PPPL Quality Assurance Audit Report

To: Hutch Neilson, NCSX Project Manager
From: Charles Gentile
Subject: Audit #0314, NCSX Management Systems
Date: June 06, 2003

This report documents audit number 0314, NCSX Management Systems. For this audit there were no findings, twelve (12) observations, and nine (9) recommendations. Since there are no findings, the audit is considered closed.

Reference material pertaining to this audit is available in the audit file and may be obtained by contacting the Lead Auditor at x2139

Should you have any questions, please contact the Lead Auditor.

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Charles Neumeyer, Auditor, Engineering Judy Malsbury, Auditor, Head QA

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Charles Gentile, Lead Auditor, Engineering

Accepted by:

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Hutch Neilson, NCSX Project Manager

cc:
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Audit File 0314

AUDIT REPORT

Audit Number:	0314
Audit Name:	NCSX Management Systems
Date(s) of Audit:	4/24/03 – 5/9/03
Place of Audit:	PPPL
Auditors:	C. A. Gentile (Lead Auditor), Judy Malsbury, Charles Neumeyer
Organizations Audited:	NCSX
Individuals Contacted:	R. Simmons, W. Reiersen, R. Strykowsky, H. Neilsen, B. Nelson (ORNL), T. Brown, J. Levine, J. Chrzanowski, H. Carnevale, G. Pitonak (PAO/DOE), P. Heitzenroeder, L. Dudek, R. Templon, M. Kalish, R. Ramakrishnan
Exit Meeting:	June 5, 2003 1:30 PM Hutch Neilson's Office Present = H. Neilson, W. Reiersen, J. Malsbury, C. Gentile
References:	1. DOE O 413.3, Program and Project Management for the Acquisition of Capital Assets, Attachment 1, Contractor Requirements Document 2. DOE O 414.1A, Quality Assurance 3. DOE P 450.4, Safety Management System Policy 4. Various NCSX Plans and Procedures available at the NCSX web page (http://www.pppl.gov/ncsx/)

Executive Summary

This is the first audit of the NCSX Project. Due to the early stage of the project – it is in the preliminary design stage, there were limited records to review; as a result, the audit consisted primarily of interviews of personnel and reviews of plans and procedures. The primary purpose of this audit was to review the project's readiness for the CD-2 milestone, start of final design and finalize the cost and schedule baselines.

There were no findings for this audit. However, twelve (12) observations and nine (9) recommendations were identified. Some of these observations are significant enough for the CD-2 milestone that they should to be resolved prior to the PDR scheduled in October, 2003.

It should be noted that for some observations (documented by the Audit Team), NCSX Project Management was aware of these and had in some cases begun working on the resolution. However individuals interviewed during the audit, mostly at the WBS and working level were not aware of this.

I. Audit Overview

A. General

The primary scope of this audit is how well the project is ready for the CD-2, Approve Performance Baseline, recognizing that CD-2 has been delayed and that all the requirements have not yet been satisfied.

B. Objectives of the Audit

The performance objectives and criteria for this audit are taken from DOE O 413.3, Program and Project Management for the Acquisition of Capital Assets, Attachment 1, Contractor Requirements Document, the DOE M 413.3, Project Management for the Acquisition of Capital Assets (guidance only), and the DOE document Environmental, Safety, and Health (ES&H) Considerations for Planning and Review SC Projects (CD-1 and CD-2). They are listed in attachment 1.

C. Commendations, Findings, Observations, and Recommendations

For this audit, there were no findings, twelve (12) observations, and nine (9) recommendations.

Observations The observations are listed below. **Had the PDR already occurred, observations 1 – 3 would have been findings.**

1. The NCSX Training Matrix has not been developed nor has training on the project requirements and systems been given. Such training is required by DOE O 414.1A, Attachment 1, Contractor Requirement Document, Criterion 2 – Personnel Training and Qualification, which states:

   (a) Personnel must be trained and qualified to ensure they are capable of performing their assigned work.
   (b) Personnel must be provided continuing training to ensure that job proficiency is maintained.

   The NCSX QA Plan, Rev. 0, approved 11/08/2002 states that this implementation for this requirement is specified in the NCSX Training Matrix.

   The impact of this observation is that interviewed individuals were not aware of project requirements or systems. Some are counting on project management to help them, as needed, navigate the project requirements. However, while high level project management may have the necessary knowledge of project requirements, WBS managers are not adequately aware of these requirements. Training will be

key to effective use of the plans and procedures being developed by NCSX, since they tend to be much more rigorous than those used in the past at PPPL and they introduce much new terminology, nomenclature, and acronyms which are not familiar to PPPL staff.

