

**Status Report for Recommendations from the
Performance Baseline Review of the NCSX Project**

May 10, 2004

The performance baseline review (PBR) of the NCSX project was conducted by the Office of Science on November 18-20, 2003, at PPPL. The final panel report, issued in early January, 2004, contained nineteen recommendations to be addressed prior to approving the performance baseline (CD-2). There were also numerous comments in the panel report, which the project treated as recommendations. Similar items were combined as appropriate for purposes of responding. In all, twenty-one items are identified.

Immediately after the PBR, the project developed a response and a disposition plan for each item. Because of the urgency of establishing the project baseline for CD-2, an effort was made to come to prompt decisions on those items with cost and schedule impact. These are summarized below.

All of the items that required any significant follow-up activity were incorporated into the project's CD-2 schedule and budget. This document provides the status of each item as of the May, 2004 Final Design Review of the Modular Coil Winding Forms and Vacuum Vessel Sub-Assembly. Many have already been fully addressed during final design and are now completed. All issues affecting the design of the MCWF and VVSA are in that category. For those items which require further work to fully complete the plan, that work is in the baseline work scope, which will be tracked to completion following the project's normal project control processes.

Cost/Schedule Impacts of PBR Responses on the CD-2 Baseline

| Item | Summary | Cost Impact (\$K) | Schedule Impact (months) |
|-------|---|-------------------------|--------------------------------|
| 1 | Second winding line | 475 | |
| 2 | Cold test all modular coils | 550 | |
| 4 | R&D to evaluate vacuum vessel spool piece | 15 | |
| 10 | Ground fault monitor | 150 | |
| 13/14 | Machine assembly estimates | 119 | |
| 20 | Expanded CD-4 criteria | 1,850 | 4 |
| Total | | 3,159 | 4 |

Modifications to the project plans resulting from the PBR are incorporated in the revised project baseline that was approved at CD-2. The total change between the PDR and CD-2 baseline, from all reviews and revised DOE guidance, was \$5.3Min cost and 8 months on the schedule.

The project's responses were documented in the form of a tracking log which the project has used to track each sequentially-numbered item since the PDR.

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|----|--------------------------------------|---|---|--|
| 1 | WBS 14 Williamson, Chrzanowski | Comment, Section 2.1: The project should consider two winding lines for the modular coils. | <i>Project Response/Plan:</i> Agreed. After consideration, it was decided to add a second winding station. It will provide additional schedule flexibility as well as improve the quality of the oversight coverage. | Closed. Included in CD-2 baseline. |
| 2 | WBS 14 Williamson, Chrzanowski | Recommendation 1, Section 2.1: Include performing cold testing of all the Modular Coils during the construction project. Determine the cost and schedule impact of these tests before CD-2. | <i>Project Response/Plan:</i> Agreed. Testing each modular coil will verify their integrity and reduce the risk of installing a faulty or lower quality coil in the machine. | Closed. Included in CD-2 baseline. |
| 3 | WBS 13 Kalish, Templon | Comment, Section 2.1: Attention should be given early to insure that delivery of these (TF/PF) coils does not affect the machine assembly schedule. Potential for major schedule impact. | <i>Project Response/Plan:</i> Agreed. An effort has begun to solicit interested vendors by providing a preliminary specification for the conventional coils now instead of after the final design is complete. Information will be posted on the NCSX Manufacturing Web Site, vendors will be contacted and a "sources sought" announcement will be posted on the Federal Business Opportunities (FedBizOpps or FBO) web site. <i>FDR Update (May, 2004):</i> Information has been posted on the NCSX Manufacturing Web Site and an announcement is posted on the Federal Business Opportunities (FedBizOpps or FBO) web site soliciting vendors for the conventional coils. In addition a list of potential vendors has been compiled and contacted directly by the Project to determine which are viable prospects. We find that there are at least four viable vendors capable of fabricating PF1 through PF4. There are at least two viable commercial vendors with the capability to build all of the coils including PF5, PF6, and the TF Coils. Oversight by Project engineering and QA personnel would be essential to success with any of these suppliers. As a fallback position, there are a number of R&D organizations, including PPPL, who could fabricate these coils if necessary. | Closed |

