RESPONSE
TO THE EIR-TEAM INITIALQUESTIONS

FOR THE

EXTERNAL INDEPENDENT REVIEW

National Compact Stellarator Experiment
(NCSX)
Princeton Plasma Physics Laboratory
Oak Ridge National Laboratory

14 November 2003

INTRODUCTION

On 7 November 2003, the NCSX EIR-Team provided their plan for conducting the NCSX External Independent Review. Section 1.3 of this plan contained a number of Questions and requirements for additional information. This document provides the NCSX project answers to these initial questions and provides the requested information or indicates where it may be found. The NCSX team will be available to further discuss or clarify these issues during the review.

1. *Resource Loaded Schedule*.

For selected Work Breakdown Structure (WBS) elements identified below, the EIR Team will summarize the detailed basis for the cost estimate and schedule duration. The EIR Team will assess the method of estimation and the strengths/ weaknesses of the cost and schedule estimates for each WBS element reviewed. The EIR Team will identify and assess key cost and schedule assumptions and evaluate the reasonableness of these assumptions as related to the quality of the cost and schedule estimates.

Additional EIR Team questions/information requirements:

1. *Several activities do not appear to have costs (e.g. ID 1201-100 thru 1201-500). Please explain the rationale for these items.*
   Many detailed tasks may have their resource estimates shown in hammock activities. In this example the resources for tasks 100 to 500 are included in task 1201-050. (ref Master Schedule page 1).

2. *There are inconsistencies in the contingency rate shown in the resource-loaded schedule vs. the contingency rate in the cost and schedule backup e.g. WBS 81 and 82 (7-8% in schedule vs. 17-34% in cost backup). Please explain.*
   The contingency percentages for WBS 19, 81 and 82 are 17% on balance of scope (excludes FY03 actual cost). This is shown in the backup contingency worksheets and in the calculations that quantified the contingency dollars. The contingency percentage shown on the master schedule is shown for reference info only and is in error. This has since been corrected.

Selected WBS Elements for review:

A. WBS 121 Activity ID 121-038 VV vendor Fab. Test & deliver 3 periods (303 days, $2.95 million)

Additional EIR Team questions/information requirements:

1. *Please provide predecessor/successor reports.*
   See attached document "predecessor successor report.pdf"

2. *Provide the rationale for the 303 day duration and how the $2.95M cost is spread across the duration.*
   One vendor schedule quote was received showing a 12 month overall. Considering the critical nature of the vacuum vessel, the technical risk in this fabrication, as well as the lack of a detailed schedule from both vendors, a duration of 14 months is judged to be prudent for planning purposes. An end deliverable from both VV R&D vendors will be a firm fixed price cost and schedule estimate. The total estimate for the vacuum vessel fabrication is $2,729,340 (the average of two quotes) which translates to $2,948,437 with escalation and overhead applied. For BA planning purposes it was decided to phase fund this procurement with 30% committed in FY04 and the balance committed in FY05. For BO planning the project assumed linear cost distribution at this time. The project master schedule will be adjusted once we receive the firm fixed price proposals (est. June 04 task 1202-435 and 1202-335)).

3. *Please provide the design specification for this item.*
   http://www.pppl.gov/me/NCSX_MFG/VV_MDPF/NCSX-CSPEC-121-01-01.pdf

4. *Please provide the vendor(s) budgetary estimates, as well as any other documentation to support this estimate.*
   http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PDR_WBS/WBS121_CostBackup.pdf
   Hard copies of Major Tool's and Rohweddder's budgetary estimates will be made available during the review.

5. *The resource-loaded schedule shows an activity cost of $2.95 million. The cost estimate backup documentation shows a cost of $2.73 million. Please clarify the difference.*
   The larger figure includes escalation and overhead. See response to Question 2 above.

6. *Please discuss the rationale for the 40% contingency.*
   Please see
   http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PDR_WBS/WBS121_Contingency.pdf
   There it says:
   WBS Level 4 Identifier: 121 Title: Vacuum Vessel Assembly
   Originator: Paul Goranson Date: 9/18/03

Technical / Schedule / Cost Risk Factors (Table 2-1): 6 8 4
Technical / Schedule / Cost Weighting Factors (Table 2-2) 4 1 2
Technical / Schedule / Cost Percent 24 8 8 40
Recommended Contingency Allowance (%): 40%
Rationale for Selection of Contingency Allowance:
The extremely close tolerances and need for significant R&D warrant a large contingency.

The NCSX team will be available to further discuss this estimate at the review.

B. WBS 131 Activity ID 131-037 TF Coil Procurement (425 days, $1.22 million)

Additional EIR Team questions/information requirements:

1. *Please provide the rationale for the 425 day duration and how the $1.22M cost is spread over the duration.*
   An 89-week (20 1/2 month) fabrication schedule and its cost was calculated based upon a bottoms-up process-based analysis performed by the WBS 13 manager, based on Laboratory experience with the development of similar coils for NSTX and TFTR. The entire estimated cost of this procurement, $1,051,990, was planned to be committed (BA) at time of award. For BO planning purposes linear distribution was assumed.

2. *Please be prepared to discuss the magnitude of the float at delivery.*
   The delivery of the TF coils was staged to support pre-assembly of the 3 TF coil sub-assembly in WBS 185. These linkages can be viewed in the critical path plot ("critical path plot resource.pdf") tasks 131-037 and 184-100 thru 125. The critical path for the TF coils is the delivery of the last TF coil, which supports pre-assembly of the TF coils and installation over the sub-assembled modular coils and vacuum vessel.

3. *Please provide predecessor/successor reports.*
   See attached document "predecessor successor report.pdf"

4. *The contingency analysis states that the TF coils are reasonably simple and standard. If so, what are the specific issues driving the 24% contingency and how do they relate to the requirement for "close tolerances of the device?"*
   To better understand the Contingency Sheet http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PDR_WBS/WBS131_Contingenc.pdf please refer to pages 11 and 12 of the Cost and Schedule Guidance document http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PC_RonS/COST_SCHEDULE_GUIDANCE.pdf which describes each of the technical, schedule, cost, and risk factors used to calculate the contingency. Tolerances for the TF coils are less critical than the tolerances for the modular coils. Technical risk for the TF coils is relatively low but schedule criticality is relatively high.

5. *The resource-loaded schedule shows an activity cost of $1.22 million. The cost estimate backup documentation shows a cost of $1.05 million. Please clarify.*
   The total cost of $1,223,543 includes escalation (2%) as well as overhead G&A. The $1,051,990 was based upon a bottoms-up manufacturing calculation performed by the WBS manager and includes an assumed 10% vendor profit marked-up. (But did not include escalation or overhead).

Example;	
WBS manager estimate	=$956,362
10% vendor markup	= $95,636
subtotal	= $1,051,990
escalation and overhead	= $171,545
TOTAL COST	= $1,223,543

6. *In the M&S backup sheets, the individual costs for tooling, material, and labor add up to $1.036M (excluding profit), not the $956K shown elsewhere. Please discuss.*
   There appears to be a spread sheet error. "Ordering/stocking materials" as well as "Tooling Fab for nose" were inadvertently left out of the totals. This has now been corrected.

7. *Please provide the detail for the complete build-up of the estimate, including vendor quotes, equipment specifications, manhour determination and rates.*
   Please see spread sheets:
   http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PDR_WBS/WBS131_CostBackup.pdf Laboratory experience with the development of similar coils for NSTX and TFTR provided the basis for these estimates. Material costs are based on epoxy, insulation, and Kapton costs incurred on NSTX.

8. *Please discuss the difference between tooling and labor.*
   "Tooling" encompasses the vendor labor and materials required for the development of the machine tools for the manufacture of the TF Coils. These would include fixtures for coil winding as well as tools for machining the angles on the TF Coil nose. A better title for this section might be "Design and Fabrication of Tooling". "Labor" encompasses the vendor man-hours required to fabricate the TF Coils including the actual insulating and winding of the coils. A better title for this section might be "Coil Fabrication". All costs in these categories are M&S.

C. WBS 141 Activity ID 172-037 Modular Coil Casting Procurement vendor cost (371 days $5.2 million)

Additional EIR Team questions/information requirements:

1. *Be prepared to discuss the 2000 day float.*

This task is a hammock for the fabrication of the 18 modular coils (tasks c-121 thru C-501b). Being a hammock task the float is inconsequential however the detail tasks c-121 thru c-501b each have their float based upon the linkages established in the master schedule. The most critical delivery is the first modular coil (task C-121 total float = 116 working days) which links to the winding and VPI phase of the first mod coil (WBS 142 task P1-001). The actual winding process at station 3 is the critical path driver of the entire project schedule. (see critical plot).

2. *Please provide the rationale for the 371 day duration and how the $5.2M cost is spread over the duration.*
   The 371 day duration was based on an initial vendor schedule that showed delivery of the first machined casting approx 15 weeks after contract award with each subsequent casting arriving each 3 1/2 weeks. For BA planning purposes it was decided to phase fund this procurement with 30% committed in FY04 and the balance committed in FY05. For BO planning the project assumed linear cost distribution at this time. The project master schedule will be adjusted once we receive the firm fixed price proposals (est. June 2004 task 1404-235 and 1404-125)

3. *Please provide cost information for ID "MT-PVVS-Fab"*
   Each vendor provides budget input and progress status for R&D vendor work. See attached document "MT PVVS FAB.pdf" for this task. Note, this task is in WBS 121 not 141.

