NCSX

Systems Engineering Management Plan

NCSX-PLAN-SEMP-00

January 12, 2005

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Systems Engineering Management Plan

Record of Revisions

Revision	Date	Description of Changes
0	1/12/2005	Initial Issue

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document has been prepared for the National Compact Stellarator Experiment (NCSX) Project to describe the systems engineering process and management practices to be utilized by the NCSX Project in accomplishing its mission. NCSX has been designated as a Major Item of Equipment (MIE) by the Department of Energy. The NCSX MIE project formally begins with Title I (Preliminary) Design and ends at first plasma.

This Systems Engineering Management Plan (SEMP) defines the processes, organization and procedures used by the NCSX MIE project to accomplish the systems engineering objectives. *It does not cover the operations phase.* Systems Engineering (SE) is a disciplined process for engineering development that started in Department of Defense programs and has evolved into a discipline that includes three main elements[1]:

- **SE Management** – applies the system engineering processes to the development of the project's design;
- **Requirements and Architecture Definition** defines the technical requirements, defines a structure (or architecture) for the project and subsystem components, and allocates these requirements to the components of the architecture; and
- **System Integration and Verification** integrates the components of the architecture at each level of the architecture and verifies that the requirements for those components are met

1.2 APPLICABLE DOCUMENTS

This SEMP draws on the documents listed below. In general, the NCSX Project (including ORNL) will follow the existing PPPL plans and procedures. Specific NCSX plans and procedures commit the project and implement the guidelines of existing relevant DOE orders specified in the PPPL Master Contract and PPPL plans, procedures, and standards. NCSX-specific procedures have been developed as needed to expand on or augment the requirements and processes defined in the relevant PPPL plans, procedures, and standards.

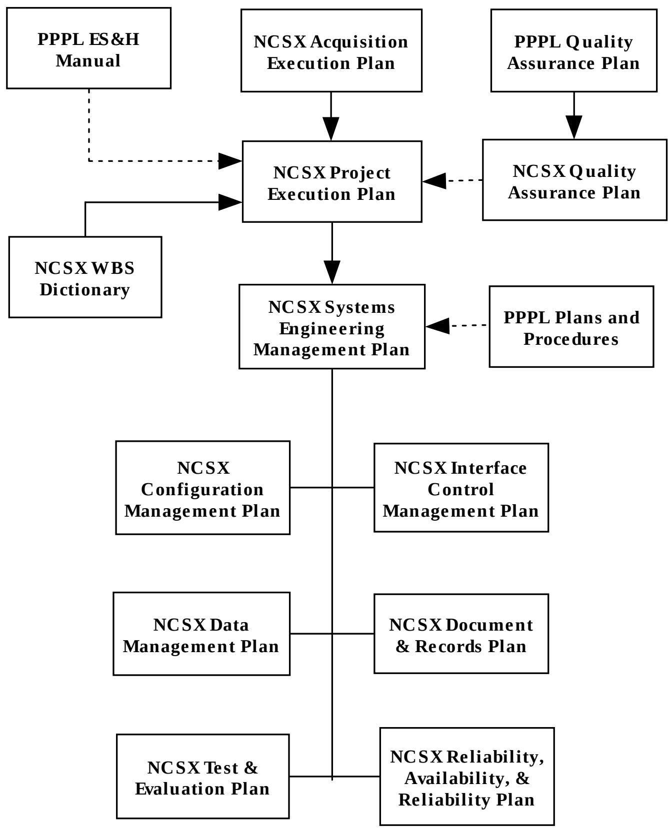
The NCSX Project has a dedicated NCSX Engineering Web Page in which each of the latest versions of these plans and applicable NCSX procedures are available. This web site is located at:

< http://ncsx.pppl.gov/NCSX_Engineering/ >

[1] Martin, J.M., *Systems Engineering Guidebook*, CRC Press, 1996, pg.3

The SEMP is the key engineering management plan. All engineering plans are derived from the concepts and approaches outlined in this SEMP. Rather than repeat the details contained in other plans, this SEMP will limit itself to an overview discussion. Figure 1-1 below provides the relevant document hierarchy of the SEMP to other NCSX Project, PPPL, and NCSX Engineering documents and plans:

Figure 1-1 NCSX Project Document Heirarchy



Supporting and expanding upon these plans are the PPPL and NCSX-specific procedures.

2 TECHNICAL PROGRAM PLANNING AND CONTROL

2.1 PROJECT ORGANIZATION AND DECISION MAKING

2.1.1 Systems Engineering and Project Management

A Work Breakdown Structure (WBS) has been defined for the NCSX Project. The WBS is a product-oriented family tree consisting of components and services that define the scope of the NCSX Project. It provides the overall architecture on how work is organized and is the starting point for planning and executing work on the NCSX Project. The Project Execution Plan (NCSX-PLAN-PEP) provides a more global discussion of the NCSX WBS and the definition of each WBS element can be found in the Work Breakdown Structure Dictionary (NCSX-WBS*X*, where *X* is the 1-digit WBS number).

The NCSX team organizational structure has been aligned with the Work Breakdown Structure. A fully integrated team is executing the NCSX Project, even though the participants may be geographically and institutionally distributed. Work will be governed by project-wide plans and procedures. The WBS-oriented organizational structure within the NCSX Project can be found in the NCSX Project Execution Plan (NCSX-PLAN-PEP).

Systems Engineering is integral to the NCSX management approach. The application of System Engineering principles has driven the development of the following processes to ensure that:

- **Common databases are established and controlled** for documents and drawings to ensure that everyone is using the same information. This includes the establishment and implementation of controlled configuration control processes to ensure that proposed changes to system configurations are properly processed and approved and that the common databases are updated in a timely manner.
- **System requirements are developed through an iterative process** in which the overall objective is to develop an optimally balanced and robust design that meets cost and schedule objectives.
- **System requirements and design constraints are allocated to subsystems and components** through a hierarchy of specifications. Requirements will be traceable and verifiable. Configuration Items (CI's) represent the lowest level of control under configuration management and may be a single physical or functional item or collection of items that will satisfy a final end product or deliverable. A CI may be a subsystem, a component, assembly, or subassembly. The WBS Manager will determine the appropriate level of the CI. The process of identifying and agreeing to the interfaces between CIs is key to fully understanding requirements and design constraints.
- **Design reviews are conducted** during the project cycle to ensure that the design is robust and meets requirements at all levels, identifies deficiencies, and allows correction in a timely manner.
- **Verifications are conducted** at the CI, subsystem, and system levels to assure that the "as-built" design meets specifications. This may take the form of testing, prototypes, and/or analyses.

The Engineering Manager has overall responsibility for implementing the SE program on the NCSX Project.

The Systems Engineering Support Manager and the Design Integration Manager support the Engineering Manager in implementing the SE program. In the line organization, four project engineers report to the Engineering Manager – the Stellarator Core Systems Project Engineer, the Ancillary Systems Project Engineer, the Power and Heating Systems Project Engineer, and the Machine Assembly Project Engineer. A Start Up Test Director will be assigned prior to first plasma to conduct integrated systems testing, coordinate the development of operations and maintenance procedures, and assume other responsibilities related to preparation for operation. Individual WBS Managers report to the Project Engineers.