Prior to this planning, procedures should be developed to translate the requirements of the plans to the steps required by individuals – what they should do with their "hands and feet".

2. The NCSX Reliability, availability, Maintainability Plan referenced in the NCSX QA Plan remains to be developed. A schedule for this plan should be developed.

3. Many extremely complex calculations are being performed for WBS 1 using complex analysis codes. Others within the project will be using the results for their designs.

   Typically the people performing these analyses are the most talented on the project within their specific areas. However, even extremely talented individuals may make mistakes that, if not detected in time, can have a significant impact on the project's success. The audit team was not provided with satisfactory answers that a method has been identified for the effective review of these analyses.

4. Concerns were identified with estimating project costs, in the context of the PDR. Specifically:

   a. With Everson out of business, are there available domestic suppliers for the convention coils? If the project needs to go international to obtain these coils, the costs may be significantly higher. If it is decided to build these coils in-house, potential staffing and schedule impacts need to be addressed.

   b. Until recently, the services of the Defense Contract Management Agency (DCMA) for on-site supplier inspections were free to PPPL. Now the Lab must pay for these. While NCSX, QA, and DOE/PAO are working on developing cost estimates for these services, this is included in the report as a reminder.

   c. The cost estimates for WBSs 2 – 6 (excludes stellerator core systems) are based on experience and will not be at the PDR level when the project itself has its official PDR. While the team recognizes that this is driven by project funding, the project should be prepared to justify its estimates. There should be a formal process in place to do an internal validation of the costs (and associated schedule) prior to the External Cost Review.

   d. Per DOE M 413.3-1, cost estimates should cover the entire project life cycle. Costs for D&D of the project have not been estimated.

   e. With the exception of WBS 4, the impact of Davis Bacon has not been considered. The project plans to resolve this before the PDR.

5. Concerns with identified with the schedule. Specifically:

a. The schedule for the project PDR has slipped, but the prototype suppliers are still expected to adhere to the original, tight schedules. The audit team questioned whether this would impact the quality of the information supplied by them. The Project should consider providing some relief to these suppliers, if there is evidence that it is needed.

b. The project needs to develop a concise list of tasks to be accomplished prior to PDR, and track progress against same. Without such a list, it is difficult to assure that the PDR is ready to be performed.

6. Concerns with staffing were identified. Specifically:

   a. The redesign and fabrication of the NSTX TF inner leg, together with the prototype NCSX modular coil winding presents two major coil fabrication projects of major importance to the laboratory. The number of experienced persons at PPPL to accomplish and support this coil fabrication work is very limited.

   b. In general at PPPL, there is limited knowledge in depth ("corporate knowledge'). For example, the individual most knowledgeable about the design and manufacturing of coils is working on both the NSTX redesign and NCSX. This could have a significant impact if key individuals were unavailable to key assignments.

7. While facility improvements are, in general, funded with the GPP process, they need to be identified as early in the design as possible to assure that they are funded and implemented prior to significant project assembly work in the NCSX Test Cell.

8. Drawing Control Issues

   a. The lack of as-built drawings and known state of the legacy equipment increases the level of risk for some tasks, e.g. meggering cables at C-site or the recent discovery that a 40' wall that was thought to be concrete is actually lead.

   b. The NCSX Documents and Records Plan (approved) and the Data Management Plan (near approval) both address the electronic generation and storage of drawings. There are a large number of existing vellum drawings that will be used by NCSX for auxiliary systems and maintained as such. Neither Plan addresses these drawings.

   c. Some of the hardware existing at C-site will remain for use by NCSX, for example, some power components. As systems and components are removed from C-Site, a system needs to be established to review drawings where they do exist for dispositioning. Some drawings may be discarded and some modified to reflect items removed. These decisions should be made by those most knowledgeable about the associated hardware and its potential use on NCSX.

   d. WBS 4 has no plans for renumbering many existing (electrical) drawings. The logic behind this decision is sound as it will lead to less confusion, but

it is inconsistent with the Data Management and Documents and Records Plans.

e. Specific procedures for the processing of the various types of drawings within NCSX - Pro/Engineer, AutoCAD, vellum, etc. should be developed.

9. Changes to shared NSTX and NCSX systems, e.g., power supplies, site utilities, etc., need to be fully understood so that a change in a shared system for one project does not inadvertently effect the other. It helps that, for these shared systems, responsibilities are assigned by system, enabling the same individuals to be responsible for the same systems on both projects.