4. *The resource-loaded schedule shows an activity cost of $5.2 million. The cost estimate backup documentation shows a cost of $4.8 million. Please clarify.*
   The estimated cost of $4,839,300 was based on the two quotes received. The activity cost of $5,213,477 includes escalation and overhead.

5. *Please provide the detail for the complete build-up of the estimate, including vendor quotes, equipment specifications, manhour determination and rates.*
   Please refer to the estimate build-up which can be downloaded from http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PDR_WBS/WBS141_CostBackup.pdf. We will available to discuss these details during your visit.

6. *Please provide the design specification for this item.*
   Please see attached document "NCSX-CSPEC-141-01-02.pdf" : NCSX Product Specification - Prototype Modular Coil Winding Form. This specification is for the prototype winding forms, and was also used as the basis of the budgetary estimates for the production winding forms.

D. **WBS 141 Activity ID 171-041** Modular coil winding (18 coils) (184 days $3.13 million)

Additional EIR Team questions/information requirements:

1. *Please provide predecessor/successor reports.*
   See attached document "predecessor successor report.pdf"

2. *Provide the rationale for the 184 day duration and how the $3.13M cost is spread across the duration.*
   The overall duration of 184 workdays is a hammock task spanning a detailed task schedule which was provided by the WBS manager. The estimated cost of $3.13m is based upon an estimate of 38,776 technician hours spread uniformly during this time period. (see attached document "Mod Coil Est 40 Turn.xls")

3. *Explain the 138 day float at delivery*
   The critical path of the project runs through the winding process specifically the modular winding occurring at station 3. The current float is 116 days not 138 days. (see attached document "critical path plot resource.pdf")

4. *This activity appears to be a combination of a fairly low-cost procurement coupled with extensive in-house fabrication expense. Is this correct? If so, how are both estimated? Please provide specifications and vendor quotation.*
   Yes, this is correct. This line item does not include any procurement and only includes the labor to manufacture the (18) modular coil windings. Estimates are based upon a combination of years of in-house winding experience as well as findings from the NCSX R&D activities. The WBS detailed estimate is attached to this document (Mod. Coil Est. 40 turns.xls)

5. *Are all 18 coil windings the same, and therefore, does each coil cost $174K?*
   There are (3) different Modular coil designs with a quantity of (6) coils for each type. Even though there are differences in the three designs, the degree of difficulty (complexity of winding surface), types of materials and the number of turns remains the same for all.

6. *It is difficult to correlate the $3.13 million shown in the resource-loaded schedule with the numbers presented in the cost backup. The cost backup does not reference activity ID nos., therefore, how are costs allocated and tracked?*
   See attached "Mod Coil Est 40 Turn.xls"

E. WBS 62 - Cryogenic Systems (409 days, $944K)

Additional EIR Team questions/information requirements:

1. *Please provide predecessor/successor reports.*
   See attached document "predecessor successor report.pdf"

2. *Provide the rationale for the 409 day duration and how the $944K cost is spread across the duration.*
   We don't understand this question. No tasks with this duration or cost appear in this WBS element. Please clarify.

3. *Please provide schedule duration and cost details for the 88 day duration for GN2 Cryostat Cooling System with a cost of $189.2K. Be prepared to discuss the scope and scheduling logic for the Design, Fab/Assy/Installation, and Procurement elements.*
   The cost and schedule for the GN2 Cryostat Cooling System, WBS Element 623, is summarized in the password-protected 10NOV03 NCSX Master Schedule, which you should have online access to Figure 1 shows schedule details for WBS 623 while the back-up sheet for 623, http://www.pppl.gov/ncsx/Project_Control/PDR_PC/PDR_WBS/WBS_62_Backup.pdf, shows the cost detail under WBS-633 (previous WBS system).

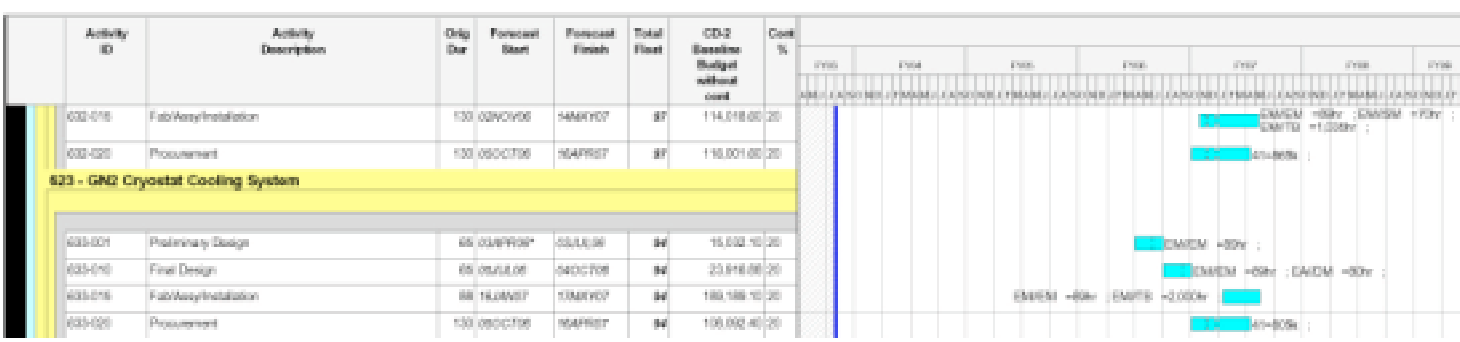


Figure 1, WBS 623 Details

4. *The cost backup detail sheet needs clarification.*
   - *Please define the column headings.*
   - *Please clarify the material quantities, lengths, volumes, etc used for estimating purposes?*
   - *Where are the specifications for material and equipment?*
   - *Please provide vendor quotes, actual procurements, engineering calculations, or whatever has been used to develop the cost.*

   Column Headings
   EMEM – Mechanical Engineer, Facility Maintenance &Operations (FM&O) Division
   EMTB Mech – Mechanical Craft Worker, FM&O Division
   EMTB Elec – Electrical Craft Worker, FM&O Division
   EMSM – Senior Mechanical Worker/Supervisor, FM&O Division
   EADS – Subcontract Drafting, Engineering Analysis Division
   EADM – Senior Designer, Engineering Analysis Division
   #units – usually "each", except 100 ft. & 2800 ft^2.

   The WBS62 estimate and backup has telephone-quoted prices such as the ACD-brand AC-30 pumps and the piece-parts such as the resistive heaters. Previous PPPL history in the construction of cryogenic piping and mechanical systems and input from experienced laboratory personnel were also used to generate this initial estimate. It should be noted that the WBS 62 scope, with detailed specifications, is not scheduled for Title 1, Preliminary Design until April of 2006 and that uncertainties in costs were incorporated into the contingency of 20% for this system.

5. *The total cost for this WBS, according to the backup sheet, appears to be $618K. This does not agree with the summary estimate figure of $787K. Please clarify.*
   General comment on detail backup material; the detail backup material provides estimating rational and detail man-hour and material/supplies estimates. Any cost figures shown on backup sheets do not necessarily reflect official laboratory rates and escalation. All pricing is performed in the Primavera database using official laboratory rates and escalation.

F. WBS 85 - Systems Integrated Testing (928 days, $924K)

Additional EIR Team questions/information requirements:

1. *Please provide predecessor/successor reports.*
   See attached document "predecessor successor report.pdf"

2. *Provide the rationale for the 928 day duration and how the $924K cost is spread across the duration.*
   NCSX Startup consist of 2 components (as detailed in the Test and Evaluation Plan - TEP).

- The first component is the preparation of required technical documentation required for first plasma. Fifty two technical documents have been identified which need to be in place for NCSX first plasma. These documents include Safety Assessment Document (SAD), Administrative Procedures, Operating Procedures, Test Procedures. Many of these documents exist in some form as a result of past and current MFE devices at PPPL. A large fraction of these existing documents require revision to make them applicable to NCSX. After a review of the current status of the existing documentation it is estimated that ~ 80 person weeks of effort is required to revise / and or develop the appropriate documents for NCSX first plasma. This work is planned to parallel NCSX construction activities allowing incorporation of appropriate input from NCSX design reviews and associated activities germane to NCSX design, fabrication, assembly & construction.

- The second component of NCSX Startup and First Plasma is the cost of the Startup Team. The NCSX Startup team is comprised of; Test Director, Operating Engineer, Project Engineer, Physicist in Charge (PIC), Computer Engineer, Power Systems Engineer, associated sub-system technicians. It is estimated that NCSX Startup, from from the end of NCSX construction to First Plasma, will take ~ 3 months. This estimate is based on our recent experience with the startup of MFE devices at PPPL of similar complexity, in particular NSTX.

3. *Please provide the lower level schedules that support "Procedure/Document Preparation" with 509 days duration and $437.2K cost.*
   Please see " Cost and Schedule" pages 9-13 of the NCSX TEP.

4. *Please provide the lower level schedules that support "Integration System Tests" with a 65 day duration and a cost of $332.6K. Be prepared to explain why this WBS is not on the Critical Path?*
   Please see " Cost and Schedule" pages 9-13 of the NCSX TEP.

5. *Please provide complete details and backup for how the cost estimate is developed. What is the estimate based on? What resources are required, and for how long? What are the discrete activities that are planned? What milestones are planned? What are the deliverables? Is there a planning document for this WBS?*
   Please see the NCSX TEP.

