

NSTX-U

QUALITY ASSURANCE PLAN

NSTX-U-QAP-001-00

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NSTX-U PROJECT QUALITY ASSURANCE PLAN

1.0 INTRODUCTION & SCOPE

The Department of Energy (DOE) Princeton Plasma Physics Laboratory (PPPL) National Spherical Torus Experiment-Upgrade (NSTX-U) spherical tokamak fusion device will periodically require component repair, upgrade, or replacement, as well as the addition of new systems or components. This plan describes the quality assurance system used to control such modifications and repairs, up to and including Integrated System Testing, to NSTX-U during planned or unplanned outages.

This plan uses “Major”, “Serious,” and “Standard”, as defined in PPPL procedure ENG-032, to classify not only systems, but also items and processes.

2.0 APPLICABLE DOCUMENTS

- 2.1. DOE O 414.1, Quality Assurance
- 2.2. The PPPL Institutional Quality Assurance Plan (IQAP), EQP-004

3.0 NSTX-U QUALITY ASSURANCE (QA) PLAN

Quality assurance requirements for non-nuclear facilities are described in the DOE order on quality assurance, DOE O 414.1. The PPPL Institutional QA Plan referenced above has been approved by DOE for non-nuclear work performed at PPPL. This NSTX-U QA Plan integrates the PPPL QA Plan with implementing PPPL & NSTX-U documents to assure that an appropriate quality assurance program exists for all project work activities.

The following paragraphs start with the Quality Assurance Criteria of DOE O 414.1 and then describe how the NSTX-U Project addresses them. Appendix 1 is a non-exclusive listing of key implementing documents for each criterion.

- 3.1. Management/Program – The current NSTX-U Management structure is defined in the organization chart posted on the NSTX-U Recovery home page. Management processes are defined in the PPPL Project Management System Description and this plan.
 - 3.1.1. PPPL Procedure ENG-029, Technical Definitions & Acronyms, includes definitions of the following positions:
 - Cognizant Individual (COG): The individual selected by the RLM to plan and expedite work safely using the Work Planning system, ECNs, procedures, and Design verification, as well as ES&H Directive 5008, and other lab policies and procedures. The COG is responsible for the work process and conduct per ENG-032 Work Planning and associated ENG procedures.
 - Responsible Line Manager (RLM): The manager who accepts responsibility for the work and the planning process leading to the performance of the work. This includes accepting responsibility for the change and the process leading to the change and all associated procedure changes. These individuals are identified by the Department Heads.

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- System Engineer: The individual assigned responsibility by line management for a specific system, such as the C-Site Motor Control System. A list of approved system engineers is available on the Engineering Department web page
 - a) For the NSTX-U Recovery Project, the RLM is the NSTX-U Engineering Director, with the Deputy Engineering Director functioning as an alternate.
 - b) For the NSTX-U Recovery Project, the Responsible Engineer (RE) is defined as the engineer designated as responsible for one of the Organizational Breakdown Structures (OBS) defined for the Recovery Project. It is recognized that the position overlaps with other responsibilities in practice, with some RE's also functioning as COG's or System Engineers, as described above, and also as Cost Account Managers (CAMs).
- 3.1.2. When the specified approving individual is not available and an alternate has not been designated, signature authority is moved up the organization chart.
- 3.2. Training – In addition to the Department and Division Training Matrices and training required by each procedure, NSTX-U personnel shall:
- 3.2.1. Complete training (read-only or classroom) on this plan.
 - 3.2.2. Complete the on-line Conduct of Operations training.
 - 3.2.3. Complete the training defined in procedure OP-NSTX-012, if NSTX-U Test Cell access is required.
- 3.3. Quality Improvement – NSTX-U shall use the existing PPPL procedures with no added NSTX-U requirements.
- 3.4. Documents & Records – NSTX-U shall comply with the records and documentation requirements of PPPL procedures.
- 3.4.1. In all cases, NSTX-U personnel shall assure that there are records generated, clearly identified, assembled, and transmitted to the Ops Center for all tests, inspections, and verifications done for component or system acceptance.
 - 3.4.2. Numbering schemes, approval requirements, and storage locations for documents and records are in Appendix 2.
- 3.5. Work Processes – NSTX-U shall use the existing PPPL procedures along with procedure D-NSTX-OP-AD-129, Work Control Center Operating Procedure. Where additional procedures are required at the Project level, they will comply with Appendix 2.
- 3.6. Design: – NSTX-U shall use the existing PPPL procedures with the following additions:
- 3.6.1. Calculations –
 - c) For NSTX-U, formal calculation checks shall be required and specified in Work Planning Forms for any calculation used to support a design decision.
 - d) Calculations shall be entered in NSTX-U Calculation Log.
 - 3.6.2. Design Reviews –
 - a) The NSTX-U Engineering Director will approve the Design Review Board membership.