10. The Acquisition Execution Plan, revision 2, June 28, 2002, contains a requirement in section II.K to comply with the requirements of 10 CFR 45 (Energy Conservation). This is not a valid requirement. The intended CFR is 10 CFR 435, Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings. There are no new buildings that are part of the NCSX project.

11. Plans are to wind the coils in the TFTR Test Cell. This is, however, a radiological area, requiring extra funds for addition Health Physics technicians (estimate $400,000). There is also a risk that the coils may become contaminated, requiring extra time and effort to clean up. Also, when the time comes to build a new device in the TFTR Test Cell, additional costs will have to be borne to dismantle and relocate the coil winding facility. Are there alternative sites that could be used for this work? Or, could the $400,000+ be put to better use to complete the decontamination of the Test Cell so that it is no longer a radiological area ?

12. Some of the NCSX geometry is too complex to be communicated to suppliers via paper drawings, thus models will be used. The project should assure that appropriate documented controls are established for these models.

Recommendations The recommendations are listed below.

1. Intralink is a database used to contain the approved drawings in PDF format. While the PC interface works well, problems exist with the Macintosh interface. Since much of the PPPL staff use Macintoshes, the interface should be improved.

2. NCSX plans to use the PPPL Work Planning System once field work commences. Using the electronic WP system, a user can search the WP forms by number, date opened, text in the title (new feature just added), but not by WBS number or project. The project is part of the WP system so adding a search by project should be easy. The WBS number is not part of the database and would need to be added.

3. For all major procurements, the Project should require that all documentation be provided in the native electronic format (electronic as-built drawings, word files, etc.) In addition, drawings should also be provided in pdf format. This will facilitate storage, access, and modification.

4. NCSX should consider maintenance access as a priority in laying out the machine proper, including platform etc. In the past, e.g., NSTX, access to the top of machine has been an afterthought, leading to inefficiencies and safety hazards, which could have been avoided.
5. PPPL has limited experience with the engineering of cryogenic systems, including safety issues related to the same. Interaction with other machines, e.g., C-MOD, and/or industry with more experience would be beneficial. As a minimum, engineers with ample experience in this area should review the NCSX designs.
6. Field errors are a major concern, design driver, and technical risk area. The NCSX Project is very sensitive to this and has taken measures to minimize same by choosing non-magnetic materials, enforcing low permeability on welds, maintaining stellerator symmetry in structures, minimizing structural deflections via stiff structures, minimizing temperature rise, etc.. At the same time the physics requirements place very stringent tolerances (of order 1mm) on current centers which cause concern amongst engineers. Furthermore, it may be very difficult to develop means for measuring and mapping the fields to sufficient extent and with sufficient precision to confirm adequacy of engineering systems and understand machine behavior. It may be beneficial for the Project to document its approach to these issues, making sure that requirements on engineering systems are well defined, measurable, and achievable.
7. Both the QA Order (DOE O 414.1A,Quality Assurance) and the ISM policy (DOE P 450.4, Safety Management System Policy) require continuous improvement. NCSX should develop a method for incorporating feedback from the staff to improve the systems and processes. Regular management assessments would provide an excellent means for project participants to feed back on the positive and negative aspects of their work experience on the Project.
8. Although formal value management and risk management plans are not required based on the cost to construct NCSX, much work has been done in this area. It is recommended that the project develop such plans, taking credit for work already performed.
9. C-site is not controlled with the same level of rigor as D-Site. Some of the D-site controls have been made lab wide systems, e.g., the design verification process, and some are planned to migrate to lab wide systems, e.g., the temporary modification system. It is recommended that the Engineering Department review all D-Site systems and identify those having value to NCSX. These should either be made lab wide or systems unique for NCSX should be developed.

II. History

This is the first audit of the NCSX project.

Appendix 1 - Audit Performance Objectives and Criteria

The following performance objectives and criteria will be used for this audit:

1. The prerequisites of DOE O 413.3 for CD-2 are either already satisfied or will, with confidence, be ready for CD-2. From DOE O 413.3, the prerequisites are:
   - Preliminary Design
   - Review of contractor project management system
   - Final Project Execution Plan and performance baseline
   - Independent cost estimate
   - National Environmental Policy Act documentation
   - Project Data Sheet for construction
   - Draft Preliminary Safety Analysis Report
   - Performance Baseline External Independent Review
2. When appropriate, the requirements of DOE O 413.3, Contractor Requirements Document, have been satisfied. Otherwise, appropriately detailed plans are in place to satisfy the requirements
3. Processes are in place for controlling changes to the technical, cost, and schedule baseline.
4. The ES&H Considerations for Planning and Reviewing SC [Office of Science] Projects have been appropriately included in the NCSX management systems and plans.