6. *The Summary Description for this WBS states that pre-operational tests are **assumed** covered by the individual WBS elements. Is this in fact the case, and can you verify that these costs are covered elsewhere? Does this refer to the testing of individual pieces of equipment prior to assembling the entire stellerator?*
   All sub-system Pre-Operational Tests are covered in the individual WBS elements specific to the sub-system (ie, Water Systems, Energy Conversion Systems (ECS), Motor Generator Systems (MG), Vacuum Pumping Systems (TVPS), etc. The cost of

the development and implementation of the PTP's in support of NCSX startup are identified in the specific sub-system jobs and included in their estimates.

7. *The 20% contingency for this activity seems low (in relation to other contingency values in the estimate), given the statements that integrated systems testing and startup of a complex fusion system has high technical and schedule risk. Please discuss.*
   As a result of the Startup and Operation of other MFE devices at PPPL, particularly NSTX, the Startup requirements for NCSX are well defined and understood. The documentation requirements have already been established within an existing technical documentation platform already in place at PPPL. The Startup team requirements and duration have also been well defined, the result of similar Startups at PPPL of MFE devices of similar complexity.

8. *The resource-loaded schedule total cost for this activity and the Cost Baseline Update (part of the backup documentation) total cost do not agree. Please clarify.*
   The cost for NCSX Startup, WBS 85, is estimated at $ 770 K (not including 20 % contingency). Components of this cost are;

   $437.2 K for Documentation Preparation (80 person weeks).
   $332.6 K for Starup Team (3 month Startup Duration).

   = $ 770 K

   ($154 K 20 % contingency)

   Grand Total = $ 924 K (with contingency)

2. Total Estimated Cost (TEC) and Project Schedule. The EIR Team will provide an independent evaluation of the TEC and overall Project Schedule, and discuss whether the TEC and schedule are reasonably consistent with similar DOE and/or other government/industry type projects. The EIR team will assess cost and schedule contingency and other cost and schedule factors related to TEC and the project completion schedule. As part of this work, the EIR Team will assess whether the TEC include all costs necessary for completion including startup and "hot" testing, as appropriate. Identify specific work activity that constitutes project completion and whether these completion activities are sufficiently well defined. The EIR Team will include an assessment of whether the project completion activities are consistent with DOE guidance for work to be included/excluded from the project. The EIR Team will also assess whether the project funding profile is consistent with the resource-loaded schedule.

Additional EIR Team questions/information requirements:

1. *Please be prepared to discuss the 2000 day float in WBS 121.*
   We don't understand the reference to 2000 day float. General note however, some tasks (primarily LOE and other period dependent tasks) have not been linked thus they display large values of float which should and can be ignored. The vacuum vessel fabrication (task 121-038) has 175 days float and is based upon all 3 field periods being delivered to PPPL together. Once received, cooling tubes are installed prior to the modular coil installation (which is on the critical path).

2. *What is the rationale for the 163 day duration and spread of $451.7K costs for ID "MT-PVVS-Fab"*
   See attached document "MT PVVS FAB.pdf" for this task

3. *Please provide supporting schedules for or activity "E10-encumr (A/9)costing $330K and activity "JPP-encumr (A/9) costing $ $550K.*
   The detailed base estimates provided by these vendors can be seen in attached documents "JPP S04340.xls" and "EIO S04341.xls". The tasks referenced pertain to the amount of money encumbered in FY03 yet planned to be costed in FY04 as shown in tasks 1404-110 and 210.

4. *Be prepared to explain the logic for the Critical Path among "Modular Coil final Design", "Mod Coil Winding for R&D", and "Mod Coil Casting. Concentrate on the activities with 116 day float.*
   See attached document "critical path plot resource.pdf"

5. *Please explain the rationale for the duration for activity "JPP-encumr (A/9)" of 48 days at a cost of $505.6K.*
   See answer to Question 3 above.

6. *Are the "Resource Loaded Schedule", "Master Schedule" and the "NCSX Cost Estimate Baseline" based on the same schedule?*
   Yes. The terms "Resource Loaded Schedule" and "Master Schedule" are both used within the project to refer to the Primavera based resource loaded schedule which contains linked schedule tasks which are resource loaded. Labor, overhead, and escalations rates have been established and applied to all tasks. The NCSX Cost Estimate Baseline is based on this schedule.

7. *Provide a Critical Path printout of Zero float activities. Explain the Critical Path float of over 116 days.*
   The project critical path's float or schedule contingency is 116 days or 5.5 months, as shown in the attached document "critical path plot resource.pdf". The rationale is explained in Question 9 below. Tasks with less than 116 days float are shown in the attached document "critical paths less than 116", however, these float values are based upon intermediate near term milestones that have since been accomplished (i.e.; VV/MC

PDR in October 2003 and Joule milestone #1 release MCWF vendors for fabrication) or since changed i.e. Joule milestone #2 and #3 as shown in the project milestone table.

8. *Please indicate what level mentioned in PEP Section 7.2 corresponds to the "NCSX cost Estimate Baseline Schedule.*
   The resource loaded master schedule is level II.

9. *Please provide the rationale for the schedule contingency.*
   The remaining 48 months until CD-4 includes 5.5 months of schedule contingency, or 13% on scheduled work. This is the total float that exists on the project's critical path schedule. The project is measured against the master schedule, however the DOE milestones are scheduled later than when the accomplish occurs the master schedule in order to provide a schedule buffer. For example, the project early finish date on the master schedule is 17-Apr-2007 however the CD-4 milestone is 30-Sep-2007, a difference of 5.5 months.

   The major intervals on the critical path from 10/1/03 to 9/30/07, with durations (and included contingencies) are:

1.	Final Design and R&D to Award of Production Contract:	14 (4.2) months.
2.	Coil & VV Fab to Start of Field Period Assy	20 (0.6) months
3.	Field Period Assy / machine assy, test, to 1st plasma	14 (0.7) months
	Total	48 (5.5) months

   The schedule risks are largest in the first interval because design and R&D are each serial activities susceptible to delays stemming from the challenging geometry, which are not readily mitigated by workarounds. The activities in the second interval- fabricating and winding coils– are also susceptible to schedule uncertainties due to the tight tolerances that must be achieved, but because they involve repetitive or parallel activities, schedule delays can be mitigated by adding additional shifts or production lines. For example, the project could elect to procure modular coil winding forms from both of the vendors who are producing prototype winding forms, if both qualify. The winding activities could proceed in parallel with multiple winding lines. To get a head start on field period assembly, the vacuum vessel field periods could be delivered as they are completed instead of waiting for all three field periods to be completed before delivery. The third interval is again more serial in nature but except for field period alignment and welding the field joint, most operations in that phase are relatively predictable.

10. *What are the reasons for the project cost growth from $72 million at CD-1 to $81 million today?*
    Between the CDR and CD-1, the cost increased from $72M to $73.5M and the project was extended by 3 months as a result of project re-scheduling to fit within OFES funding profile constraints.

The cost estimate increased from $73.5M at CD-1 to $81M today. Though physics requirements have not changed, their cost implications have become better understood through design and R&D efforts. As a result, estimates for stellarator core fabrication were revised upward in all phases: engineering design, R&D, manufacture, assembly. Budgets for system engineering and construction support were increased to reduce the risk of greater cost growth downstream due to poor integration or coordination. The increases were partially offset by cost savings due to value improvements and deferral of some ancillary system scope not needed for first plasma and field-line mapping.

11. *The contingency analysis does not appear to use Monte Carlo or other probabilistic techniques. Please discuss the particular technique used, and what advantages/disadvantages it holds over conventional probabilistic techniques.*
The contingency is estimated at the subsystem level by the WBS managers, who evaluate cost, schedule, and technical risks on a numerical scale, assigning relative weighting among these factors, and computing per cent contingency from these assessments using an algorithm. The algorithm, assessment criteria, and a template to facilitate the analysis are provided by the project to ensure a uniform methodology, but the evaluation is done by the WBS manager based on their understanding of the risks. The advantages of this method are its direct derivation from risks by those most familiar with those risks and their implications, namely the WBS managers, and its simplicity.

12. *The project contingency in May 2002 was 28% (prior to CD-1). It is still 28% prior to CD-2. Please discuss.*
There are competing effects which have tended to cancel each other. Design and R&D progress since May, 2002 has increased our understanding of the project issues and work scope and has reduced uncertainties. The work breakdown and estimates have been developed in greater detail. Component estimates have been developed by industrial manufacturers from detailed manufacturing, inspection, and test plans based on the project's specification. At the same time, our understanding of project risks has also improved. The difficult geometry and tight tolerances have challenged our computer design and analysis tools more than we expected, requiring ongoing tool improvements and slowing the design process. While we have adjusted our estimates in response, it is clear that these root causes of risk will manifest themselves through the remainder of design and through manufacture, inspection, and assembly. Hence the risks have not decreased. It is important to note that while the critical manufacturing processes have been analyzed, they have not yet been demonstrated through fabrication of realistic prototypes. Our risk assessments and contingency estimates, like our cost estimates, are on a much sounder footing now than they were at the time of the May, 2002, CDR.

