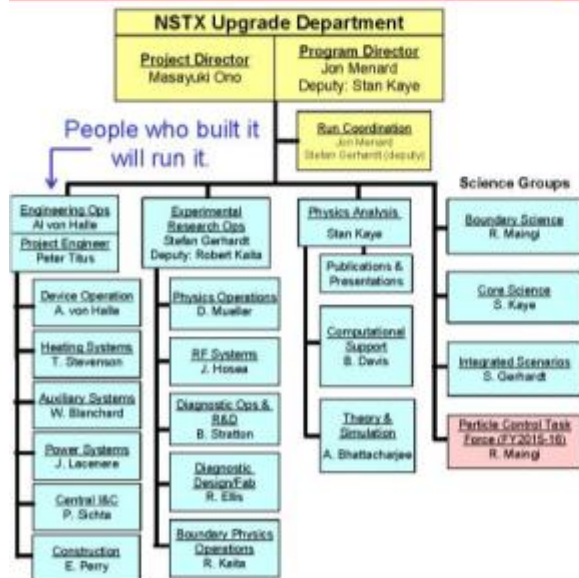
#### NSTX-U Experimental Program Organizational Structure is Clearly Defined



NSTX-U

CD-4 Close-Out - Transition to Operations, S. Gerhardt (9/2016)

#### NSTX-U Experimental Program Organizational Structure is Clearly Defined



NSTX-U

CD-4 Close-Out - Transition to Operations, S. Gerhardt (9/2016)

This structure defines  
i) science program, &  
ii) engineering/operations structure to execute the activities.

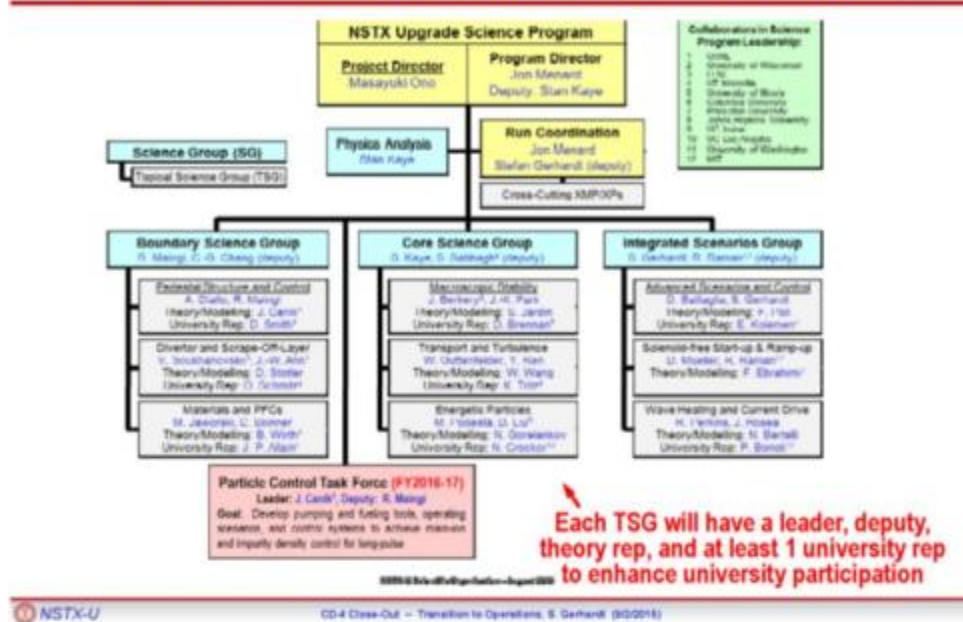
Actual design, fabrication, & construction activities accomplished by PPPL engineering via their procedures and processes.