The relationship among the various levels of the WBS, the organization, and work authorization and control is:

Level 1	WBS X	Project Engineer
Level 2	WBS XY	WBS Manager
Level 3	WBS XYZ	Same WBS Manager as Level 2, when used.
Level 4	Job XYnn	Job Manager
Level 5	Task XYnn-mmm	Job Manager of Job XYnn

Each of the four project engineers oversees one or more Level 1 WBS elements. All WBS elements are subdivided to at least Level 2, the larger or more complex ones go to Level 3. Level 4 is always the Job Level. Work plans and cost accounts are established at the Job Level. Each Job is subdivided into a number of tasks (Level 5), for which the Job manager is responsible.

2.1.2 Systems Integration Team

To be successful, the SE approach requires a have broad and coordinated participation by project participants. The NCSX Systems Integration Team (SIT) has been established with the charter to facilitate this integration. The Project Manager chairs the SIT. Permanent members of the SIT include the Project Manager, the Deputy Project Manager for Program, the Engineering Manager, the Project Control Manager, the Project Physics Manager, and the Systems Engineering Support Manager. As appropriate and needed to support SIT agenda items, the Deputy Project Manager for Engineering, the Stellarator Core Systems Project Engineer, the Ancillary Systems Project Engineer, the Power and Heating Systems Project Engineer, the Machine Assembly Project Engineer, the Design Integration Manager, specialty disciplines, other WBS managers, or other project personnel will be requested to participate.

The SIT will ensure that the project has an established a forum for discussion of systems engineering matters such as requirements interpretation, potential areas of risk, system level trade studies/analyses, coordination of processes, and resolution of issues. Resolutions are worked outside the SIT by the responsible organizations and designated working groups formed as needed to address and resolve specific issues. Results are reported back to the SIT. The SIT will facilitate obtaining decisions through line management that are best for the project as a whole.

The SIT will meet on a regularly scheduled basis with a frequency appropriate to the phase of the program and magnitude of system related activities in progress. All standard agenda item status reports are by exception only, i.e., the focus is on problem areas needing attention by the SIT, not a review of schedule and usual business activities.

2.2 PROJECT PLANNING AND STATUSING

2.2.1 NCSX Integrated Cost and Schedule Management

As described in the in the Project Execution Plan (NCSX-PLAN-PEP), the NCSX Project is responsible for developing and maintaining an integrated cost and schedule management process. NCSX will use the existing PPPL Project Control System (PCS) as described in the PPPL Project Control System Description.

WBS Managers develop detailed, resource-loaded schedules in collaboration with the Project Control Manager that include all the labor and procurements required to complete the required scope of work. The detailed schedule that defined the cost and schedule baselines came under change control following approval of DOE Critical Decision 1. The resource loaded schedule will be maintained in a Primavera Project Planning (P3) database. Jobs will be identified in the resource loaded schedule that will be used as the basis for earned value reporting.

2.2.2 Work Planning

Many different types of planning documents will be used on the NCSX MIE Project to define the work that needs to be accomplished. While many different planning tools and documents will contribute to ensuring that the necessary activities are properly identified, planned, and executed, the focal point for planning work on NCSX is the PPPL Work Planning Form (WP). PPPL Work Planning Procedure ENG-032 provides the guidelines for preparing a WP. The WP defines project expectations for the WBS Managers for each phase of the project in the form of a checklist of activities and deliverables that need to be provided for a design review and/or field-related activities. These activities and deliverables are addressed by WBS Managers in the development of the detailed schedules.

For the NCSX Project, the WP will also reference the appropriate WAF to ensure a one-for-one linkage. The WP will also cover including any design work entailing modifications to modifications to an existing system and/or facility, on-site or off-site work involving fieldwork, fabrication, physical changes to facilities, control computing, and fabrication of components and test stands/equipment during design for R&D.

The Head of the Engineering and Technical Infrastructure Department has designate certain managers to be Responsible Line Managers (RLM). The list of approved RLMs is contained on the PPPL Engineering Department Web Page (http://engineering.pppl.gov/). For each WP for the NCSX Project, the NCSX Project has designated specific RLMs for different aspects of the NCSX work scope. The completed WP represents an agreement between the appropriate NCSX RLM and the Cognizant Engineer/WBS Manager that the work activity has been adequately defined and that appropriate controls have been implemented. However, the RLM will not necessarily have full knowledge on the design, so the cognizant engineer/WBS Manager will have to ensure that necessary design considerations are taken into account. A NCSX-specific procedure (NCSX-PROC-004) has been developed that outlines and implements the WP requirements.

2.2.3 Detailed Planning and Statusing

The WP is the starting point in the work planning process and will eventually evolve into a job estimate represented by resource loaded plan as a first step in getting the work authorized to proceed. Once the job estimate has been reviewed and approved by the RLM, the Project Control Manager will enter the job estimate, in the form of logically linked resource-loaded tasks with estimated durations, into the P3 database and generate a Work Authorization Form (WAF) and open a job cost account. On the NCSX Project, the WAF is represented by a detailed P3 resource loaded schedule for that job. Work will be authorized in advance of the scheduled start date, but not necessarily at the beginning of each fiscal year. The WAF will be the basis for work authorization (i.e., the job manager can start work).

Monthly, the project will conduct status meetings that will address cost and schedule performance as well as providing a forum to review potential and defined risks and the steps being planned or taken to mitigate those risks.

3 SYSTEMS ENGINEERING PROCESS

The systems engineering process is a comprehensive and iterative problem solving process that is designed to transform validated user requirements and project objectives into a functional system that optimally meets the mission requirements. Requirements analysis efforts define the problem and the success criteria for a system that can address the problem. Then development of alternatives, the selection of a balanced solution, and the description of the solution as a design package is accomplished via design definition and systems analysis and control.

3.1 NCSX MIE PROJECT CYCLE

Technical aspects of a project cycle are illustrated in Figure 3-1. This chart depicts the various DOE Critical Decision milestones (CD-0 through CD-4), as outlined in DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets*, and the major systems engineering processes and deliverables expected at each stage of a project.

Inherent in the completion of the CD milestones as well as project design reviews is the attention and priority given to safety and quality as underpinnings of the successful evolution of the design and subsequent assembly, installation and testing. The NCSX Project adheres to the spirit of and procedures specified in the PPPL Integrated Safety Management Plan. In addition, the NCSX Project adheres to the requirements of the PPPL Quality Assurance Plan via the project specific Quality Assurance Plan (NCSX-PLAN-QAP).