13. *The Project Management contingency of 17% seems high given that it is level-of-effort and specific resources are defined. Please be prepared to discuss how this contingency level is determined.*
14. *Why does Project Engineering carry a 34% contingency? This seems very high. Why would Project Engineering carry a significantly higher contingency than Project Management?*
    Taking Questions 13 & 14 together: Both Project Management (WBS 81) and Project Engineering (WBS 82) carry 17% contingency. Each has specific resources defined which constitutes a base level-of-effort. However, there is a risk that some of the activities included in these work packages will need to be augmented sporadically to respond to unexpected project or system-level issues. As illustrative examples, an extra cost/schedule re-baselining exercise involving additional effort by project control staff, component inspection variances requiring a rapid assessment of field error implications, or CAD difficulties requiring the design integration group to bring additional expert resources to bear. The 17% contingency corresponds to approximately 1 f.t.e. per year for WBS 81 and 82.

15. *What escalation rates have been used and how is escalation incorporated in the estimate? What is the total escalation for the project?*
    See attached document "Rates and Resource Codes 092603.pdf" for baseline labor rates, overheads, and escalation. Application of these rates is performed in the Primavera based master schedule.

16. *Some WBS elements have no "backup" cost estimating files in the Cost and Schedule documentation. Please provide missing backup documentation.*
    The Work Breakdown Structure for NCSX includes the entire life cycle scope (as we see it now) of the Project. However, only a portion of that scope is included in the MIE Project. Anticipated future upgrades are also included in the WBS for completeness. Historically, fusion scientific projects have followed this exact same logic – a minimum set of basic systems and components were provided for first plasma and future upgrades made as the experimental program develops and evolves.

    In reviewing the information posted, we have confirmed that backup was provided for all elements included in the MIE Project with one exception : WBS 39. This information has now been posted. What contributed to the possible confusion was that the 3 digit WBS Dictionary provided contained some errors and was not current with the final elements included in the MIE Project. In addition, it should be noted that the backup documentation for the power systems (WBS 4) is provided at the summary level since the spreadsheet was provided in that format – however, the detail is provided in this spreadsheet to the 3 digit level.

    The corrected 3 digit WBS is shown in Appendix 1. The following changes/corrections were made:

- WBS 114, 212, and 231 were incorrectly listed as part of the MIE Project – this was an error. In fact all three elements are anticipated to be possible future upgrades.

- WBS 62 and WBS 64 were incorrectly listed as "Not in MIE Project." This has now been corrected and the WBS Dictionary updated to include the descriptions shown in Appendix 2.

- The cost estimate backup for WBS 39 has now been posted. This was an inadvertent omission.

- WBS 15 and WBS 19 have been expanded out to the 3 digit WBS to agree with the cost estimate backup provided.

17. *Are spares required for some of the NCSX components? If so, where are the costs captured, and how are costs determined? If not, what is the rationale for not having spares, and does this present a risk to the project?*
    No spares are provided for stellarator core components, which include the modular coils, conventional coils, and vacuum vessel. Modular coils are being designed to minimize the potential for failure through the application of conservative design margins and careful quality assurance. Electrical joints and hydraulic connections are located on the outside of the shell where there is access to effect repairs, if necessary, without replacing the modular coil. Consideration is being given to providing local access through a hole in the shell to the modular coil winding in the region where the turn-to-turn transitions and current feeds are located, as recommended by the PDR Review Committee.

    We are "designing out" failure modes which would require removal of a modular coil (and disassembly of the stellarator core), which would be a time consuming effort, to the extent possible. However, some credible failure modes requiring removal of a modular coil would remain. An electrical failure in the winding is the most likely of these failure modes. It is extremely unlikely that a new winding form would be required because of the low stress levels in that structure. In the event of a failure requiring removal of a modular coil, the failed modular coil would be removed, the winding would be stripped off, and the coil re-wound. Excess conductor (enough for 20 modular coils) has been ordered as part of the MIE project, which could be used to re-wind a failed modular coil.

    The rationale for not providing spares for the conventional (TF, PF, and external trim) coils is similar. These coils are also being designed to minimize the potential for failure through the application of conservative design margins and careful quality assurance. The regions where failures are most likely, i.e. where the turn-to-turn transitions and current feeds are located, will be accessible so local repairs could possible be effected without replacing the coils.

If replacement of a conventional coil was required, we have the facilities to expeditiously wind replacement coils here at PPPL. Consideration will be given to ordering excess conductor for the PF coils and TF coils.

No spares have been ordered for the vacuum vessel either. The vessel is a robust structure without insulating breaks. The most likely failure mode would be a vacuum leak. Vacuum leaks typically occur at weld joints or conflat seals and do not typically require replacement parts to effect repair.

Ancillary systems make extensive use of legacy equipment. Legacy systems include Water Systems, Neutral Beam System, Torus Vacuum Pumping System, and Electrical System. The initial configurations of these systems do not make full use of the equipment that is available, so in effect, we have ample spares. The NCSX Water System makes use of only a fraction of the capacity of the C-Site water system, which is already operational. Pumps and gasket sets (items which typically would be required to effect repairs) are stocked in the warehouse. At the time of First Plasma, only one of the four neutral beams available will be installed. The other three beamlines could be used to supply any spare parts that might be required, and additional spare parts for some components are available. The Torus Vacuum Pumping System will use only two of the four turbo-molecular pumps which are available. NCSX will share power supplies with the NSTX project. Together, they do not use all of the Transrex power supplies available in the FCPC building. The bottom line is that we typically do not need to buy spares for the legacy systems because they are already operational or the legacy equipment available exceeds our initial requirements.

The initial diagnostic complement includes magnetic diagnostics, which are mineral insulated flux loops located on the vacuum vessel exterior. This is a robust design, proven on devices such as DIII-D, for which ample redundancy has been incorporated into the design.

Central I&C makes extensive use of commercial off-the-shelf components that can be readily procured. In addition, there will be substantial commonality in the design (and even shared hardware) with the NSTX Central I&C, which is already operational.

In summary, providing spares is an important consideration in managing project risk. Spares have not been budgeted in stellarator core systems. Rather, we have designed with conservative design margins and careful quality assurance to minimize the likelihood of failure and provided access to fix likely failures in situ without requiring part replacement. We have the facilities to expeditiously wind replacement coils at PPPL if needed, thereby reducing risk to the project. Excess conductor for the modular coils is already budgeted. Typically, we do not need to initially buy spares for the legacy systems because they are already operational or the legacy equipment available exceeds our initial requirements. Spares support of the device during operations will be tailored based on the operational experience. This approach is consistent with the approach taken on other research projects at PPPL, such as NSTX.

18. *What are the general cost estimating assumptions?*
Guidance to our WBS managers is shown in the attached "Cost & Schedule Guidance.pdf". Additionally, please see the attached "NCSX Guidelines 3-28-031.doc" for guidelines that establishes accounting classifications for costing & budgeting.

3. Work Breakdown Structure. The EIR Team will *a*ssess whether the WBS incorporates all project work, and whether it represents a reasonable breakdown of the project work scope, and assess whether the resource-loaded schedule is consistent with WBS for the project work scope.

Additional EIR Team questions/information requirements:

1. *The cost estimate for WBS 85 ($1.05M) appears small relative to the overall project cost. Please provide detail regarding what is included in WBS 85.*
NCSX Startup costs, WBS 85, do not include the sub-system pre-operational test procedures (PTP's). The cost of this work is covered in the sub-system WBS's. The cost of documentation (excluding PTPs') are well defined in the NCSX Test and Evaluation Plan (TEP), posted with the baseline documentation under Item 11. The cost are based on a review of what documentation is required, the current status of the startup Documentation, and what resources are required to develop the documents or to revise current documentation to make it germane to NCSX startup and operation.

   The cost of the startup team for a 3 month startup duration is based on the recent startup of MFE devices at PPPL with similar complexity (e.g. NSTX) employing many of the same (proven) sub-systems.

2. *Please explain the vehicle for accomplishing the WBS elements marked "not in MIE" and where their costs are included.*
The Work Breakdown Structure for NCSX includes the entire life cycle scope (as we currently envision) of the Project. However, only a portion of that scope is included in the MIE Project. Anticipated future upgrades are also included in the WBS for completeness. Future upgrades will be funded out of research operating budgets.

3. *The WBS and WBS dictionary are inconsistent leading to questions about what is included in the scope. For example, WBS 231, 232, and 233 are stated in the WBS as not being in the MIE Project, but the Dictionary provides a SOW. This same comment applies to WBS elements 32, 33, 34, 35, and 37. A couple WBS elements – 62 and 64 – are referred to in the Dictionary as future upgrades. Please explain why the two documents differ.*

WBS 231-WBS 233, WBS 32-35, and WBS 35 are examples (as are WBS 24 and WBS 26) where the program anticipates the likelihood that these elements will be added as the experimental program develops. In fact, our research plan includes a time-line projecting when these elements might be brought on board. These specific elements are clearly identified as either "not in MIE Project" or not in (Operating) Phase 1 or 2 (essentially the same meaning) in the WBS dictionary.

4. *WBS 62, 64, and 65 are stated in the WBS as not in the MIE Project, but the resource-loaded schedule shows activities and costs for all. Please explain.*
   This was an error, WBS 62 and WBS 64 are in fact in the MIE Project. The response to question #16 in the TEC area addresses the proper scope.

   WBS 65 was collapsed into other WBS 6 elements, since it was felt that this integration task was more appropriately part of each WBS element. Rather than attempt to arbitrarily allocate the ~$9K of costs accrued in WBS 65, it was decided to keep these costs there, but to delete this WBS element.