# Appendix G

## Transition to Operations Plan (continued)

### NSTX-U Research Program Is Organized Along 3 “Science Groups” and 9 TSGs for the FY15 run



## Many Non-Upgrade Tasks Have Been Undertaken to Prepare for the Run

- Crucial diagnostics
  - Many upgrades to the magnetic diagnostics
  - Large changes to the critical Thomson scattering systems successfully implemented
  - All major profile diagnostics installed and calibrated.
  - Many new or upgraded diagnostics...
- Upgrades to the High Harmonic Fast Wave (HHFW) antenna.
- New boronization systems with improved safety features.
- New plasma control computers and many algorithm upgrades

## Appendix G

### Transition to Operations Plan (continued)

#### Daily Operations Directed by Experimental Proposals (XPs) and Experimental Machine Proposals (XMPs)

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XPs	XMPs
<ul style="list-style-type: none"> <li>• Describe experiments to answer science questions</li> <li>• Governed by OP-ADX-03</li> <li>• Reviewed by               <ul style="list-style-type: none"> <li>– topical science group</li> <li>– run coordinator</li> </ul> </li> <li>• Typically described 1/2-2 days of machine operations</li> <li>• Expectation that that each XP will lead to a publishable result</li> </ul>	<ul style="list-style-type: none"> <li>• Describe experiments to qualify new machine capabilities</li> <li>• Governed by OP-ADX-02</li> <li>• Reviewed by               <ul style="list-style-type: none"> <li>– physics operations branch head</li> <li>– research operations division head</li> </ul> </li> <li>• Typically describe ½ -1 day of machine operations</li> <li>• Expectation is that each XMP will facilitate multiple XPs.</li> </ul>

#### XPs and XMPs Defined at the Research Forum, then Further Refined

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- Research Forum was held at PPPL Feb. 24<sup>th</sup>-27<sup>th</sup>
  - 127 billion (??) proposals presented in Topical Science Group and Science Group breakout sessions.
  - Initial prioritizations performed.
  - Initial XP sequencing defined.
- Now in the process of reviewing and finalizing XPs and XMPs.
  - ? XMPs have been approved, ?? more in active development.
  - ?? XPs have been approved.
  - These are sufficient for the first ~2 months of the run campaign

## Appendix G

### Transition to Operations Plan (continued)

#### Outline

- NSTX-U scientific goals
- NSTX-U CD-4 plasma results
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NSTX-U CD-4 Close-Out – Transition to Operations, S. Gerhardt (8/2/2015) 19

#### Sequence From CD-4 To Full Research is Well Defined

- Phase 1 Coil Testing ✓
  - Commission TF, OH, PF coil systems required for CD-4.
- CD-4 ✓
- Phase 2 Coil Testing: ✓
  - Do remaining coils for magnetics calibrations
- Small Vent ✓
- MPTS Rayleigh-Raman ✓
- Bakeout ✓
- Phase 3 Coil Testing
  - Prepare for Commissioning/Startup Phase
- Commissioning/Startup Phase
- Research Ops
- Phase 4 Coil Testing
  - Increase to full fields for research phase
- Final Research Operations



NSTX-U CD-4 Close-Out – Transition to Operations, S. Gerhardt (8/2/2015) 20



# Appendix G

## Transition to Operations Plan (continued)

### The NSTX-U Research Program Will Initiated By a Sequence of XMPs

- XMPs for pre-plasma calibrations (3)
- XMPs to reestablish basic “L-mode” plasma operations (7).
- XMPs for “H-mode” access and advanced plasma boundary control (5)
- XMPs for additional control development and initial diagnostic checkout (6)
- XMPs for advanced diagnostic checkout (6)

***At the completion of this list, we will be ready to execute the critical XPs ( $I_p$  &  $B_T$  Scaling, Characterization of the 2<sup>nd</sup> NB Line)***

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CD-4 Close-Out - Transition to Operations, S. Gerhardt (8/5/2015)

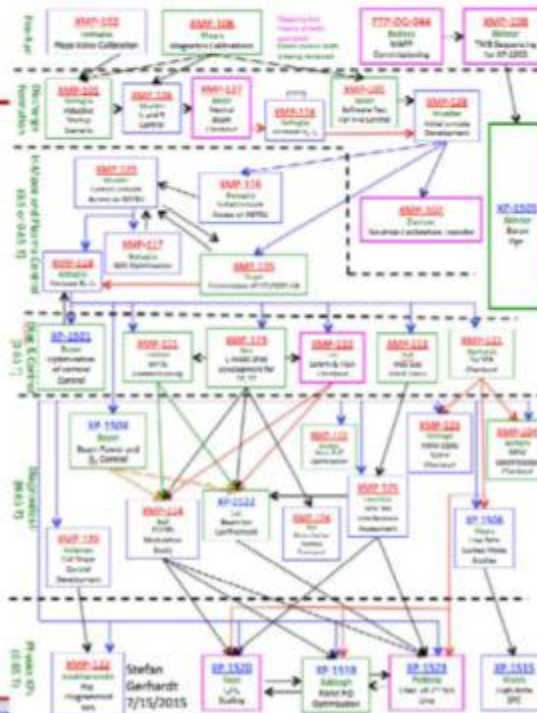
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#### The Linkages of the First XMPs and XPs Have Been Defined