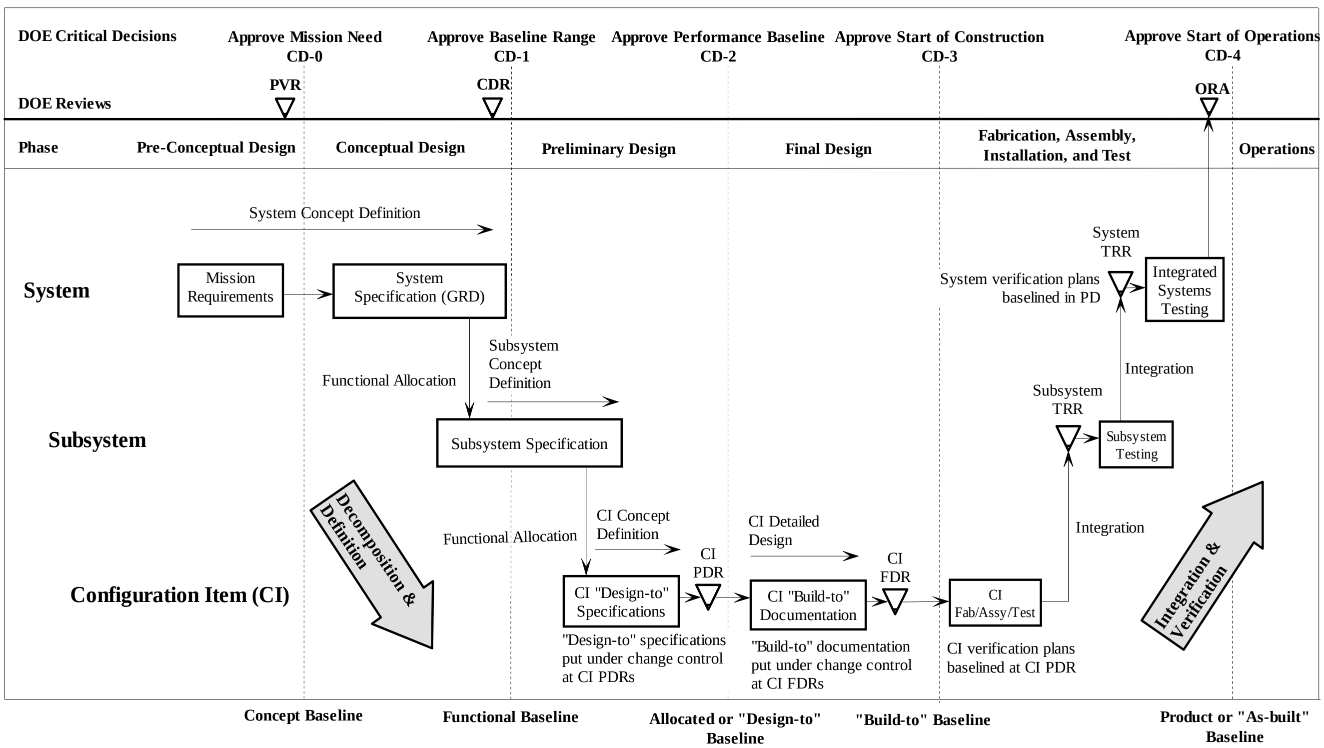
The evolution and development of the NCSX design has been accomplished in several phases:

- Pre-Conceptual Design – during this phase which commenced in 1997 and was completed with receipt of the DOE Critical Decision 0 (CD-0) in the summer of 2001, the emphasis was on exploring and defining the mission need and overall requirements of the NCSX device. Critical to this phase was the successful completion of a Physics Validation Review (PVR) in March 2001 that confirmed the design concept and the use of the test cell formerly occupied by the PLT and PBX-M experiments.

- Conceptual Design - During this phase, the plasma, stellarator core, ancillary systems, and facility design concepts were refined. Manufacturing studies of critical, developmental components were conducted by industry. Mission requirements were translated into a formal system specification, the General Requirements Document (GRD). Detailed, bottoms-up cost and schedule estimates were generated with substantial input from industry. A procurement strategy was developed. Major risks were identified and risk mitigation plans developed. This phase culminated with a successful Conceptual Design Review (CDR) May 2002 and the receipt of the DOE CD-1 milestone in November 2002.
- Preliminary Design – during this phase, the focus turned from an overall perspective of the entire NCSX device to individual subsystems. During this phase, more detailed functional and performance requirements are successively allocated to subsystems. A series of developmental specifications are generated down to the appropriate component level. Analyses and R&D required to establish the feasibility of the design concepts are completed. Interfaces are identified and plans developed at the start of Preliminary Design to define the interfaces. Following a successful Preliminary Design Review (PDR) of one or more lower level components, the specifications developed in preparation for the PDR are placed under change control. Following successful completion of the PDR, the technical baseline and self-consistent cost and schedule baseline are also updated to reflect these specifications and associated design concepts, and the WP updated to reflect the items necessary to be completed during final design. The PDR for the NCSX Project, with emphasis on the Vacuum Vessel and Modular Coils was successfully completed in the fall of 2003 as well as a DOE Independent Project Review. The series of these project reviews provided the basis for DOE providing the CD-2 approval in February of 2004. It is anticipated that the remaining subsystems will undergo PDRs within the next few years.
- Final Design - During this phase, the designs of the hardware and software required to satisfy the performance requirements specifications are completed. Analyses of critical design basis calculations performed earlier are checked and any additional analyses needed to confirm the adequacy of the detailed designs is performed and checked. Verification plans for testing during assembly and installation are developed. Detailed requirements for building or fabricating the CI are developed and placed under change control following a successful Final Design review (FDR). The technical, cost, and schedule baselines are also updated completion of the FDR. Most of the major procurements on NCSX are expected to be "built to print", with only minor engineering being done at the supplier to enhance manufacturability. The FDR for the major NCSX components, the Vacuum Vessel and Modular Coil Winding Forms was successfully completed in May 2004 and led to DOE approval of the CD-3 milestone, authorizing the start of manufacturing and construction activities in September 2004. It is anticipated that other CIs will undergo FDRs at the appropriate time in the next few years.
- Fabrication, Assembly, and Testing – with the approval of the DOE CD-3 milestone, work on the assembly, installation, and testing can proceed with due respect to safety and quality. Test readiness reviews will be conducted in advance of actual testing to ensure that all of the elements required for testing are in place, especially provisions to ensure safety. Based on experience with previous fusion experiments built at PPPL, it is anticipated that NCSX will be classified as a high hazard facility per ES&HD 5008

Section 11. Accordingly, a Safety Assessment Document (SAD) will be prepared and a Safety Certificate be issued by the PPPL ES&H Executive Board prior to the start of operations. The final step in this phase will be the integration and verification activities represented by integrated systems testing. Integrated systems testing will culminate in the production of the first plasma, which is a demonstration that the device and facility are operating as intended at the initial performance levels specified for the first plasma milestone (DOE CD-4). An Activity Certification Committee (ACC) has been formed to provide an independent safety review of plans and readiness for integrated systems testing and first plasma. The ACC will advise the PPPL ES&H Executive Board with respect to issuance of the Safety Certificate. Prior to the start of operations, DOE will conduct an Operational Readiness Assessment (ORA). NCSX intends to emulate the successful NSTX model wherein the ORA and activities of the ACC were conducted in concert.

Figure 3-1 NCSX Project Cycle



Legend
PVR- Physics Validation Review, CDR - Conceptual Design Review, ORA - Operational Readiness Assessment, TRR - Test Readiness Review, PDR - Preliminary Design Review, FDR - Final Design Review

3.2 REQUIREMENT DEVELOPMENT PROCESS

3.2.1 Specifications

Requirements for the NCSX Project are captured in a hierarchy of requirements documents. These requirements are initially defined in an hierarchy of specifications and then evolve down into detailed models and drawings. There are several types of specifications that will be used on NCSX. These are:

- General Requirements Document (GRD) – the GRD represents the overall top-level NCSX Project (system) engineering requirements. There is only one GRD. The GRD meets that requirements set forth in the PPPL ENG-006 "Review and Approval of Specifications & Statements of Work" and provides a complete set of performance requirements and constraints at the system/project level and initial subsystem allocations. The top-level system requirements in the GRD flow down to a set of specific developmental requirements and further down to the appropriate product component/procurement level.