4. Risk Management. The EIR Team will determine if risks have been identified and properly classified as high, medium, and low; assess whether appropriate risk mitigation actions have been incorporated into the baseline; assess whether adequate contingency has been included in TEC and Schedule; and describe the approaches used to determine risk and assess adequacy.

Additional EIR Team questions/information requirements:

1. *Are there any concurrent line item projects or GPP that may impact this project through limiting resources or access? If so, please be prepared to discuss impacts and risks.*
   None.

2. *Please be prepared to discuss how your process for contingency assessment (both cost and schedule) relates (or does not relate) to the risk identification/mitigation process.*
   Risks are identified and evaluated at the subsystem level by the WBS manager. They identify and plan appropriate risk mitigation measures and include those costs in their estimates. Examples are R&D, analysis, oversight of critical operations, and system engineering to name a few. Budget contingency, another form of risk mitigation, is estimated by the WBS managers by evaluating the risks, after other risk mitigation measures are taken into account, on a numerical scale and calculating per cent contingency according to a project-supplied algorithm. This algorithm was successfully used by the NSTX project, and has been used in high-energy physics projects and on other fusion projects. The details can be discussed during the review. Schedule contingency is developed at the project level, based a global assessment of risks to the critical path schedule.

3. *Be prepared to discuss how specific risk mitigation actions incorporated into he cost and schedule baselines.*
   Some examples of where risk mitigation measures are budgeted and scheduled:
   - Extensive R&D activities in WBS 12 & 14.
   - Engineering oversight of coil winding (WBS 14) and assembly (WBS 18, 7)
   - System engineering and technical assurance in WBS 82.
   - Contingency in all WBS.

4. *What is the plan for releasing contingency? What is the impact of released contingency on the EAC?*
   Changes to the controlled baseline are implemented via engineering change proposals (ECPs). A change proposal that reduces contingency increases the EAC by the same amount and requires the approval of the Federal Project Director.

5. Preliminary Design and Design Review. The EIR Team will evaluate adequacy of preliminary design including adequacy of drawings and specifications, and assess whether they are consistent with system functions and requirements; assess whether all safety Structures, Systems, and Components are incorporated into the preliminary design; review results of the preliminary design review; and assess whether additional work identified in the design review has been incorporated into the Performance Baseline.

Additional EIR Team questions/information requirements:

1. *Are there any costs or modifications needed for the liquid nitrogen storage tank and helium supply manifold? Have these existing systems been checked out and verified as adequate for the NCSX?*

   1. Both systems have been investigated and confirmed as adequate for NCSX.

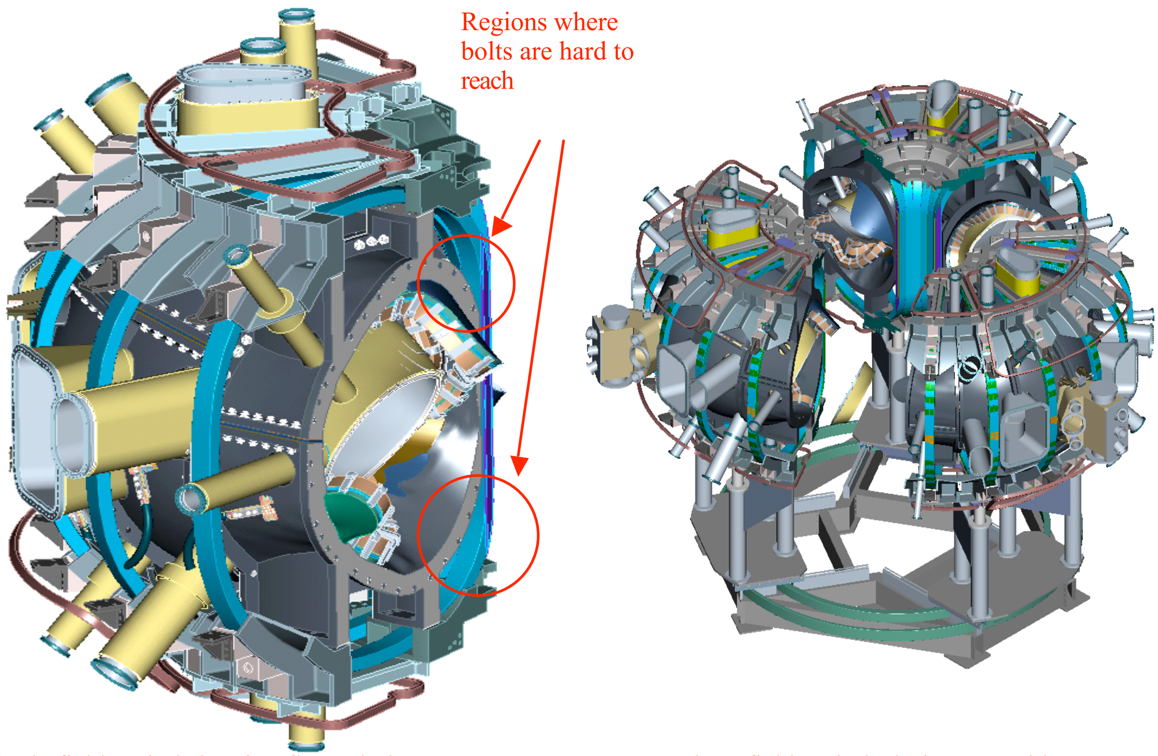
   2. An unfortunate overpressure tragedy in Germany drove an industry-wide refit program of truck-loaded dewars last summer. The C-Site dewar has been fitted with an approved automatic excess flow inlet shutoff valve and is otherwise in fine condition.

   3. The old PBX-M liquid take-off still exists. The D&D effort carefully preserved this. Some re-wrapping of insulation will be required.

   4. The helium rig will require replacement of some seals due to entropic decay, but this effort is not part of the MIE project.

2. *The Preliminary Design Review recommended that the Project address the issue of lack of access for bolt installation and tightening of fasteners between field period assemblies in the inboard area. How has the Project resolved this issue?*

   Background: The modular coil structure consists of individual winding forms that are bolted together to form a continuous toroidal shell. The bolting sequence starts by bolting 3 coils together to form a half field period, then bolting this half field period to an identical set of three coils to form a full field period, then bolting three field periods together to form the complete structure. The bolt pattern shown at the PDR included some bolts that were hard to reach during this final assembly step, bolting the three field periods together. Figure 2 illustrates the bolts that are hard to reach.



Single field period showing flange bolt pattern

Three field periods during assembly

Figure 2
Final assembly flange joint for modular coil shell

The approach to solving this problem will follow two steps. The first step will simply determine which bolts are difficult to reach. The second step will explore whether any of these bolts are actually needed to provide an adequate structural arrangement. The principal loading direction on the modular coils is inward in all cases, causing the inboard region of all the connecting flanges to be in compression. The only requirement for bolts in these regions is for shear purposes. The shear capability can be provided by pins, which in principal can be blind, or by friction, which would be provided by the compressive magnetic loads and by the preload afforded from the bolts located in the outboard regions of the mating flanges. It is very probable that the bolts which are difficult to reach can be eliminated from the design.

6. System Functions and Requirements. The EIR Team will assess whether "design to" functions and requirements are reflected in the baseline, including safety and external requirements such as permits, licenses, and regulatory approvals; and evaluate whether system requirements are derived from and consistent with Mission Need.

Additional EIR Team questions/information requirements:

1. *It appears that one Neutral Beam system will be installed as part of the Project, with other NBs planned for installation during the operational phase. Is there sufficient room and availability to install additional beams later and can the project meet the scope baseline with a single neutral beam?*
   The NCSX device and facility are being designed to accommodate four beams in either a 2 co/2 counter or 3 co/1 counter orientation, as specified in the GRD. The scope baseline, per the Project Execution Plan, is to provide a single neutral beam.

***7. Hazards Analysis*.** The EIR Team will evaluate the quality of the Hazard Analysis and assess whether all scope, schedule, and costs necessary for safety are incorporated into the baseline. The EIR Team will review the classification of SSCs as safety class or safety significant; assess the Hazards Analysis process, including the use of internal and external safety reviews; and review any Defense Nuclear Facilities Safety Board and/or Nuclear Regulatory Commission interface and discuss the status of their involvement.

***8. Value Management/Engineering*.** The EIR Team will assess the applicability of Value Management/Engineering, and whether a Value Engineering (VE) analysis been performed with results being incorporated into the baseline. Also, the EIR Team will provide an assessment of the VE process for this project.

Additional EIR Team questions/information requirements:

1. *Please make available any formal documentation, in addition to the briefing, from the engineering task force that focused on value engineering. How was each VE item resolved?*
   Please see the NCSX VE Reports:
   http://www.pppl.gov/ncsx/Meetings/PDR/PDR_Docs/NCSX_VE_Report.pdf
   http://www.pppl.gov/ncsx/Meetings/PDR/PDR_Docs/ValueEngineering_091903.pdf

2. *Be prepared to discuss how value management incentives have been incorporated into the contracts awarded to date and the plan for incorporating these incentives into future contracts.*
   The Project and the PPPL Procurement Division are using "best value" procurement techniques to ensure that critical components and services are awarded to those suppliers whose combination of technical, management, and cost control expertise provide the necessary levels of timely performance and necessary quality at minimum cost to the Project. To incentivize productivity and give additional opportunities for contractors to value engineer certain technically challenging critical path items (namely, the modular coil winding forms and the vacuum vessel) during their design and prototype phases, the Project has opted to fund two suppliers. The plan is to have these suppliers compete head-to-head in a second "best value" technical and price competition for award of the production contracts.