- Obviously, not going to discuss this in detail.
- Engineering requirements are consistent with present facility plans.
  - 2 beam boxes
  - Full set of TF, OH, PF coils
    - TF to 0.65 T.
  - 6 SPAs (for RWM coils)
  - Boronization

NSTX-U

CD-4 Close-Out - The



## Appendix G

### Transition to Operations Plan (continued)

#### Physics Operations Staff+Collaborators Will Be Ready to Execute the NSTX-U Research Program

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- Three NSTX physics operators will return to NSTX-U.
  - D. Mueller is a world-recognized tokamak driver.
    - Operated TFTR
    - Has collaborated on EAST and K-STAR control development over the last year.
  - D. Battaglia has spent the last 2 years as a DIII-D operator
    - Was responsible for the CD-4 XMPs
  - R. Raman (U. of Washington) provides leadership in CHI, MGI areas + physics operations.
- D. Mueller holding a physics operator course.
  - ½ in July, ½ in September.
  - Plan to train an additional 2-3 physics operators.
  - Slides for course:
    - [http://nstx.pppl.gov/DragNDrop/Operations/Physics\\_Operations\\_Course/](http://nstx.pppl.gov/DragNDrop/Operations/Physics_Operations_Course/)
- Major diagnostics have primary and backup support.

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CD-4 Close-Out – Transition to Operations, S. Gerhardt (9/2/2015)

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#### Summary: NSTX-U is Well on the Way To an Exciting First Run Campaign

---

- Upgrade was designed to facilitate the research program.
  - And successfully built (Ron's talk).
- The CD-4 plasma activity was very successful.
- The scientific program and management team are in place to develop and exploit the facility.
- The sequence of events leading to research operations is well defined, and we are well along the way.

NSTX-U

CD-4 Close-Out – Transition to Operations, S. Gerhardt (9/2/2015)

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# Appendix H

## Lessons Learned

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
1	1.5	O	Management/Organization	DCPS was a project unto itself and had too many conflicting “cooks” spoiling the soup. The specifications and requirements changed very late in the project after our main FDR. The functional organization stepped in and inappropriately communicated ways yet made key improvements to the requirements. Software was new and made use of new tools and languages not employed at PPPL much before. Teaming among the several branches of the project was very low and communication was at times poor or non-existent except that the COG who was gifted in many areas of this project held it all together. Unfortunately we lost this COG and had to make do. Yet, the effect of this loss on this team was a cautious yet palpable coming together to finish their own scope such that the system arrived on time. The false starts, rework, changes in direction early, and the overall inefficiency cost dollars and clock time but it came together in the end.
2	1.1	O	Organization/Staffing	Better balance in assigning CAM's to scope. The centerstack design and fabrication was assigned to one CAM who was the laboratory's expert in coil manufacturing. The work scope should have been distributed to at least 3 CAM's. The failure to do so led to some oversights in procurement inspections, timely reconciliation of cooling wave analysis, more complete field supervision, and support of EVMW CAM duties. The Center stack WBS relied heavily on one senior COG who quickly became overloaded. The main bottleneck was for tooling which required a lot of attention. Some earlier support on engineering the tooling might have helped save some rework.
3	All	O	Resources	Earlier recognition of the need for an independent QC receipt inspector. During the last 20 years PPPL has reacted to budget challenges by reducing overhead cost (and staff) by transferring work scope to directly funded project staff. One of the positions eliminated was a full time QC receipt inspector whose responsibilities were transferred to the project procurement technical representative (CAM in most cases). Mid way through the project it became apparent that hardware deliveries for non critical, small hardware (at the time) did not receive timely and complete inspections. The project requested, and PPPL agreed to hire a QC inspector which offloaded the CAM's..