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| 4 | WBS 12 Goranson | <p>Recommendation 2, Section 2.1: Investigate alternative designs for the Vacuum Vessel spool pieces to optimize the final assembly and closeout welding.</p> | <p><i>Project Response/Plan:</i> Agreed. The baseline spool design was chosen after investigating numerous alternatives during preliminary design. A design review was held to choose the baseline. Nonetheless, the spool configuration and weld prep will be further evaluated during an R&D program, which will simulate the spool and weld.</p> <p><i>FDR Update (May, 2004):</i> The VV weld joint R&D program has begun. Results of small-sample tests may be available by the time of the FDR, A full-scale sample is being procured for tests later this FY.</p> <p>The results of the weld joint R&D will influence plans for final assembly but are not expected to impact the VVSA manufacture. The reason is that the spool piece machining is not performed until final assembly, so adjustments can be made to match the as-built vessel sectors. Therefore, the weld prep machining details do not have to be finalized until that time.</p> | <p>Closed. Included in CD-2 baseline.</p> <p>Current state of development is sufficient to re-release MCWF and VVSA for fabrication.</p> |
| 5 | WBS 1 Cole | <p>Recommendation 3, Section 2.1: Evaluate the use of tolerance stack-up software for performing 3-D assembly in Pro-E.</p> | <p><i>Project Response/Plan:</i> An evaluation has been performed, showing that this product might reduce risk and would cost \$40k plus 200 engineering hours for training and analysis. We will not implement it at this time, but can do so in the future if its costs are shown to be offset in the form of reduced contingency (due to risk reduction) or some other cost savings.</p> | <p>Closed. Evaluation complete.</p> |
| 6 | WBS 17 Gettelfinger | <p>Recommendation 4, Section 2.1: Evaluate the use of fixators for base adjustments.</p> | <p><i>Project Response/Plan:</i> Agreed. Full evaluation will occur during Title 1 and Title II design of the Base Structure (FY-06)</p> | <p>Planned</p> |

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| 7 | WBS 14 Williamson, Chrzanowski | <p>Comment in Section 2.1: The shape and position of the coil block will be determined by the clamping arrangement at the vacuum impregnation stage. Consideration should be given to resolving coil positioning at that time rather than on a turn-by-turn basis.</p> <p>Recommendation 5: Evaluate the option of determining the position of the Modular Coils winding packs by tooling/fixturing during winding and prior to impregnation.</p> | <p><i>Project Response/Plan:</i> Agreed. During the prototype winding activities, we will investigate this option by winding a section of the coil without turn-by-turn shims, but instead make adjustments to the whole winding pack. We will evaluate winding accuracy, process efficiency, and potential impact to the design of the winding clamps. Any changes to the final design of the clamps and tooling can be incorporated prior to FDR in Oct, 2004.</p> <p><i>FDR Update (May, 2004):</i> Winding trials are still in progress. It is currently believed that shimming the entire pack after winding would be extremely difficult. Measuring and shimming after every 3 or 4 layers to accommodate the winding pack tolerances would be more practical, but this needs to be evaluated. The winding clamps have already been redesigned based on experience in the early winding trials. The winding R&D program has been beneficial for tooling design, staff training, conductor handling, labor and schedule estimating, and other aspects of the winding process. A change in the bag mold groove depth was incorporated in the MCWF specification as a result of potting trials. The MCWF design can accommodate any foreseeable changes in the winding process that might result from the winding program.</p> | <p>In progress</p> <p>Current state of development is sufficient to release MCWF and VVSA for fabrication.</p> |

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| 8 | WBS 1 Goranson | <p>Recommendation 6, Section 2.1: Evaluate the effect on the overall project schedule and cost of a Vacuum Vessel delay sufficient to cause it to become the critical path.</p> | <p><i>Project Response/Plan:</i> Agreed that vacuum vessel schedule delays are a risk to the overall schedule because of its proximity to the critical path. In response we have focused on measures to improve the vacuum vessel schedule.</p> <p><i>Update (March, 2004):</i></p> <ol style="list-style-type: none"> 1. A decision was made to take delivery of each vacuum vessel sector as it is fabricated rather than wait for the complete assembly. This will allow the project to start adding attachments earlier, improving schedule flexibility. 2. A decision was made to change to a mechanical attachment scheme for the tubing, eliminating the need for grouting or welding. This reduces cost and installation time and provides more options for installation. 3. An R&D program will simulate the VV weld joint and qualify the assembly procedures, well before delivery of the VV. This will reduce risk and prevent delays caused by unforeseen problems. <p><i>FDR Update (May, 2004):</i> Schedule improvement opportunities will continue to be sought as part of the project's approach to risk management.</p> | Closed |
| 9 | WBS 84/R.P. Zarnstorff | <p>Recommendation 1, Section 2.3: Consider negotiating an agreement between PPPL and IPP/Greifswald, Germany that would allow sharing of plasma physicists (and possibly plasma diagnostics systems) during the current construction phase and the first 2-3 years of NCSX operations.</p> | <p><i>Project Response/Plan:</i> Agreed. We have started to explore with IPP-G and OFES management and will pursue it.</p> <p><i>FDR Update (May, 2004):</i> The needs of both U.S. and German stellarators were presented at a special session, "Diagnostic Opportunities on New Stellarators," at the High Temperature Diagnostics Conference in April, 2004. Opportunities for U.S. and non-U.S. scientists to collaborate on the research and join the NCSX research team were discussed. Representatives from IPP-G are expected to attend the NCSX research forum planned for 2005.</p> | In progress |