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- b) For Final Design Reviews and Design Verification and Validation Reviews, the review documentation shall be submitted to the reviewers no less than one week prior to the review. Reviewers are encouraged to respond with questions and CHITS prior to the review.
- c) For each design review, the COG shall summarize the review in a Design Review Report identifying scope of review, supporting documentation presented, issues raised with their resolution, and outcome including any unresolved issues. The Design Review Report shall be reviewed for acceptance by the NSTX-U Engineering Director.

3.6.3. Design Changes –

- a) The NSTX-U Engineering Director, as RLM, is the approval level for drawing (design) changes. They shall either approve the requested change (documented on an Engineering Change Notice per ENG-010) or refer it to an NSTX-U Change Review Board (CRB). To accommodate shift work for NSTX-U, the RE may make and implement a minor change with a redlined drawing in accordance with the ENG-010 criteria, “minor and within the scope and context of all reviews that apply”. The RE must obtain the RLM (NSTX-U Engineering Director) concurrence signature on an ECN for the change by the end of the next work day.
- b) The NSTX-U CRB shall consist of the RE’s with engineering interfaces to the change under consideration, the Engineering Analysis Branch Head, QA, and ESH. The NSTX-U Engineering Director is the CRB Chair, who accepts or rejects the change.

3.7. Procurement – NSTX-U shall use the existing PPPL procedures with the following additions for items classified as Major or Serious using Table 1 of ENG-032. This includes custom fabrications and materials for such items. The NSTX-U Engineering Director can make exceptions based on their evaluation of associated risk.

- 3.7.1. Items shall not be purchased until the associated Design Review is completed unless explicit, written direction is given by the NSTX-U Engineering Director or the NSTX Recovery Project Head.
- 3.7.2. Items shall be purchased using the requisition system with QA Review required. Where the NSTX-U Engineering Director makes an exception for urgently needed items, documented acceptance processes for such items must be agreed upon with Quality Assurance.
- 3.7.3. Items shall be purchased with appropriate pedigree – Certified Material Test Report (usually for metals), Certificate of Analysis (common for powders and ceramics), or Certificate of Authenticity (statement that the item is the specified product). Ancillary common commercial parts without Major or Serious implications need not have such documentation.
- 3.7.4. Items and materials, other than common commercial parts without Major or Serious implications, shall have documented receipt inspection. “Receipt Inspection Required” shall be selected on the requisition.

3.8. Inspection and Acceptance Testing –

- 3.8.1. Major or Serious items, and parts for such items, which are fabricated in-house shall have a documented plan for required inspections, tests and verifications, as well as formal, documented reports of the results.

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- 3.8.2. The RE and QA shall agree on when witnessing (Hold Point required) or verification (review of data after the fact) is appropriate and on the appropriate independent witness/verifier (QC or a subject matter specialist).
 - 3.8.3. Calibrated inspection, measuring, and test equipment shall be used for Major and Serious system or component acceptance and shall have been calibrated at a frequency appropriate to the equipment, but not to exceed 1 year.
 - 3.8.4. Records of acceptance inspections and tests shall document, at minimum, the calibrated M&TE used, the printed name and signature of the individual leading the inspection or test, the date, and the results.
- 3.9. Management Assessment – NSTX-U shall use the existing PPPL procedures and such data sources as Key Performances Indicators (KPIs), management status meetings, and reviews.
- 3.10. Independent Assessment – NSTX-U shall use the existing PPPL procedures plus DOE and other external (peer) reviews.
- 3.11. Suspect/Counterfeit Items – NSTX-U shall use the existing PPPL program restrictions and requirements.