## Appendix H

### Lessons Learned (continued)

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
4	ALL	O	Procurement	<p>Causal Analysis – Vendor "X", Inc. February 2/8/2013.  (Detailed report available upon request) Multiple awards (6) to a new, unknown supplier for NSTX/U components resulted in unacceptable quality, rework, and/or re-award of contracts, all of which resulted in a delay in schedule for the project and additional costs. After award, one of the work activities covered by these six awards became part of the critical path and, as a result, had a significant impact on the schedule. As a result, PPPL initiated an analysis to identify the causal factors so that actions can be taken to prevent this from recurring. The root cause identified was the evaluation and oversight of the vendor was inadequate. Contributory causes were:</p> <p>A. Inadequate incoming inspections and supplier oversight due to lack of appropriate resources assigned to these procurements.</p> <p>B. Inadequate hold points/first article inspections for jobs requiring weld preparation.</p> <p>Recommendations include;</p> <ol style="list-style-type: none"> <li>1. Develop a process for the evaluation and oversight of new and unknown fabrication suppliers until adequate confidence is achieved. Such a process should consider financial stability, types of contracts to be awarded to this supplier, time frames of the contracts, performance parameters, risks associated with work to be done, references, timely feedback from first wards, etc</li> <li>2. Insure adequate staff for the timely inspection of hardware and components.</li> <li>3. Insure hold points/first article inspections, which are especially important for vacuum welds or other welds with high loads.</li> </ol>
5	All	O	Resources	<p>Key pacing resources like welding required careful handling and often became pinch points. Veteran welders were in high demand throughout the project. The PPPL Tech Shop work order system was well managed and the Work Control Center (WCC) did an outstanding job applying timely use but early training of welders in anticipation of this peak need might have eased project problems.</p>
6	ALL	O	Testing	<p>Insufficient time was budgeted for testing. The troubleshooting time always takes more than expected and should be included in future estimating considerations.</p>
7	1.7	O	Management/Organization	<p>Number of Project reviews. The time spent in preparing for, conducting and follow-up from both PPPL and DOE initiated reviews was under estimated. This project conducted 34 high level reviews that utilized over 72 externals reviewers from 22 institutions. While somewhat beneficial, impacts to project cost, schedule, and resources should be more adequately budgeted.</p>



## Appendix H

### Lessons Learned (continued)

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
8	1.7	O	Resources	Sharing the analysis engineers with the ITER project led to delays in the completion of calculations. This led to late receipt of drawings and subsequent late delivery of materials/components to the field. This required the project plans to be adjusted on a weekly basis which resulted in cost inefficiencies. While this did not impact critical paths tasks it did impact the cost and schedule for machine assembly (i.e. structural supports).
9	1.7	O	Policy/Procedures	Institutional overtime policy led to lost scheduling opportunities during those weeks that included holidays. Holidays were not counted toward the 40 hour work week calculation for premium time hence staff were not inclined to work overtime. The project schedule could have been shortened by an estimated 20 work days.
10	ALL	O	Design	Consider better management of design tolerances. Be surgical in requiring small tolerances. This will drive the vendor's procurement cost, require extensive in-house engineering time to disposition nonconformance reports (NCR's), and increase assembly time. The impact manifests itself in both increased cost and schedule stretch-out. This has been a chronic challenge on projects at PPPL. 'Better is the enemy of good enough'
11	1.1	O	Design	PPPL calculation documentation was complete and accurate but lacked clear and definitive conclusions and summaries. This led to misunderstandings and time wasted in completing designs/drawings. Crisp conclusions and design direction needs to be included in the final closing statements.
12	1.1 and 1.5	O	Resources	Personnel single point failures has led to schedule impacts when critical people were not available (due to prolonged illnesses and deaths). These could not have been anticipated but for projects spanning long periods of time they are likely to occur and should be factored into cost and schedule contingencies. Also, critical corporate skills should be identified with backup people assigned to be mentored.