3. *How will Value Engineering activities be continued through the life of the Project?*
   A design study is under way to resolve the main open item from the pre-PDR Value Engineering study, namely the use of C-site power systems as an alternative to the baseline D-site design. That VE study was conducted at the project level. In the future, the project will continue to seek lower-cost solutions in all phases, i.e., design, manufacture, assembly, installation, etc.

9. Project Controls/Earned Value Management System (EVMS). The EIR Team will assess whether all project control systems and reporting requirements will be in place prior to Critical Decision-2. For projects where EVMS is not required, the EIR Team will assess the adequacy of an alternate project control system for monitoring and controlling project costs and schedules.

Additional EIR Team questions/information requirements:

1. *Please provide a list of all PPPL generic management procedures and be prepared to supply copies of specific procedures as required.*
   The list of PPPL procedures is provided in Appendix 3. Copies will be provided at the review upon request.

2. *Please provide copies of the CD-0 and CD-1 approval letters for this project*
   Hard copies of the CD-0 and CD-1 approval letters will be provided at the review. . They are posted on the NCSX web site, on the "Management" page.

3. *Does PPPL have a 10-year Site Comprehensive Plan? If so, please provide.*
   The current "10-Year Strategic Facilities Plan" for PPPL will be provided at the review.

4. *Has a Construction Project Data Sheet (CPDS) been prepared for the project? If so, please provide.*
   An OMB Exhibit 300, Capital Asset Plan (OMB-300), has been prepared for NCSX and is updated periodically. The latest version, dated 9/4/03, is provided and posted on the project web site at http://www.pppl.gov/ncsx/Management/OMB/OMB300.html. There is no CPDS because NCSX is a Major Item of Equipment (MIE), not a line item project.

5. *Please be prepared to discuss each progress-reporting document (progress reports) with emphasis on derivation of reported earned value—how is it determined and by whom, and how verified. Please use the progress reporting documents to appraise current project status. Be prepared to describe the frequency of distribution, and recipients, for each status reporting document.*
   The NCSX project control processes can best be illustrated in the attached document "PCS REVIEW PRESENTATIONr1.pdf". This provides a good overview of our system, which we will be glad to go over with you.

6. *Be prepared to describe the process for developing revised estimates of cost at completion based on performance to date, commitment values for material, and estimates of future conditions. Who does it, how often, and in what context?*
   Estimates at Completion (EAC's) for the tasks in progress are provided by the cost account (job) manager as part of the monthly statusing process. At key milestones, such as a final design review or major contract award, a bottoms-up estimate at completion will be developed at the subsystem level by the cognizant WBS manager. Once a year, typically in conjunction with a semi-annual DOE project review, an updated bottoms-up EAC will be developed at the project level.

7. *What is the Laboratory Project Controls organization, and the interrelationships and information exchanges between it and the cost account managers? Be prepared to discuss the experience and training level of the project controls personnel assigned to this project.*
   Each project within PPPL has a project control officer assigned. These individuals are matrixed to the project manager from the controller's office (business operations). The NCSX project has two project control officers currently assigned. See attached document "project control org.pdf".

8. *Be prepared to discuss the information exchange and integration processes between the accounting, budget, and PCS systems pictorially shown in exhibit B-4-A of the document, "PPPL Project Control system Description."*
   We are prepared to discuss this at the EIR team's convenience. Please see the attached document *"PCS REVIEW PRESENTATIONr1.pdf" page 10.*

9. *How is the process for assessing earned value for R&D work documented?*
   We are prepared to discuss this at the EIR team's convenience. Please see the attached document *"PCS REVIEW PRESENTATIONr1.pdf" pages 19 and 20.*

10. *Describe the communication process for conveying variance information to appropriate levels of management for implementing corrective actions.*
    Cost and schedule status is updated and measured against the performance measurement baseline on a monthly basis. Most members of the project management team and the Laboratory's Engineering department head participate in the collection of status data from the WBS managers, which includes considerable discussion of problems and planning of corrective actions. Performance results, including variances and cost and schedule performance indeces are reported to the project management team, to Laboratory upper management, and the Federal Project Director. The project manager is responsible for identifying and implementing appropriate corrective actions in response to cost and schedule problems. Problems are communicated in weekly meetings with the Laboratory Deputy Director, who works with the project to ensure that Laboratory resources are made available to meet project needs. We are prepared to discuss this at the EIR team's convenience. Please see the attached document *"PCS REVIEW PRESENTATIONr1.pdf" pages 23 and 24.*

11. *How does PPPL follow the guidance ANSI/EIA 748-A-1998, Earned Value Management Systems for implementing EVMS for projects? Has PPPL been certified as compliant with ANSI/EIA 748-A-1998?*
    The NCSX Project Control System was reviewed and validated in February 2003 by an independent DOE review committee. We are prepared to discuss this further at the EIR team's convenience. Please see the attached report "NCSX PCS REVIEW REPORTS.pdf".

12. *Who are the stakeholders? Are there coordination issues with other DOE Sites besides ORNL?*
    Other than DOE, the major stakeholder group is the fusion research community, especially so because NCSX will be operated as a national research collaboration involving several DOE-sponsored fusion institutions besides PPPL and ORNL. The community's interests are addressed in a variety of ways. In its early stages, the project made numerous presentations to the Fusion Energy Sciences Advisory Committee, who endorsed the scientific mission and proof-of-principle designation for the project. The NCSX program advisory committee meets periodically to advise the project from the perspective of the research community and potential participants in the NCSX research program. The project participates in OFES's annual budget planning meeting, presenting its budget needs and participating in the community-wide discussion of fusion program budget issues. Finally, peer participation in major project reviews keeps the project accountable to the larger research community for maintaining high standards in physics, engineering, and technical management.

13. *Describe the funds management system. What ensures that annual funding is not exceeded?*
    In brief, all funds appropriated to the project for a given fiscal year are allocated to the project at the beginning of the year. The funds are provided by DOE directly to PPPL and ORNL via those Laboratories' financial plans. The DOE typically follows the project's recommendations for the division of project funds between the two Laboratories as well as any requests for financial plan transfers needed to make adjustments during the year. All project work and expenditures of project funds, regardless of institution, must be authorized by the project manager. At the beginning of the fiscal year, the project manager authorizes work against the available budget, keeping a portion of it as management reserve. Management reserve funds are released during first part of the fiscal year by the project manager, with the concurrence of the Federal Project Director, either to solve problems or to accelerate in-scope work scheduled for future years.

    The project manager is responsible for staying within the annual budget. The work authorization system provides the means to control expenditures. Management reserve is set aside to provide the ability, within the approved budget, to respond to problems or opportunities that arise during the year. The monthly laboratory cost reports provide, via the NCSX project control system, information on costs and cost trends that the project manager uses as input to spending decisions and cost control efforts.

***10. Project Execution Plan (PEP)*.** The EIR Team will review the PEP and determine if it reflects and supports the way the project is being managed, is consistent with the other project documents, and establishes a plan for successful execution of the project.

Additional EIR Team questions/information requirements:

1. *The PEP (Revision 1, Draft K, page 13) states that Quality Assurance support is provided by PPPL however, the organization chart (Figure 4-1, page 12) does not include a position for QA. Be prepared to discuss how PPPL supports the QA process.*
   QA appears on the organization chart in the same box with ES&H because both are included in the same WBS (83). The boxes can be separated if necessary to make it clearer. The Project's QA Manager also heads the Laboratory's QA organization, which reports to the PPPL Director through the line organization. Any of us can discuss QA with the EIR team. A presentation on this subject will be made as part of the Lehman review and a copy of the slides will be available to the EIR team.

2. *The organization chart (Figure 4-1, page 12) does not include a position for "Start-Up Manager." What is the plan for the position of Start-Up Manager?*
   Charles Gentile is the Start Up Coordinator on the NCSX project. At the present time, this is a planning function. Start Up Coordinator is a staff position reporting to the Engineering Manager. Prior to the activity changing from planning to execution, the position of Start Up Test Director will be created and filled as a line management position reporting to the Engineering Manager.

3. *The version of the PEP provided has no signatures. Who has reviewed and approved the PEP and what are plans to obtain DOE HQ approvals?*
   The Preliminary Project Execution Plan (PPEP) was reviewed and signed by the NCSX line management personnel in the Laboratories, the local area office (PAO), the operations office (CH), and the Office of Science. It was approved by Anne Davies, Associate Director for Fusion Energy Sciences, in July, 2002. The PEP is a revision of the PPEP incorporating updates as needed and modifications to conform with new DOE manual M413.3-1 that was issued in the past year. Following the EIR and Lehman review, it will be circulated for review among all signatories so that their comments can be incorporated and the PEP made ready for approval at CD-2.

4. *Be prepared to discuss the qualifications, experience and training levels of the management organization (described in the PEP), particularly for the PPPL Project Manager and the NCSX Federal Project Director.*
   All project management personnel will be available and prepared to discuss these topics with the EIR team.

5. *What is the plan for addressing Safeguards and Security issues in the PEP? What other documents describe the Safeguards and Security processes?*

   The project is covered by PPPL's approved Physical Security Plan which addresses Laboratory wide Security concerns. The Plan addresses the issues identified in PPPL's Vulnerably Analysis and ensures that systems, procedures, and security forces are in place to protect employees, visitors and the general public and to protect PPPL and DOE assessment against theft, damage or sabotage. Although we are not a classified facility, the Security Plan is closely controlled. The Site Protection Division will be available to discuss the plan and any related aspects with the review team. In the context of this plan, further treatment of safeguards and security issues in the PEP is not required.