- Developmental Specifications – there will be a number of developmental specifications, generally at the subsystem WBS level (e.g., Vacuum Vessel, Modular Coils, etc.) level. However, as deemed appropriate by the responsible WBS Manager, developmental specifications may also be prepared for major components. The developmental specifications focus on the functional requirements that a subsystem and/or major component must fulfill. These developmental specifications will focus at the subsystem and/or major component level on the following:
  - The performance and design requirements;
  - The performance requirements related to manning, operating, maintaining, and logistically supporting the subsystem to the extent these requirements define or constrain design of the subsystem/major component;
  - The design constraints and standards necessary to assure compatibility of subsystem components;
  - The principal interfaces between the subsystem being specified and other subsystems with which it must be compatible;
  - The major components of the subsystem and the principal interfaces between such major components;
  - The allocation of performance to, and the specific design constraints peculiar to, each major component;
  - Requirements for formal tests/verifications/inspections of subsystem performance and design characteristics and operability;
  - The identification and relationship of major components that comprise the subsystem; and
  - The identification and use of any Government Furnished Equipment (GFE) to be designed into and delivered with the subsystem, or to be used with the subsystem.

The approved NCSX developmental specifications can be found on the NCSX Engineering web page, along with specification guidelines and samples. The URL for this page is:

< http://ncsx.pppl.gov/NCSX_Engineering/ >

- Product Specifications – these specifications provide specific assembly and fabrication details and constraints at the component level. There are several types of product specifications:
  - Product fabrication specifications define the product by specifying the design (essentially a "build-to-print" contract);

- Product function specifications define the product by specifying its functionality/performance. These types of specifications are typically used when the supplier will do the design based on the required functions.

Product specifications naturally flow into the procurement process for obtaining goods or services. A graded approach will be applied where new and complex systems and components will require extensive and detailed product specifications whereas catalogue items such as some electronic components will not require as detailed product specifications. Product specifications may provide leeway for the vendor to design and build in accordance with a set of performance and physical requirements and/or constraints, may detail how a particular product/component shall be produced, may detail how a particular process such as manufacturing techniques shall be achieved, or how a particular material shall be developed. Since NCSX is planning to re-use much equipment previously used on other PPPL experiments (e.g., vacuum pumping equipment, neutral beam injection systems, power supplies, etc.) performance requirements will be generated that the legacy equipment must satisfy, however, it is not expected that product specifications and detailed component drawings for legacy equipment will be developed. Verification that the legacy equipment satisfies the performance requirements will be provided via testing and the results documented as tasks are completed. Specific attention will be paid to defining the interfaces of and interlocks between new NCSX systems to legacy equipment. Product specifications will focus at the component level on the following:

- Performance requirements which are to be demonstrated by quality conformance inspections outlined later in the specification. It may also include requirements for performance, reliability, etc, when such requirements are not completely controlled by detailed drawings. Requirements shall be specified in physically measurable quantitative terms with tolerances. Such performance shall be in terms of the item itself without reference to equipment or facilities to which it must be compatible.
- Design and construction details not controlled by drawings or other referenced drawings.
- Production drawings shall be referenced and will provide the basis for the design and fabrication.
- Standards of manufacture or essential processes that, because of their significance, must be defined as requirements for the manufacture of the item. Requirements specified shall be to the level of detail necessary to clearly establish limits for inspections.
- General requirements for workmanship that are incident to the manufacture of the critical item must be specified. Although general in nature, the workmanship requirements relate to the finesse of manufacture which should be provided by the craftsman and is not always specifically covered by the drawings. The workmanship requirements shall generally cover features that can be verified by visual examination.
- Requirements for formal tests/verifications/inspections of subsystem performance and design characteristics and operability.

- Preproduction sample – if deemed appropriate and necessary, a preproduction sample(s) may be required and tested prior to regular production to demonstrate the adequacy and suitability of the contractor's processes and procedures in achieving the performance that is inherent in the design. The purpose of preproduction tests is to provide a basis for design approval in a preproduction sample, like periodic production tests are intended to show that the techniques employed do not degrade the design.

The approved NCSX product specifications can be found on the NCSX Engineering web page, along with specification guidelines and samples. The URL for this page is:

< http://ncsx.pppl.gov/NCSX_Engineering/ >

- Product Requirements Lists (PRLs) – are used when the product may be a catalog item. PRLs will list minimum characteristics to assess whether a catalog item is appropriate.

- Other Types of specifications (e.g., process or material, etc.) may be added as appropriate and deemed necessary.

3.2.2 Design Constraints

Design constraints are a class of non-functionally derived requirements. Requirements that do not have to be derived and cannot be modified or dropped as a result of a tradeoff study can generally be considered a constraint. Typical design constraint categories include environmental conditions, transportability, interchangeability, workmanship, etc. The NCSX Engineering Manager is responsible for defining an overall project approach to the implementation of design constraints and for developing a complete set of system level design constraints for incorporation into the system specification (GRD). Cognizant WBS Managers are then responsible for addressing system level design constraints allocated to their subsystems and any additional constraint definition that may be required in their developmental and product specifications.

It is important to note that the evolution of the design is an iterative approach where the design concept is created to satisfy a given set of requirements. The design then evolves and matures with more detailed analyses, resulting in increasingly more detailed design concepts as the requirements grow more detailed and become allocated to lower levels within the system. Typically, a set of alternative concepts will be developed and each in turn evaluated to develop the most cost-effective solution based on specific evaluation criteria. This process will culminate in a detailed design of the entire NCSX system including all subsystem elements.

3.2.3 Statements of Work

A Statement of Work (SOW) should specify in clear, understandable terms the work to be done in developing or producing the goods to be delivered or services to be performed by a contractor. A SOW defines (either directly or by reference to other documents) all non-specification requirements for contractor effort. Qualitative and quantitative design and performance requirements shall be contained in specifications or standards. Such specifications are typically referenced in the SOW but the specific qualitative or quantitative technical requirements shall not be spelled out in the SOW. Not all procurements require a separate SOW and specification, but it is anticipated that most contracts for large and complex systems will require a SOW which will form the basis for successful performance by the contractor or developer.

A typical SOW shall contain the following information in sufficient detail in the requirements section to:

- Clearly permit the acquirer and offerer(s) to estimate the probable cost and the offerer(s) to determine the levels of expertise, manpower, and other resources needed to accomplish the task. Cites only the minimal applicable specification and standards, in whole or in part, and is tailored or scoped downward to limit costs. The SOW should only reference the minimum specifications and standards pertinent to the task and should only selectively invoke documents only to the extent required to satisfy the existing requirements.
- Permit the contractor to easily understand the specific duties of the contractor, what is required in the contract, and what it takes completes all tasks to the satisfaction of the contract. Examples are analyses or reviews required by PPPL, required HOLD points, or witness points.
- Permit the contractor to clearly distinguish between general information from direction so that background information and suggested procedures are clearly distinguishable from contractor responsibilities.