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### Lessons Learned (continued)

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
13	ALL	O	Estimating	Under estimates of several skills manifested itself into resource shortages and schedule delays. The work estimating procedure should be revised to require supervisors of the skill organizations (i.e. welding, machining, field crew installation, drafting etc.) to review and provide input to all work estimates. Furthermore, technician supervisors should be required to attend design reviews to better promote value engineering. At the very least ensure early on that what is designed can be built.
14	1.1	O	Design	Some of the components designed for this project did not take as-built field conditions into consideration. Accurately manufactured parts required re-work before they could be assembled to components that did not match the NSTX CAD model. <b>Recommendation:</b> Individuals responsible for the design should engage with the field (inspect/measure the field condition and speak with operations people) to ensure that the designs for new components integrate into the imperfect, as-built conditions that actually exist.
15	All	O	Policy/Procedures	Establish a policy for field installations – when does a review have to be completed of field design. Develop field installation policy; Revise WP procedures accordingly
16	All	O	Policy/Procedures	Clarify existing Design review procedures to ensure all applicable subject matters experts are represented. The PPPL Design Review Process needs to be comprehensive, cover all important aspects or components of a work activity, and include all technical disciplines involved in the work activity. A broader review of the PPPL Design Review Process should be performed post CD--4 as part of CAP25--75(IER).
17	All	O	Management/Organization	Ensure that a full time dedicated project engineer actively oversees the design process. The project had to "share" an experienced individual which had cost and schedule implications.
18	All	O	Policy/Procedures	PPPL needs a rigorous process to ensure that each component or system is assigned to a clearly identified individual who is aware of its current and ongoing status and history, and is someone who is both capable and responsible for its technical aspects. A broader review of the PPPL use of SME's should be performed post CD--4 as part of CAP25--75(IER).

## Appendix H

### Lessons Learned (continued)

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
19	All	O	Policy/Procedures	During the design phase and after the FDR, the project needs to ensure that the review process extends to as---built configurations including field changes.
20	All	O	Policy/Procedures	Rigid adherence to established engineering procedures to prevent inadvertent installation errors.
21	1.1	O	Design	We spent too much conceptual mechanical engineering design and analysis time trying to meet the GRD full power supply recommendations and eventually had to punt and do DCPS. Recommendation would be to craft the GRD more carefully or consider ramifications sooner. CDR was extreme. For example, GRD shot spec was also over the top. 60000 full power shots eventually became 20000 shots total, 2000 full power on OH with 6000 full power plasmas. Chewed up a lot of analysis and fatigue allowables.
22	1.7	O	Management/Organization	KPP development. The PEP section 2 on KPPs should have been more concise. This led to many conversations about what was required to meet the KPPs and project completion. There were several meetings where the demonstrated performance activities were treated as "design points", when they are far below NSTX performance criteria; definitely below NSTX-U design capabilities. Additionally, scope contingency or objective scope KPP's were missing from the PEP.
23	1.2	O	Resources	On beams we had some trouble with jobs taking too long. We had some new people and bringing the crew up to speed took a lot of hard work and training. In the end though not only did we build a new beam we built a new Beam Team too.
24	ALL	O	Procurement	Ensure that supplier fabrication contracts are awarded based on best value and not best price. More thoroughly vet suppliers qualifications.
25	ALL	O	Fabrication of components.	We were burned more than once when the vendor chosen to fabricate our components did not possess the capability to perform the job correctly. <b>Recommendation:</b> we establish criteria for matching vendor capabilities to fabrication complexity. See "Procurement Lessons Learned Causal Analysis Report" under review documents.