   In addition, PPPL is in the process of a major construction effort to procure and install a contemporary Access Control and Monitoring System (ACAMS). NCSX project and protection requirements have been incorporated into the design of the ACAMS.

   Laboratory activities that introduce changes to engineering, facilities, prototypes and their development require the preparation and completion of reviews, work planning, hazard assessments and controls to properly manage the changes. The Site Protection Division coordinates safeguards and security controls for the Laboratory. PPPL's management and administrative processes and procedures require opportunities for the Site Protection Division to participate in the planning of facility needs and enhancements.

6. *Please provide a copy of the NCSX Project QA Plan mentioned on page 33 of the PEP.*
   The QA Plan is available at http://www.pppl.gov/ncsx/SystemsEngineering/Plans_Procedures/QAP/NCSX-PLAN-QAP-00_Signed.pdf , and will be provided in hard-copy at the review.

7. *Be prepared to discuss the use of project management reserve funds.*
   At the beginning of each fiscal year, the project authorizes work against the available budget, keeping a portion of it as management reserve. Management reserve funds are released during first part of the fiscal year by the project manager, with the concurrence of the Federal Project Director, either to solve problems or to accelerate in-scope work scheduled for future years. We are prepared to discuss this further with the EIR team.

8. *Be prepared to discuss the Change Control process employed for the Project. Please provide any Change Control documentation (forms, logs, etc.) created for the Project.*
   We are prepared to discuss this at the EIR team's convenience. A copy of the NCSX Configuration Management Plan (NCSX-PLAN-CMP) and its accompanying Procedure on NCSX Configuration Control (NCSX-PROC-002) will be provided at the review. These documents provide comprehensive discussions of the NCSX configuration management and change control processes.

9. *Please explain the Configuration Control process employed for the Project. Please provide any configuration control documentation created for the project.*
   See answer to PEP Question 8 above.

11. Start-up Test Plan. The EIR Team will assess whether the start-up test plan identifies the acceptance and operational system tests required to demonstrate that system meets design operational specifications, and/or safety requirements. The EIR team will review key tests to ensure that sufficient description is provided to estimate cost and schedule durations associated with these tests and assess the adequacy of the descriptions of success and the incorporation of the test requirements into the preliminary design. Finally, the EIR team will assess whether there is sufficient cost and schedule contingency for test and equipment failure during start-up testing.

***12. Acquisition Strategy*.** The EIR Team will review the Acquisition Strategy to determine if it is consistent with the way the project is being executed. The EIR Team will evaluate any changes from CD-1 that may impact whether the current strategy represents best value to the government.

Additional EIR Team questions/information requirements:

1. *The "NCSX Acquisition Execution Plan (NCSX-PLAN-AEP)", Revision 0, June 28,2002, appears outdated. Has this document been revised? If so, please provide the update. Be prepared to discuss how this plan will be maintained up to date.*
   The AEP was prepared by the project and approved by Undersecretary Card as a prerequisite to CD1 approval (11/02). The project has reviewed the AEP vs. current acquisition strategies (9/03) and determined that there has been no significant change to the strategies outlined in this document. It is not intended to revise and resubmit this document for USEC approval unless significant changes in project direction and/or procurement philosophy materialize. The project will continue to review the AEP for general compliance.

2. *Be prepared to discuss how quality requirements are defined in contract documents and how they are enforced.*
   The requirements for quality are included in the applicable specification and statement of work, which become part of the contract. Quality requirements typically include the requirement for plans, such as a verification and validation plan, QA plan, or manufacturing, inspection, and test plan. Additional quality requirements might include the use of travelers, witness or hold points, control of special processes, generation of nonconformance reports, configuration control, calibration of measuring and test equipment, etc. NCSX personnel are responsible to identify the appropriate quality requirements for their procurements. However, QA reviews all procurement requests to assure that the appropriate quality requirements have been specified. Enforcement is a joint project/QA/Procurement responsibility. Throughout the procurement, both the requisitioner and QA maintain contact with the subcontractor to assure that the quality

requirements are satisfied at the appropriate times and adequate documentation supporting this is provided to PPPL.

3. *The AEP does not discuss the relationship(s) of the project components to the "Not in MIE Project" WBS elements. Be prepared to discuss the coordination process for WBS components designated "Not in MIE Project" with needs of fabrication and installation contractors.*
   The AEP describes the acquisition approaches for the MIE. As explained in Question 3.3, the Work Breakdown Structure for NCSX includes the entire life cycle scope, including some items envisioned as future upgrades that are not in the MIE project scope. The General Requirements Document specifies that the MIE facility must be designed to accommodate these upgrades when needed, and the design effort necessary to ensure this is included in the MIE project scope. Long-lead preparation of some upgrades will begin under Research Preparation funds in parallel with the MIE project, but since their implementation does not occur until after MIE is complete, there are no significant work coordination issues.

4. *Be prepared to discuss how are small business participation plans incorporated in acquisition planning?*
   PPPL has an active and very successful small business subcontracting program. We find that qualified small businesses are often more responsive to Laboratory needs than large business, more cost-effective, and more flexible in responding rapidly to changes in project requirements. In accordance with Article I.16 of the Prime Contract, a small business subcontracting plan, including goals in six (6) separate socioeconomic classifications, is negotiated annually with the DOE Contracting Officer and formally incorporated into the contract as Attachment J. 8 (Appendix H). For the past eight consecutive years (since 1996), PPPL has met or exceeded all of its annual subcontracting goals. In 1999, PPPL was one of four Government prime contractors to receive the Dwight D. Eisenhower Award of Excellence in Small Business Subcontracting, issued annually by the US Small Business Administration. All procurements, including those for the NCSX Project, are screened by the Laboratory's Small Business Liaison Officer, Ms. Arlene White, for possible small business set-aside, or where set-aside is impractical, for inclusion of qualified small business sources in the solicitation. Annually, the NCSX Project is requested to identify proposed procurements with an estimated value in excess of $100,000. Descriptions of the procurements are posted on the DOE Office of Small and Disadvantaged Business Utilization (OSDBU) Forecast of Business Opportunities website at https://hqlnc.doe.gov/support/SmallBusUtil.nsf/. Currently, six (6) NCSX or NCSX-related procurement opportunities are posted at the site. Since Project inception, Project management has taken a proactive and receptive approach to small business subcontracting. In fact, after a detailed best-value competition employing technical, management and cost factors, three of the four subcontracts for the critical NCSX Modular Coil Winding Form and Vacuum Vessel manufacturing feasibility studies and prototype fabrications were awarded to small businesses. In accordance with established

practice, and whenever the Project's technical, schedule and budget requirements permit, PPPL will source NCSX procurements with small business.

5. *Be prepared to discuss the current strategy for incorporating "shared savings" incentives (or the like) in the fabrication and installation contracts?*
   PPPL is familiar with the application of incentives to direct and motivate subcontractors. In fiscal year 2003, the Procurement Division worked with the National Spherical Tours Experiment (NSTX) engineering staff to craft a series of incentivized purchase orders for the accelerated fabrication of key repair parts by local machine shops. The process involved analysis of critical path procurements, identification of candidate actions where acceleration was feasible, development of tailored incentive language, negotiation of mutually agreeable delivery terms with selected suppliers, close monitoring of supplier performance, and timely incentive re-negotiation dictated by Project-directed configuration changes. The Procurement Division will work closely with the NCSX Project to identify situations where use of incentives may provide a material benefit to the Project. As outlined in Subpart 16.401(a) of the Federal Acquisition Regulation, PPPL will only use incentives when it is possible to establish reasonable and attainable targets that are clearly communicated to the contractor; and when PPPL can include appropriate incentive arrangements designed to motivate contractor efforts that might not otherwise be emphasized, and discourage contractor inefficiency and waste. When such opportunities arise, Procurement will work with Project representatives to develop appropriate incentive vehicles, with due consideration of the need to balance enhanced technical and schedule performance against cost considerations, and the increased administrative effort necessary for successful incentive contracting. In most cases where incentives can be used effectively, PPPL will prepare a fixed price incentive contract with firm targets for cost and profit, with a negotiated share ratio for over/under-runs and a hard cap. If definition of a fixed price incentive agreement is impossible, Procurement and the project will consider use of cost-reimbursement incentive contracts.

13. Integrated Project Team (IPT). The EIR Team will assess whether the project management staffing level is appropriate, and determine if appropriate disciplines are included in the IPT. The EIR Team will identify any deficiencies in the IPT that could hinder successful execution of the project.

Additional EIR Team questions/information requirements:

1. *How and by whom was the Integrated Project Team (IPT) selected? What is the IPT charter? Are the duties and responsibilities of the IPT being met?*
   The DOE Federal Project Manager was assigned to this project by the DOE Princeton Area Office Manager following consultation with the Program Office. The Laboratory Project Manager and Deputy Project Manager were assigned by the PPPL & ORNL Laboratory Directors. IPT members are designated in the Project Charter and laboratory management supports their participation. The Federal Project Director and Laboratory

Project Manager will assess & add additional members as needed during the life of the project.