The approved NCSX SOWs can be found on the NCSX Engineering web page, along with specification guidelines and samples. The URL for this page is:

< http://ncsx.pppl.gov/NCSX_Engineering/ >

3.2.4 Installation and Assembly Procedures

As the design progresses into the fabrication stage, the product specifications will give way to installation and assembly procedures. These documents provide the step-by-step processes and material requirements for installation and assembly. Specific requirements for these procedures are outlined in PPPL Engineering Procedure ENG-030, *PPPL Technical Procedures for Experimental Facilities.*

3.2.5 Interface Control Documents

Section 3.7 of this SEMP and the NCSX Interface Control Management Plan (NCSX-PLAN-ICMP) detail the interface control process on this project.

3.2.6 Models and Drawings

For the NCSX Project the majority of the drawings and models will be developed using Computer Aided Design (CAD) software; e.g., Pro/Engineer for mechanical 2D and 3D drawings and models and AutoCAD for electrical drawings. All drawings and models that interface with the stellarator core will be prepared in 3D using Pro/Engineer. Configuration control and approval processes are detailed further in the NCSX Configuration Management Plan (NCSX-PLAN-CMP) and the NCSX Model and Drawing Control Procedure (NCSX-PROC-007).

3.2.7 Deviations and Non-Conformances

3.2.7.1 Deviations

A deviation is a specific written authorization to depart from a particular requirement(s) of the item's current approved technical documentation. A Request for Deviation (RFD) must be submitted and granted prior the start of the first manufacturing step that incorporates the proposed deviation. A RFD shall be submitted by the manufacturing organization (project or supplier) in either a letter or tabular format and will contain specific required information as defined in the NCSX Request for Deviation Procedure (NCSX-PROC-009).

A RFD shall be processed and adjudicated under the ECP process defined in Section 3.5 of this SEMP and the NCSX Configuration Management Plan (NCSX-PLAN-CMP) and accompanying NCSX Configuration Control Procedure (NCSX-PROC-002). Until the RFD is approved, the item may not deviate from the technical requirements. The RLM shall decide on the on how the technical documentation may reflect the approved RFD. He has three options:

- Do nothing – do not update or annotate the design documentation;
- Update the design documentation to add a stamp the clearly identifies the approved RFD; or
- Revise the design documentation to incorporate the approved RFD.

The first option to do nothing will likely only be selected if the item is a prototype or not to be used in the experiment. If the item is a production unit, then at a minimum, the RLM will direct that the design documentation be updated to add a stamp the clearly identifies the approved RFD.

3.2.7.2 Non-Conformances

Non-conformances are similar to deviations in the intent to document departures from the technical performance or design requirements. Non-conformance requests shall be used to document departures from technical performance or design requirements that cannot be documented via a RFD (e.g., after the start of a specific manufacturing step). PPPL QA Procedure QA-005, "Control of Nonconformances," provides the guidance on the preparation, processing, and approval of Non-Conformance Reports (NCRs). As indicated in the NCSX Configuration Management Plan (NCSX-PLAN-CMP), if the project decides to not update the design documentation to as-built configuration, it is acceptable to make notations on individual models and drawings to indicate approved Requests for Deviation (RFD) and/or NCRs.

3.3 RISK MANAGEMENT

3.3.1 Overview of Process

Risk management is a process to assure that the system design is feasible and can be built in a timely and cost effective manner. For purposes of the risk management process, risk is defined as the probability of an undesirable event occurring multiplied by the severity of the event. Unmitigated risk could have an adverse effect on program cost and schedule. Responsibility for risk management lies with NCSX line management. The Risk Management Plan (NCSX-PLAN-

RMP) provides an oversight of the risk management and mitigation processes used on the NCSX Project.

3.3.2 Risk Identification, Mitigation, and Tracking

As part of the WP process and requirements identified in PPPL Engineering Procedure ENG-032, risk categories are assigned and risk mitigation strategies outlined. However as the work proceeds additional more detailed level risks are likely to evolve. These risks will be identified and mitigation strategies addressed in weekly discussions between the NCSX Engineering Manager, the NCSX Project Engineers, WBS Managers and cognizant engineers. These risk mitigation strategies will then be reflected in the WAFs. The design engineers, with the appropriate management oversight, establish the specific approaches to addressing the individual risk elements. These risks are addressed through design improvements, manufacturing studies, prototypes, schedule contingency and cost contingency.

The Systems Integration Team (SIT) will facilitate identifying areas of critical and near term risk, coordinating the development of risk mitigation plans for these items, and monitoring performance against these plans. To assist in this process, the SIT has developed a Critical Risk Issues List that is addressed during weekly SIT meetings. This Critical Items List has replaced the Critical Items List originally published in the RMP and provides a concise and succinct summary of critical and near term risks, an assessment of the potential impact of the risk, the risk mitigation approach, and the current status in mitigating/eliminating the risk. PPPL Engineering Procedure, ENG-032, *Work Planning Procedure*, provides a risk consequences assessment matrix that provides a relative ranking of risks and their impacts. Items on this Critical Items List have three stages of life:

- Stage One – the risk has been identified, but no risk mitigation plan has been developed
- Stage Two – a risk mitigation plan has now been developed and is being implemented
- Stage Three – the risk is now retired.

Minimization and mitigation of risk on the NCSX Project will be provided through early management oversight allowing the application of additional resources, development of alternative technologies, and appropriate contingency allowances. It should be noted that the NCSX Project has already implemented a proactive approach to risk management. Early in the conceptual design phase appropriate contingency levels were assigned based on the state of the design and perceived risks and a series of manufacturing studies were conducted to mitigate manufacturing risk in the critical path components, including the modular coils and vacuum vessel. During the prelimininary design phase, a dedicated Value Engineering (Section 4.2) Task Force not only identified possibly lower-cost alternatives, but also addressed means to mitigate risks by adopting more standardized designs in specific areas.

3.4 SYSTEM BUILD, TEST, AND DEMONSTRATION PROCESS

3.4.1 System Build

The system build process begins with design definition and continues until the system is constructed and is ready for integrated systems testing. As part of the systems engineering process, the build of the system is an extension of the requirements analysis and design tasks for all subsystems and components.

The stellarator core and interfacing components will be defined in 3D CAD models generated in Pro/Engineer to facilitate the building of a unified assembly. The Stellarator Core Systems Project Engineer is responsible for the development of the integrated model of the stellarator core. A Pro/Engineer model of the facility shall also be generated to define space envelopes for locating ancillary equipment and routing of cables and piping. All 3D models and 2D drawings shall reside in a common database. The Design Integration Manager is responsible for developing a model of the NCSX facility, which includes the integrated model of the stellarator core.

NCSX will be constructed at PPPL using existing procedures and practices that are familiar to PPPL staff. Hazard controls include: work planning; installation, test, and operating procedures; design reviews; job hazard analyses; pre- and post-job briefings; protective equipment; and worker training. The Field Period Assembly (WBS 18) Manager is responsible for coordinating all fabrication and assembly activities in the TFTR Test Cell, with oversight from the assigned RLM. The Machine Assembly Project Engineer (WBS 7) is responsible for coordinating all assembly activities in the NCSX Test Cell and Basement – he is the assigned RLM for this work. Coordination of assembly activities outside the TFTR Test Cell and NCSX Test Cell and Basement are the responsibility of the Cognizant WBS Manager, with oversight of the assigned RLM.