NSTX-U Project Quality Assurance Plan
APPENDIX 1 – KEY IMPLEMENTING DOCUMENTS FOR NSTX-U

DOE O414.1 Requirement

Applicable Documents

<p><u>1.0, Management /Program</u></p> <p>(a) Establish an organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.</p> <p>(b) Establish management processes, including planning, scheduling, and providing resources for the work.</p>	<p>NSTX-U Project Organization Chart</p> <p>PPPL Project Management System Description (EQP-009)</p> <p>This QA Plan</p>
<p><u>2.0, Management /Personnel Training and Qualification</u></p> <p>(a) Train and qualify personnel to be capable of performing their assigned work.</p> <p>(b) Provide continuing training to personnel to maintain their job proficiency.</p>	<p>Policy P-008, Staff Training, Education, and Development</p> <p>TR-006, Establishing Qualification and Certification Requirements</p> <p>Department, Division and Project Training Matrices</p> <p>OP-NSTX-012, NSTX-Operations Training</p>
<p><u>3.0, Management /Quality Improvement</u></p> <p>(a) Establish and implement processes to detect and prevent quality problems.</p> <p>(b) Identify, control, and correct items, services, and processes that do not meet established requirements.</p> <p>(c) Identify the causes of problems, and include prevention of recurrence as a part of corrective action planning.</p> <p>(d) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement.</p>	<p>PPPL Assurance System Description</p> <p>QA-005, Control of Nonconformances</p> <p>QA-012, Corrective Action Request</p> <p>QA-019, Root Cause Analysis/Extent of Condition Analysis</p> <p>QA-023, Design and Improvement of Processes</p> <p>QA-025, Management Assessments</p> <p>GEN-029 Investigation and Follow-up of Adverse Events and Conditions</p> <p>GEN-006, Investigation and Follow-up of Adverse Events and Conditions including Occurrence Reporting and Price Anderson Amendment Act Reviews</p> <p>GEN-011 ES&H Deficiency Reporting</p> <p>ENG-030, PPPL Technical Procedures</p> <p>ENG-033, Design Verification</p>
<p><u>4.0, Management /Documents and Records</u></p> <p>(a) Prepare, review, approve, issue, use, and revise documents to prescribe processes, specify requirements, or establish design.</p> <p>(b) Specify, prepare, review, approve, and maintain records.</p>	<p>Most PPPL procedures have requirements for documents and records. The key procedures are:</p> <p>GEN-001, Policy, Procedure, and Mission Statement Development, Review, and Approval</p> <p>GEN-003, Document Distribution Control</p> <p>GEN-023, Records Management</p> <p>ENG-010, Control of Drawings, Software, and Firmware</p>

NSTX-U Project Quality Assurance Plan
APPENDIX 1 – KEY IMPLEMENTING DOCUMENTS FOR NSTX-U

DOE O414.1 Requirement

Applicable Documents

<p><u>5.0, Performance /Work Processes</u></p> <p>(a) Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements using approved instructions, procedures, or other appropriate means.</p> <p>(b) Identify and control items to ensure proper use.</p> <p>(c) Maintain items to prevent damage, loss, or deterioration.</p>	<p>ENG-010, Control of Drawings, Software, and Firmware</p> <p>ENG-012, Identification and Control of Items</p> <p>ENG-014, Hydrostatic and Pneumatic Testing</p> <p>ENG-030, PPPL Technical Procedures for Experimental Facilities</p> <p>ENG-032, Work Planning Procedure</p> <p>ENG-037, General Welding and Brazing Requirements</p> <p>ENG-055, Conduct of Operations</p> <p>OP-AD-39, Conduct of Operations</p> <p>PPPL Engineering Standards</p> <p>P-072, Independent Verification</p> <p>P-086, Specifying, Using and Calibrating Measuring and Test Equipment</p> <p>D-NSTX-OP-AD-129, Work Control Center Operating Procedure</p>
<p><u>6.0, Performance /Design</u></p> <p>(a) Design items and processes using sound engineering/scientific principles and appropriate standards.</p> <p>(b) Incorporate applicable requirements and design bases in design work and design changes.</p> <p>(c) Identify and control design interfaces.</p> <p>(d) Verify or validate the adequacy of design products using individuals or groups other than those who performed the work.</p> <p>(e) Verify or validate work before approval and implementation of the design.</p>	<p>PPPL Engineering Standards</p> <p>ENG-010, Control of Drawings, Software, and Firmware</p> <p>ENG-033, Design Verification</p> <p>IT-010, Configuration Change Control Procedure (for IT Department only)</p>
<p><u>7.0, Performance /Procurement</u></p> <p>(a) Procure items and services that meet established requirements and perform as specified.</p> <p>(b) Evaluate and select prospective suppliers on the basis of specified criteria.</p> <p>(c) Establish and implement processes to ensure</p>	<p>PPPL Procurement Policies and Procedures Manual</p> <p>P-072, Procurement Assurance</p> <p>QA-003, Procurement Quality Assurance</p> <p>ENG-006, Preparation, Review, and Approval of Specifications and Statements of Work</p> <p>QA-020, Identifying and Dispositioning Suspect Parts</p> <p>ENG-012, Identification & Control of Items</p>