The IPT Charter along with IPT meeting minutes dating back to FY2000 may be found on the IPT website.
http://www.pppl.gov/ncsx/Integrated_Proj_Team/Integrated_Proj_Team.html
All duties and responsibilities are being met and the IPT concept is working well.

2. *How did the IPT participate in developing the PEP?*
   The PPEP & PEP were drafted and reviewed by most, if not all, members of the IPT. Also reviewed by HQ Program Office & Construction Management Support. Following this review it will be signed my many members before forwarding to the Program Office for approval.

3. *Be prepared to discuss the professional qualifications of selected IPT members.*
   We are prepared to discuss experience and qualifications at your convenience.

4. *Although the Integrated Project Team includes representatives from project controls, procurement and ES&H, there is no representation from QA or systems engineering. Who on the IPT will be responsible for oversight of QA and systems engineering issues?*
   As indicated above, additions to the IPT will be made during the life of the project as it evolves. You are correct to indicate that it is time for regular involvement by QA and Systems Engineers.

APPENDIX 1 – CORRECTED WBS

WBS			Description	Responsibility	Comment
1			**Stellarator Core Systems**	Nelson	
	11		***In-Vessel Components***	Goranson	
		111	Limiters		
		112	Internal Liner		Not in MIE Project
		113	Internal Trim Coils		Not in MIE Project
		114	Local I&C		Not in MIE Project
	12		***Vacuum Vessel Systems***	Goranson	
		121	Assembly		
		122	Thermal Insulation		
		123	Heating and Cooling Distribution System		
		124	Supports		
		125	Local I&C		
	13		***Conventional Coils***	Williamson	
		131	TF Coils		
		132	PF Central Solenoid Coils		
		133	PF Ring Coils		
		134	External Trim Coils		
		135	Local I&C		
	14		***Modular Coils***	Williamson	
		141	Winding Forms		
		142	Windings and Assembly		
		143	Local I&C		
		144	Modular Coil Winding Facility and Fixtures		
	15		***Coil Support Structures***	Williamson	*Post PDR, WBS 152 will be collapsed into WBS 132 PF Central Solenoid Coils and WBS 153 will be collapsed into WBS 151.*
		151	Coil Support Structures		
		152	Central Solenoid Support Structures		
		153	Support Structures Local I&C		
	16		***Coil Services***	Williamson	
		161	LN2 Distribution System		
		162	Electrical Leads		
		163	Coil Protection System		
	17		***Cryostat and Base Support Structure***		
		171	Cryostat	Gettelfinger	
		172	Base Support Structure	Kalish	
	18		***Field Period Assembly***	Chrzanowski	
		181	Planning and Oversight		
		182	Preparation of the TFTR Test Cell		
		183	Receipt, Inspection, and Testing of Coils		
		184	Receipt, Inspection, and Testing of Vacuum Vessel		
		185	Field Period Assembly		
		186	Tooling Design and Fabrication		
		187	Measurement Systems		
	19		***Stellarator Core Management and Integration***		
		191	Stellarator Core Management and Oversight		
		192	Stellarator Core Integration & Global Analyses		
2			**Auxiliary Systems**	Dudek	
	21		***Fueling Systems***	Blanchard	
		211	Gas Fueling Systems		
		212	Pellet Injection Fueling Systems		Not in MIE Project
	22		***Torus Vacuum Pumping System***	Blanchard	
	23		***Wall Conditioning Systems***	Blanchard	
		231	Glow Discharge Cleaning System		Not in MIE Project
		232	Boranization System		Not in MIE Project
		233	Lithiumization System		Not in MIE Project
	24		***ICH System***	NA	Not in MIE Project
	25		***Neutral Beam Injection System***	Stevenson	
	26		***ECH System***	NA	Not in MIE Project
3			**Diagnostics**	Johnson	
	31		***Magnetic Diagnostics***		
	32		***Fast Particle Diagnostics***		Not in MIE Project
	33		***Impurity Diagnostics***		Not in MIE Project
	34		***MHD Diagnostics***		Not in MIE Project
	35		***Profile Diagnostics***		Not in MIE Project
	36		***Edge and Divertor Diagnostics***		
	37		***Turbulence Diagnostics***		Not in MIE Project
	38		***Electron Beam (EB) Mapping***		
	39		***Diagnostics Integration***		

WBS			Description	Responsibility	Comment
4			**Electrical Power Systems**	Ramakrishnan	
	41		***AC Power***		
		411	Auxiliary AC Power Systems		
		412	Experimental AC Power Systems		
	42		***AC/DC Converters***		
		421	C-Site AC/DC Converters		
		422	D-Site AC/DC Converters		
	43		***DC Systems***		
		431	C-Site DC Systems		
		432	D-to-C Site DC Systems		
		433	D Site DC Systems		
	44		***Control and Protection Systems***		
		441	Electrical Interlock Systems		
		442	Kirk Key Interlocks		
		443	Real Time Control Systems		
		444	Instrumentation Systems		
		445	Coil Protection Systems		
		446	Ground Fault Monitoring Systems		
	45		***Power System Design and Integration***		
		451	System Design and Interfaces		
		452	Electrical Systems Support		
		453	System Testing (PTPs)		
	46		***FCPC Building Modifications***		
5			**Central I&C Systems**	Oliaro	
	51		***TCP/IP Infrastructure Systems***		
	52		***Central Instrumentation and Control Systems***		
	53		***Data Acquisition & Facility Computing Systems***		
	54		***Facility Timing and Synchronization Systems***		
	55		***Real Time Plasma and Power Supply Control Systems***		
	56		***Central Safety Interlock Systems***		
	57		***Control Room Facility***		
6			**Facility Systems**	Dudek	
	61		***Water Cooling Systems***	Dudek	
		611	C-Site Cooling Systems		
		612	Neutral Beam Water Cooling System		
		613	Vacuum Pumping Water Cooling System		
		614	Bakeout Water System		
		615	Diagnostic Water Cooling System		
	62		***Cryogenic Systems***	Gettelfinger	
	63		***Utility Systems***	Dudek	
	64		***Helium Bakeout System***	Kalish	
	65		***Facility Systems Integration***	NA	No Longer in Project - was in CDR
7			**Test Cell Preparation and Machine Assembly**	Perry	
	71		***Shield Wall Reconfiguration***	Perry	
	72		***Control Room Refurbishment***	Perry	
	73		***Platform Design and Fabrication***	Perry	
	74		***Machine Assembly Planning and Oversight***	Perry	
	75		***Test Cell and Basement Assembly Operations***	Perry	
	76		***Tooling Design and Fabrication***	Perry	
	77		***Measurement Systems***	Perry	Will use 187 Measuring Systems
8			**Project Oversight and Support**	Neilson	
	81		***Project Management and Control***	Neilson	
	82		***Project Engineering***	Reiersen	
	83		***Environmental and Safety/QA Management***	Levine & Malsbury	
	84		***Project Physics***	Zarnstorff	
	85		***Integrated Systems Testing***	Gentile	

APPENDIX 2 – CORRECTED WBS 62 AND WBS 64 DESCRIPTIONS

WBS Element: 62		**WBS Level: 3**
WBS Title:	**Cryogenic Systems**	
Description:	This WBS element consists of the following subsystems: ? LN_2-LHe Supply System (WBS 621); ? LN_2 Coil Cooling (WBS 622); and ? GN_2 Cryostat Cooling System (WBS 623).	
WBS Element: 621		**WBS Level: 4**
WBS Title:	**LN_2-LHe Supply System**	
Description:	This WBS element consists of the effort to design and install a system to supply liquid nitrogen and liquid helium to the NCSX facility. End users include the LN_2 coil cooling supply system (WBS 622), the GN_2 cryostat cooling supply system (WBS 623), and the NB system (WBS 25). This WBS element also includes connection to the existing LN_2 storage tank. This WBS will support two beamlines with provisions for a total of four beams and a pellet injector. Initially, the neutral beamline will be tested using an individual LHe dewar, which is not part of this work package. The facility is required to accommodate (as a future upgrade) a LHe transfer line between the helium dewar in the C-site Helium Dewar Storage Shed and the beamline~~s~~.	
WBS Element: 622		**WBS Level: 4**
WBS Title:	**LN_2 Coil Cooling Supply System**	
Description:	This WBS element consists of the effort to provide a closed loop LN_2 system for the cooling of the modular coils (WBS 14), and conventional coils (WBS 13). The distribution system within the cryostat for cooling the coil systems is the responsibility of WBS 1.	
WBS Element: 623		**WBS Level: 4**
WBS Title:	**GN_2 Cryostat Cooling System**	
Description:	This WBS element consists of the effort to circulate GN_2 through the cryostat to provide heat removal during cooldown from room temperature and also during operation. This WBS element provides heating to bring the equipment within the cryostat up from the operating temperature of 80K back to room temperature. The cryostat cooling system is vented to the outside environment through a stack that is also part of this WBS element.	

WBS Element: 64		WBS Level: 3
WBS Title:	**Helium Bakeout System**	
Description:	The WBS element consists of the effort to provide heating and cooling to the vacuum vessel and plasma facing components (PFCs). Prior to Initial Auxiliary Heating (Phase 4), there will be only minimal coverage of the interior with carbon tiles so bakeout capability of the PFCs is not required for the Fabrication Project. However, accommodating bakeout of the PFCs is required as a future upgrade. The capability to bakeout the vessel will be provided for by WBS 64 in the Fabrication Project.	

APPENDIX 3 – PPPL PROCEDURES

PPPL PROCEDURES MANUAL

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