3.4.2 System Test

System verification is accomplished through a combination of inspection, demonstration, test, and analysis activities. The Engineering Manager will establish a cost effective approach to verifying system performance. Emphasis will be placed on the reduction of overall verification costs and timelines. A verification compliance matrix will be developed and maintained that identifies the verification method and status of each system requirement in order to ensure that system performance requirements, as documented in the GRD, are verified and maintenance and operations procedures are validated.

System level tests will include activities to verify that subsystems interface properly and individual performance requirements are met, as well as verifying full system operation. A Test and Evaluation Plan (TEP) will be developed and maintained by Project Engineering to establish how the integrated system testing will be performed and managed. The TEP will include an overview and schedule of the integrated system test program and the purpose, scope, and objective of each system test; test configurations; and test responsibilities.

Early development of test plans is essential because it may drive when certain capabilities and interfaces are required to be operational. The TEP will be developed during Preliminary Design to provide the WBS Managers knowledge as to what their system test responsibilities are and within what time frame they occur. This will enable the WBS Managers to do the planning necessary to support system testing. Initial subsystem test plans will also be developed during Preliminary Design. In support of testing activities, Project Engineering will conduct preparedness reviews, track test activities, and resolve test issues.

3.5 CONFIGURATION MANAGEMENT PROCESS

The Configuration Management (CM) program is described in the NCSX Configuration Management Plan (NCSX-PLAN-CMP). The CMP and its accompanying NCSX procedure (NCSX-PROC-002) describe in detail the concepts and processes of the NCSX configuration control program, including types and approval levels of Engineering Change Proposals (ECPs). The Engineering Manager is responsible for implementing an effective CM program. The Systems Engineering Support Manager will assist in developing the CM program and will be responsible for its administration.

The physical and functional description of the components, systems, and software/firmware comprise the "configuration" of the NCSX Project. The NCSX project (and details of its design configuration) is progressively described in greater detail as it proceeds through the design process.

At the end of the fabrication project, as the NCSX enters its operational phase, the actual physical and functional configuration should be documented. Depending on an assessment of the risk and availability of resources, the NCSX Project may decide that it is necessary to update selected drawings and models. In lieu of physically preparing as-built drawings, it is considered acceptable to call out on affected drawings the approved NCR and or ECN that documents each nonconformance or change on the drawing and models to represent the as-built condition. Configuration Management (CM) is an integrated program that ensures that the configuration is identified and properly document and that changes to the configuration are controlled during this life cycle. An effective CM program must allow for design evolution without compromising cost and schedule objectives.

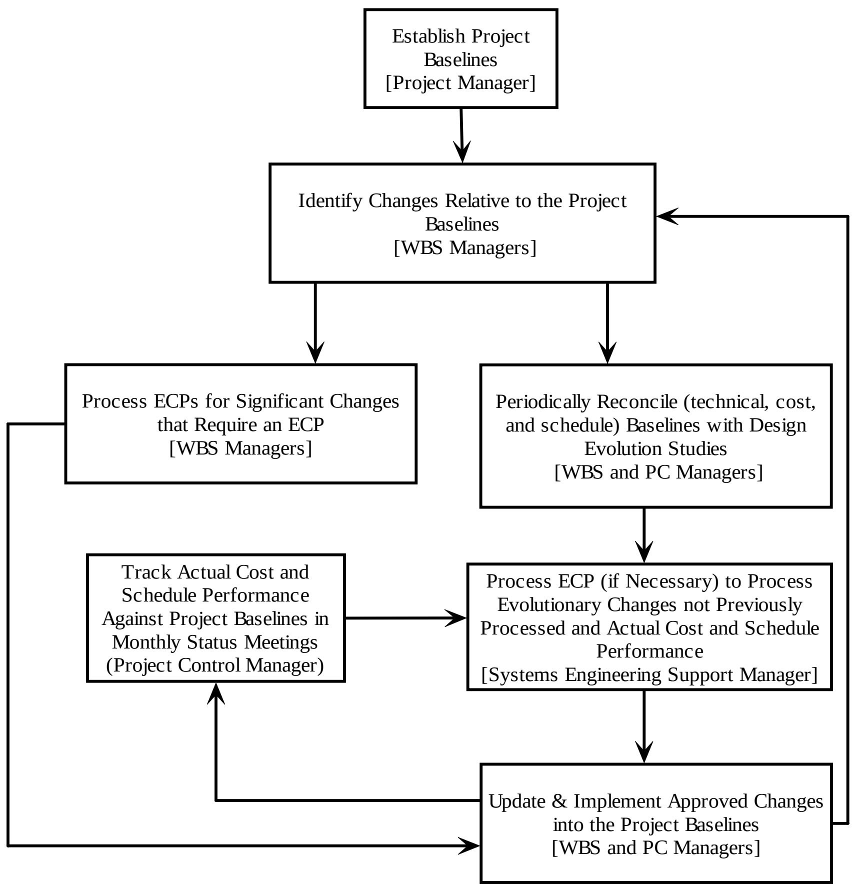
Figure 3-2 illustrates the process for managing the development and changing of project baselines. The technical baseline is defined by the General Requirements Document (GRD), the system concept defined by the Pro/Engineer model of the stellarator core, and supporting technical documentation. During Preliminary Design and Final Design, subsystem and component designs will evolve as changes are made and more detail is added. This process is natural and must be encouraged. However, there are two risks that the project needs to manage:

- Proposed changes may compromise cost and schedule objectives
- Proposed changes may compromise the ability of interfacing systems to meet their technical, cost, and schedule objectives.

WBS Managers have the responsibility to identify changes and the impact of the proposed change on cost, schedule, or interfacing systems. For significant changes, the WBS Managers are obligated to initiate Engineering Change Proposals (ECPs) for updating the project cost, schedule, and technical baselines prior to proceeding with the design. The project will also require WBS Managers to periodically reconcile the cost and schedule baselines with proposed design changes that have occurred since the project baselines were last changed. These periodic updates will typically be coordinated with the semi-annual DOE cost and schedule reviews and formal design reviews (such as the Preliminary Design Review and Final Design Review). "Omnibus" ECPs will be required for these periodic updates to formally update the project baselines and proceed with the design. The ECPs for these periodic updates will also reflect the actual cost and schedule performance. An electronic system for preparing and processing ECPs is available via a link from the NCSX Engineering Web page:

< http://ncsx.pppl.gov/NCSX_Engineering/ >

Figure 3-2Updating Project Baselines



In accordance with the CMP, minor or editorial changes will not require the processing of an ECP to revise a specification or drawing. The NCSX Engineering Manager will make the decision on a case-by-case basis on whether an ECP is required.

3.6 DATA MANAGEMENT PROCESS

Data management is provided through defined procedures and the document and drawing control systems. Two NCSX plans describe the data management process utilized for the NCSX Project.

The NCSX The Data Management Plan (NCSX-PLAN-DMP) describes the processes to be used for document and drawing control. The DMP will be reviewed and approved at the start of preliminary design.

The majority of project documents will be accessible electronically. These electronic records are subject to the same degree of configuration and revision control as those hard copy records stored in the PPPL Operations Center. In addition, in order to maintain the records current, the electronic records on the NCSX Project Web are automatically backed up periodically (at least weekly) by the PPPL Data Management and Retrieval Systems. Since these records are subject to the same degree of rigor in maintaining them current, those records stored electronically on the ***NCSX electronic sites are considered to be a satellite locations of the PPPL Operations Center.***

Electronic Data will be stored in seven electronic sites and physical data not readily convertible to electronic format will be stored in hardcopy format in the PPPL Operations Center. The paragraphs below outline the general content and purpose of each of the seven electronic sites and the PPPL Operations Center. A more detailed table listing the seven sites and their customers, custodians, document types, and access restrictions is provided in the NCSX Data Management Plan (NCSX-PLAN-DMP).