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APPENDIX 1 – KEY IMPLEMENTING DOCUMENTS FOR NSTX-U

DOE O414.1 Requirement

Applicable Documents

<p><u>8.0, Performance /Inspection and Acceptance Testing</u></p> <p>(a) Inspect and test specified items, services, and processes using established acceptance and performance criteria.</p> <p>(b) Calibrate and maintain equipment used for inspections and tests.</p>	<p>QA-004, PPPL Site Inspection Program</p> <p>ENG-014, Hydrostatic and Pneumatic Testing</p>
<p><u>9.0, Assessment /Management Assessment</u></p> <p>Ensure that managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives.</p>	<p>QA-025, Management Assessments</p>
<p><u>10.0, Assessment /Independent Assessment</u></p> <p>(a) Plan and conduct independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement.</p> <p>(b) Establish sufficient authority and freedom from line management for independent assessment teams.</p> <p>(c) Ensure persons who perform independent assessments are technically qualified and knowledgeable in the areas to be assessed.</p>	<p>QA-002, PPPL Audit Program</p>
<p><u>11.0 Suspect/Counterfeit Items</u></p> <p>An S/CI prevention process must be developed and implemented as part of the contractor’s QAP and must be commensurate with the facility/activity hazards and mission impact.</p>	<p>P-041, Suspect Parts</p> <p>QA-020, Identifying and Dispositioning Suspect Parts</p>

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APPENDIX 2 – NSTX-U DOCUMENTS & RECORDS

1.0 PURPOSE

This Appendix defines the official documents and records for the NSTX-U Project. This Appendix defines the purpose, content, required review and approvals and file/document naming convention for each document and record.

2.0 DOCUMENTS AND RECORDS

The official documents and records are defined in Table 1. For each document or record, the following is given:

- a. Purpose - This gives the purpose of the document. If relevant, this also defines the circumstances under which the document may serve as an official NSTX-U record.
- b. Review and Approval - This defines the required review and approval for the specified document. The NSTX-U philosophy is to limit the number of approvals to as few as is reasonable, however appropriate content specialists such as ES&H, and QA shall be reviewers where the subject has implications for their areas of specialty. Revisions are uniquely identified and undergo the same level of review and approval as the original document. *Note that some of these documents were issued prior to release of this plan. Review and approval requirements apply only to new or revisions of these documents.*
- c. Naming Convention - This specifies both the identifier for the document and the name of the file containing the document.

The following items apply to all NSTX-U documents and records, as relevant:

- a. For documents or records with the characters "OBS" in the name specified in Table 1, substitute the OBS abbreviation from the following list.
 - VV & Internal Hardware (VV+IH)
 - Magnets (MAG)
 - Vacuum & Fueling Systems (V+F)
 - Cooling Systems (COOL)
 - Power Systems (PWR)
 - Heating Systems (HEAT)
 - Realtime Control & Protection (RTC+P)
 - Central I & C (I+C)
 - Bakeout System (BAKE)
 - Diagnostics (DIAG)
 - Test Cell (TC)
- b. The "sss" in the naming convention refers to a sequence number that is assigned by the NSTX-U Document Administrator. Each number is assigned once and only once. It is desirable that the

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APPENDIX 2 – NSTX-U DOCUMENTS & RECORDS

sequence number be assigned to a document at the time of its first official version. However, when necessary, it may be assigned in advance. In this case, if the document is later cancelled, the number is not reused but marked cancelled.

- c. The "nn" in the naming convention refers to the revision number and must be two digits, e.g. "00", "01". This allows the proper sorting of file names.
- d. For documents or records with the characters "OBS-yymmdd-name-zz" in the name,
 - yymmdd - six digit date in format year, month, day
 - name - name of author (e.g. CLN or CNeum, be consistent but limited to 7 characters max.)
 - zz - two digit sequential number assigned by the author under that OBS element (numbers restart at 1 daily)
- e. The originals of all signed documents and the originals of the review sheets (if applicable) must be filed with the NSTX-U Document Administrator. These documents and records shall be maintained by the NSTX-U Document Administrator for the lifetime of the project. Formal provisions shall be established for the retention, protection, preservation, revision, traceability, accountability, and retrievability of these documents and records.
- f. Templates for many document types are available in the Controlled Documents folder on the NSTX-U Recovery home page.