## Appendix H

### Lessons Learned (continued)

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
26	1.1	O	Coil Molds	<p>TF Inner bundle molds with too tight-fitting around copper. Imperfect molds and imperfect copper bars resulted in quadrant and ultimately full bundle to be larger diameter than designed. This resulted in modifications to many of the parts that interfaced to the coil's over-sized diameters and also resulted in the misaligned TF connector faces. The only factor that allowed the coil to fit into the case was the fact that we had thicker ground layer around the TF Inner bundle and the OH coil. The compliance of the ground layers allowed us to "squeeze" the TF and OH coils into their molds. Conversely, if we did not have a generous ground layer we might not have been able to get the TF and OH into their molds.</p> <p><b>Recommendation:</b> If we had more fiberglass on the individual TF legs, we could have built quadrants much closer to the design dimensions.</p>
27	1.1	O	Coil VPI	<p>Plan to sand off resin rich areas from coils that VPI'd in hard molds. Allocate sufficient time in the schedule and cost estimate. Epoxy typically cures at ~100 centigrade, a temperature at which the mold had expanded, resulting with coils that have larger than nominal dimensions.</p>
28	1.4	O	Estimating	<p>An accurate global as-built model was not available at the start of design. This led to much field rework when CADD designed hardware was attempt to be fit up to the actual machine. Suggest performing detail metrology measurements and updating CADD models as a first step in the design process.</p>
29	ALL	S	Safety	<p>The attention to worker safety resulted in only 6 reportable minor injuries in over 573,000 hours worked. While we have a robust safety organization and up front Management buy-in, it came down to people not taking risks or short cuts in the name of schedule or cost. The safety culture at PPPL is one of its strongest assets.</p>

## Appendix H

### Lessons Learned (continued)

<u>LL Number</u>	<u>WBS</u>	<u>Success or Opportunity</u>	<u>Category</u>	<u>Description &amp; Discussion</u>
30	1.7	<b>S</b>	Supervision	Work control center again provide real value in establishing daily communication of field activities. Support needs (QC weld inspections, Safety support for walk downs, Health Physics) were determined in this daily 10 minute meeting. This process was established during the TFTR D&D project which was successful in finishing safely on schedule and \$3.6M under budget.
31	1.7	<b>S</b>	Scope	Be clearer in establishing project scope by establishing clear "fences" around the project scope. Define what's excluded as well as what's included. Also, document potential scope contingency as part of the CD-2 base lining requirement. The project benefited by establishing scope contingency source terms some of which was utilized (and documented) which save time and money.
32	1.7	<b>S</b>	EVMS	<b>EVMS the good:</b> monthly statusing methodology adopted, CPR reports, change control mandated good discipline. <b>EVMS an Opportunity:</b> However, the requirement for written variance analysis reports provide little value to the project management office. Causes of cost and schedule variances were discussed real time during the formal monthly status meeting. Staffing issues that drove schedule slippages were resolved many times by the PPPL engineering division and department heads that were in attendance.
33	All	<b>S</b>	Policy/Procedures	Adherence to PPPL engineering procedures eng-033 provided discipline in the design process. However, the project provided additional requirements that; 1) provided for tracking and QA verification of design review chits and 2) Required calculations to be signed by the cog engineer whom was the ultimate customer
34	1.7	<b>S</b>	Management /Organization	Project was very well organized from the beginning. We have an excellent, very strong project team. We had excellent project initiation, requirements were well defined if over the top here and there, and the work planning and WAFs were outstanding. Project Controls went very well. Project status and EVMS went nearly flawlessly. We were very well supported by the NSTX program as well ( Masa and Jon as well as Stefan)
35	ALL	<b>O</b>	General	On April 24, PPPL ESU responded to alarms from the NSTX-U experimental area. An active water leak from NSTX-U was observed. Staff discovered that several of the Ohmic Heating coils external cooling paths were damaged at the top end of the OH coil. Additionally, indications of electrical arcing were observed in the vicinity of the water leaks. Initial inspection showed no damage to the OH or other coil systems. The water was secured and investigation into the cause was initiated. As a result of this event, the Laboratory has commissioned a number of reviews to evaluate the cause, determine what actions are necessary to repair the coil, what actions are necessary to improve processes and prevent recurrence. The following teams were commissioned: An Internal Independent Review team, an Extent of Condition Review Team, an Independent External Review Team, and formal Root Cause Analysis Team. Lessons learned relative to design and construction are incorporated in the above lessons learned. Additionally, since many findings and corrective actions were related to conduct of operations and machine operation, the entire corrective action report is included in its entirety in Appendix O.
36				When somebody doesn't want to be a CAM....don't make them. Need to figure out a way to have CAM really OWN their cost/schedule
37				Implement a Corrective Action Log for VARs. Once the PEP trip level is initiated, don't make CAM write VAR for something that already has Corrective Action written. This should somehow be written into the PEP to allow this (just need to make certain that something else in Control Account is not drive variance).