The purpose and general content contained in each storage site is summarized below:

- Electronic Sites
    - NCSX Project Web < http://ncsx.pppl.gov/ > – this open access site and its related subordinate webs (Project Office, Physics, etc.) contains general project information, external design review data, physics meeting records, PAC meeting records, publications, and the project directory;
    - Procurement Web < http://procurement.pppl.gov/ > – this open access site contains all documentation required for potential suppliers to develop proposals;
    - Manufacturing Web < http://ncsx.pppl.gov/NCSX_MFG/ > – can also be reached via link off the NCSX Project web. This open access site contains project documentation of interest to potential suppliers;
    - Engineering Web < http://ncsx.pppl.gov/NCSX_Engineering/ > – a can also be reached via link off the NCSX Project web. However, this is a restricted access site (only project personnel). It contains all other project documentation including cost and schedule information, design criteria, internal design review data, engineering and project meeting minutes, memoranda, analysis reports, controlled documents not otherwise posted, and work plans;
    - Pro/INTRALINK Database – Only accessible via INTRALINK. Tthis is a restricted site (only available to personnel with access to preparing and/or reviewing/approving electronic models and drawings). It contains CAD drawings and models for project use;

- Project FTP Server < ftp://ftp.pppl.gov/Author_ >– this is an open access site. It contains large Data Files primarily used in physics analyses that are arranged in folders created by the author of the files; and
- Supplier FTP Server < ftp://ftp.pppl.gov/pub/ncsx/manuf/ >– contains CAD drawings and models, statements of work, and specifications for use by suppliers under contract.

- PPPL Operations Center – contains that information not readily convertible to an electronic format (e.g., hardcopy supplier contract deliverables, hardcopy field activity documentation, etc.).

The NCSX Document and Records Plan (NCSX-PLAN-DOC) identifies the controlled documents on the NCSX Project. The DOC will be reviewed and approved at the start of preliminary design and defines the following:

- Identifiers of all project documents, including controlled documents and memoranda
- Approval authority for controlled documents
- Location for storage and retrieval
- Records retention requirements

3.7 INTERFACE CONTROL PROCESS

Interface Control is that part of system design integration that generates and administers technical agreements between two or more activities, when the products must assemble and/or function together. An interface may define a written agreement between WBS systems or define a physical boundary, mating surface geometry or attachment details that exist between two adjoining WBS components. There are two types of interfaces. A primary interface exists between two separately deliverable items when the mutual boundary area is not controlled by a single developmental or "design to" specification, when the interface is with systems outside the project (external interfaces identified in the General Requirements Document/GRD), or when, at the discretion of the cognizant Project Engineer, the interface is determined to be critical to the performance of the NCSX program. Secondary interfaces represent technical agreements entirely within a single WBS element or between two WBS elements, but with the same WBS Manager. Only primary interfaces documented by ICDs or drawings will come under the configuration control program described in Section 3.5.

Project Engineering is responsible for establishing the processes and procedures for effecting interface control. The Interface Control Management Plan (NCSX-PLAN-ICMP) will describe the processes to be used in managing interfaces. The ICMP will be reviewed and approved at the start of preliminary design. The Systems Engineering Support Manager will administer the interface control management program. WBS Managers will jointly develop scope sheet agreements at the start of Preliminary Design that identify what interfaces exist and document work plans to finalize the interface definitions. Working groups will be established to support the development, modification, and maintenance of selected interfaces as required. Interface control documents (ICDs) will be established to document both functional and physical interface characteristics as deemed necessary by the respective WBS Managers. ICDs should be in place by the time of the Preliminary Design Review (the earliest PDR among the affected WBS elements) in order to facilitate completion of Final Design.

3.8 DESIGN REVIEW PROCESS

On NCSX, both external and internal design reviews are planned. External design reviews are determined by DOE and conducted to support DOE Critical Decisions. Internal design reviews are conducted to assess the technical adequacy of the configuration baseline as it is developed, consistent with ENG-033 Design Verification and P-010 Design Reviews. A NCSX-specific procedure, NCSX-PROC-004 (NCSX Work Planning), has been developed that augments the requirements of ENG-033 and P-010. These reviews verify the proper development, establishment, and control of the configuration baseline. They are used to verify conformance with requirements at the system, subsystem, and component levels. They also serve as an appropriate point to update project technical, cost, and schedule baselines.

The review process is continual throughout design, fabrication, and assembly. The Conceptual Design review was conducted in May 2002. There will be a series of specification validations and design reviews during Preliminary and Final Design as the design evolves from the system level to the component level. Test preparedness reviews will be conducted during the Fabrication, Assembly, Installation, and Test (FAIT) phase. The final review, which follows completion of integrated systems testing, will be the Operations Readiness Assessment (ORA).

Design reviews will be conducted at the appropriate time for all systems and components. The planning, preparation, and conduct of each design review are the responsibility of the cognizant WBS Manager for the system element(s) under review and by the responsible Project Engineer for system-level reviews.

The schedule for design reviews for major systems or critical components will be determined by the Engineering Manager (or Systems Engineering Support Manager) in consultation with the responsible Project Engineer and WBS Managers. Responsibility for scheduling design reviews for other systems and components will be delegated to the responsible Project Engineer. Before a design review is scheduled, the responsible official (Project Engineer/Systems Engineering Support Manager) or responsible Project Engineer shall confirm that the required documentation specified in the WP is completed (e.g., drawings promoted to the appropriate level, specifications approved, analyses completed and checked, etc.).

Successful completion of a design review requires that the design has matured to a level appropriate for the review and that all data necessary to properly evaluate that design is complete, including successful resolution of the design review CHITs. To facilitate this goal, a WP approach will be implemented for the design phases of the project. The WP will identify entry requirements that indicate readiness for a review and exit requirements that define review closeout. Success criteria are then established to provide a means to assess satisfaction of the entry and exit requirements. These data items establish project requirements for readiness for a design review. The WP will be documented during each phase of the design by the cognizant WBS Manager in conjunction with the cognizant Project Engineer and Engineering Manager (or Systems Engineering Support Manager) so that the required supporting activities can be properly planned.

4 RELATED ENGINEERING PROCESSES

4.1 RELIABILITY, AVAILABILITY, MAINTAINABILITY (RAM)

The RAM program to be implemented on NCSX is defined in the NCSX RAM Plan (NCSX-PLAN-RAM). The RAM Plan will be reviewed and approved as part of the Final Design Review (FDR). The RAM program will utilize a graded approach that is based on consideration of risk. WBS Managers are responsible for optimizing designs for reliability and maintainability through systematic evaluation of design options, and for performing failure modes, effects and criticality analysis (FMECAs) for RAM design improvement and verification.

4.2 VALUE ENGINEERING

Value Engineering (VE) is the systematic application of recognized techniques by a multi-disciplinary team to identify the function of a product or service, establish a worth for that function, generate alternatives through the use of creative thinking, and provide the needed functions to accomplish the original purpose of the project at the lowest life-cycle cost without sacrificing safety, necessary quality, and or environmental attributes of the project. The NCSX Project will apply VE methodologies following a graded approach to the formal elements of VE.