TABLE 1. NSTX-U DOCUMENTS & RECORDS

Document/Plan/Memo	Purpose	Review/Approve	Naming Convention
Project Execution Plan (PEP)	Describes management methodology to be applied during the design and construction stages of an NSTX-U project (when applicable)	Review :ED Approve: PD	NSTX-U-PEP-sss-nn
Quality Assurance Plan (QAP)	Provides matrix of PPPL quality requirements to implementing procedures	Review :ED, QA Approve: PD	NSTX-U-QAP-sss-nn
General Requirements Document (GRD)	Translates the top-level performance requirements stated in the PEP into engineering terms and provides other generally applicable engineering requirements that flow down to the various OBS elements.	Review :ED, RE*, NRH Approve: PD	NSTX-U-RQMT-GRD-sss-nn
System Requirements Document (SRD)	Used during the original NSTX construction project, defines the functional and performance requirements specific to each WBS entity. Includes Interface List (as an appendix) which reflects requirements imposed by other WBS elements.	Review :ED, RE* Approve: PD	NSTX-U-RQMT-SRD-sss-nn
Requirements Document (RD)	Defines the functional and performance requirements specific to new components or subsystems within an OBS or where a requirements document is needed for an existing component or subsystem.	Review :RE* Approve: ED	NSTX-U-RQMT-RD-sss-nn
Safety Assessment Document (SAD)	To document the Safety and Health risks involved in NSTX-U and the systems and controls implemented to mitigate them.	Review :ED, RE*, ES&H Approve: PD	NSTX-U-SAD-sss-nn

ED = NSTX-U Engineering Director, RE = NSTX-U Responsible Engineer, PD = NSTX-U Recovery Project Director, NRH = NSTX-U Research Head, QA = Quality Assurance, CS = Content Specialist, ES&H = Environmental, Safety and Health Personnel * If not initiator

TABLE 1. NSTX-U DOCUMENTS & RECORDS

Document/Plan/Memo	Purpose	Review/Approve	Naming Convention
Project Design Description (PDD)	The purpose of the PDD is to document the NSTX-U design point and its basis, to explain the OBS structure, and to explain the flow-down of requirements from the GRD and the Design Point Spreadsheet (DPSS) to the OBS systems.	Review + Approve: PD	NSTX-U-PDD-nn
System Design Description (SDD)	The purpose of the SDD is to provide an entry point into the documentation that conveys and justifies the design of an OBS system. The SDD will serve as a starting point for a reviewer, or a newcomer to the project that needs to develop a working knowledge of the system. See SDD Template	Review : RE* Approve: ED	NSTX-U-SDD-OBS-nn
Calculation	Documents calculations used in the design, organized based on WBS used during the original NSTX construction project.	Review: Per ENG-033 Approve: RE	NSTX-U-CALC-CC-sss-nn
Standards	Define standards to be used by project personnel, e.g. seismic design criteria	Review :ED, QA, CS Approve: PD	NSTX-U-STD-sss-nn
Guides	Provide additional guidance for use by project personnel, e.g. users' guides	Review : CS, QA Approve: ED	NSTX-U-GUIDE-sss-nn
Specifications	Specifies the requirements for an item to either be procured or built in-house	Per ENG-006	NSTX-U-SPEC-OBS#-sss-nn
Statement of Work (SOW)	Specifies requirements for services either to be procured or provided in-house	Per ENG-006	NSTX-U-SOW-OBS#-sss-nn
Memos	The use of memos to document engineering issues and other aspects of NSTX which need to be cited to form the basis for design and operation.	N/A	OBS#-YYMMDD-NAME-ZZ
Technical Procedures	NSTX-U Technical Procedures shall follow the requirements of ENG-030.	See ENG-030	Per ENG-030

TABLE 1. NSTX-U DOCUMENTS & RECORDS

Program Procedures	NSTX-U Programmatic Procedures shall use using the sample templates of GEN-001 as guides, to be customized as appropriate.	Review :ED, QA Approve: PD	NSTX-U-PROC-sss-nn
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ED = NSTX-U Engineering Director, RE = NSTX-U Responsible Engineer, PD = NSTX-U Recovery Project Director, NRH = NSTXU Research Head,
QA = Quality Assurance, CS = Content Specialist, ES&H = Environmental, Safety and Health Personnel * If not initiator