On NCSX, value engineering methods have already been applied during Conceptual Design. Specific examples include:

- Coil topology studies conducted by a multi-disciplinary team of physicists and engineers that led to the selection of modular coils for providing helical fields
- Manufacturing studies of the vacuum vessel and modular coils conducted by manufacturing engineers in industry (and supported by laboratory design engineers) that identified and evaluated a variety of fabrication options

Project Engineering and the individual WBS Managers will review each subsystem during Preliminary Design and determine what design areas would likely benefit from additional value engineering. These value engineering studies would be completed prior to the subsystem PDR.

4.3 QUALITY ASSURANCE (QA)

The NCSX QA program provides a framework that defines quality in terms of goals and expectations and establishes processes to fully integrate the quality function into all phases of the program by providing continual, independent, and disciplined reviews/audits of all processes, products, and services. The Quality Assurance Plan (NCSX-PLAN-QAP) establishes the requirements for controlling work and for providing management and independent self-assessments to find, report, and solve problems. The plan identifies implementing policies, plans, and procedures for the NCSX QA program. The QAP has been reviewed and approved.

While performing their assigned duties and responsibilities, workers, line management, and immediate supervisors are assigned immediate responsibility for the quality of the project's efforts. Personnel independent of the activities being performed are assigned the responsibility of verifying and validating that the project's efforts are commensurate with project standards. All personnel have a responsibility to identify quality problems and to recommend solutions.

4.4 PARTS, MATERIALS AND PROCESS STANDARDIZATION AND CONTROL

The purpose of the NCSX parts standardization program is to reduce the number of part types, improve system maintainability, and optimize logistics support by standardizing part types and selecting parts with two or more reliable sources wherever practical.

4.5 MANUFACTURABILITY

Manufacturing, Inspection, and Test Plans (MITPs) shall be required to document agreements of manufacturing processes, inspections, and tests. The purpose of these plans is to provide an up-front understanding of how an item will be manufactured, how it will be inspected, and how it will be tested to ensure compliance with the specification requirements.

MITPs will be developed as required, with major procurements and/or especially complex manufacturing processes needing more detailed plans. In some instances, however, the decision may be made that an MITP is not required. If required,

These plans shall include a process flow diagram showing each of the major manufacturing operations. They will identify any special process procedures required to produce the component to be fabricated. Inspection and test plans shall also be described. The MITPs along with product specifications provide the technical basis for the procurement of components.

4.6 CONSTRUCTABILITY

The Machine Assembly Project Engineer is responsible for coordinating all assembly activities in the NCSX Test Cell and Basement. The Machine Assembly Project Engineer is a member of the Systems Integration Team (SIT) and will provide input for risk management, and participate in all design reviews for issues of constructability**.** Designs shall reviewed for constructability, covering (as a minimum) the following topics:

- Space allocations for ease of construction and maintenance
- Access for assembly
- Required assembly sequence
- Early identification and mitigation of constructability risk issues
- Design features to reduce construction costs

4.7 TRAINING

Training for the NCSX Project will lie within two primary areas:

- Lab wide training in safety and other discipline-specific skills; and
- NCSX Project specific training (e.g., operations and maintenance, plans and procedures, etc.).

4.7.1 Lab Wide Training

Safety training is an important aspect of the Project's program. The Project's training program for personnel at the PPPL site will follow the PPPL policy stated in P-008 ("Staff Training"), P-028 ("Subcontractor Training Requirements for the PPPL Site"), and P-029 ("Testing for Training Courses"). Safety training will be coordinated by the PPPL Office of Human Resources and the PPPL ES&H Division.

For personnel assigned to NCSX, whether at PPPL or ORNL, the respective department and division will decide the specific organizational training necessary for general skill and specific support of NCSX activities.

4.7.2 NCSX Project Specific Training

Cognizant WBS Managers shall be responsible for providing initial training and training materials for the operation and maintenance of the subsystems they provide. They shall create a plan to provide training on the operation and maintenance of their system. This plan shall include details of the training to be provided including documentation materials and a schedule for the training of experimenters as well as the end user operators. This plan shall be included either as part of the Final Design Review Data Package or shortly thereafter, and shall be reviewed and approved by the NCSX Project and PPPL Management.

Training will also be conducted on the various NCSX plans and procedures for each person assigned to the NCSX Project.

4.8 ES&H

NCSX will fully subscribe to the PPPL policy on Integrated Safety Management (ISM) as indicated in the Project Execution Plan (NCSX-PLAN-PEP). PPPL will furthermore ensure that the design, development, procurement, manufacture, fabrication, construction, installation, testing, operation, maintenance, modification, and eventual decommissioning of the NCSX is accomplished in accordance with the Environment, Safety and Health (ES&H) provisions of: applicable DOE Orders and other requirements the PPPL Environmental, Safety, and Health Directives (ESHDs); environmental regulations and guidelines of the U. S. Environmental Protection Agency (EPA); and, state and local requirements.

NCSX Project Management is responsible for the safe execution of the NCSX Project. The PPPL Environment, Safety, and Health Division (ES&HD) provides support to the Project and will monitor all aspects of the project to assure that potential hazards are minimized. Potential hazards will be identified and evaluated, techniques for elimination and/or control of such hazards will be studied, alternatives will be proposed, and risks will be assessed. The goals of the ES&H function will be the accomplishment of NCSX program objectives, within reasonable and acceptable risk, and with the least practicable number of undesirable results (i.e., occurrences, incidents, accidents).

The ES&H review and approval process for NCSX will begin with review under the National Environmental Policy Act (NEPA) as prescribed by 10 CFR 1021, DOE Order 451.1B, and PPPL Procedure ESH-014. An Environmental Assessment (EA) will be prepared by PPPL and submitted to DOE-PAO and DOE-CH (including review by the New Jersey Department of Environmental Protection), and a Finding of No Significant Impact (FONSI) sought from DOE-CH. The NCSX NEPA process should be completed within about 12 months.

ES&H review of systems designs, drawings and procedures will be conducted by the NCSX ES&H professionals throughout the course of the design and installation stages. Electrical safety, industrial hygiene, and construction safety staff will support the Project installation activities. The NCSX Project Manager will make a determination as to the hazard level of upcoming NCSX operations, in accordance with PPPL ES&H Directive 5008, Section 11, Chapter 1. If this determination is for "High Hazard", the PPPL ES&H Executive Board will appoint an Activity Certification Committee (ACC) to perform an independent ES&H review of the NCSX Project's readiness for operation. A Safety Assessment Document (SAD) will be prepared to provide an overview of the operation; descriptions of structures, systems and components relevant to the operation, with emphasis on environment, safety and health (ES&H) features; identification of hazards associated with the operation and methods employed for their mitigation; and a description of how operations will be conducted with emphasis on ES&H features. The SAD will be reviewed and approved by the PPPL Safety Review Committee and the ACC. Based on its review of the SAD and operating plans and procedures, and physical walkdowns of the facility, the ACC will recommend to the PPPL ES&H Executive Board whether to issue a Safety Certificate to commence NCSX operations, including any limiting conditions (see ES&H Directive 5008, Section 11, Chapter 2).