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| 10 | WBS 8 Neilson | <p>Recommendation 1, Section 2.4: Review the decision to exclude trim winding power supplies and ground monitor circuit in the scope of baseline work prior to CD-2.</p> | <p><i>Project Response/Plan:</i> These decisions have been reviewed. Ground monitor: Now that the baseline includes a significant period of operation as part of the startup program prior to CD-4, we agree that the ground fault monitor would be useful and should be included in the baseline. Trim coil power supplies: Use of the trim coils to improve flux surfaces is part of the research program that will not start until well after first plasma. The power supplies will use available PPPL legacy equipment which has been recently tested and found to be in good condition. It is straightforward to connect them to the trim coil terminals outside the cryostat when they are needed by the program.</p> | Closed |
| 11 | WBS 5 Oliaro | <p>Recommendation 1, Section 2.5: Clearly define the role and use of LabView (and any others) versus EPICS in the overall I&C system implementation.</p> | <p><i>Project Response/Plan:</i> Agreed. EPICS is used at the top-level in the NCSX I&C architecture. The subsystem experts will be given free reign to select their local control hardware and software platforms with the caveat that choosing a technology with a supported EPICS interface will be most cost effective. Therefore, all subsystem local controls will be specified in the NCSX Project Interface Control Documents in collaboration with the Central I&C Control Team.</p> | Closed |
| 12 | WBS 5 Oliaro | <p>Recommendation 2, Section 2.5: Consider moving preliminary and some detailed design of Central I&C components into the FY05 schedule and establish dialog between the Central I&C team and local control system developers to insure that these systems are compatible.</p> | <p><i>Project Response/Plan:</i> Agreed, but after re-consideration, we still believe that this work can be accomplished without changing the original I&C schedule. The I&C schedule is based upon the assumption that no significant EPICS or MDS-plus development work will be required for NCSX. Our experience on NSTX is that the EPICS interface has been integrated with all common local control system architectures. The Central I&C team will maintain a close dialog with the local control system developers, throughout FY05, to guide them to cost effective and compatible solutions.</p> | Closed |

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| 13 | WBS 7 Perry | <p>Recommendation 1, Section 2.7: Review and consider an increase in the current baseline cost of WBS 75 associated with assembling/shimming the modular magnets (during Field Period assembly) and the positioning/welding of the Vacuum Vessel sections/spool pieces. This should be done before CD 2.</p> | <p><i>Project Response/Plan:</i> Agree.</p> | <p>Closed. Included in CD-2 baseline.</p> |
| 14 | WBS 7 Perry | <p>Recommendation 2, Section 2.7: Review and consider an increase in the current contingency for WBS 75 [Machine Assy.] and 76 [Tooling] to accommodate the higher risk associated with these activities. This should be done before CD-2.</p> | <p><i>Project Response/Plan:</i> Agreed that 28% contingency should be added for the high-risk tasks noted in Item #13</p> | <p>Closed. Included in CD-2 baseline.</p> |
| 15 | WBS 7 & 1 Perry, Nelson, Raftopoulos | <p>Recommendation 3, Section 2.7: Develop a plan to efficiently compare metrology data, taken during fabrication and assembly, with the Pro-E models. This should be done before the completion of the final design.</p> | <p><i>Project Response/Plan:</i> Agreed. We have decided to advance the procurement of metrology equipment to FY-04, so that the project team can use it and gain experience during the 3D winding development activities, and to make measurements on the prototype winding forms and vacuum vessel during FY-04.</p> <p><i>FDR Update (May, 2004):</i> The first delivered prototype vacuum vessel sector provided an opportunity to demonstrate a successful method. A comparison of the supplier's dimensional inspection data with the project's CAD model was performed. The part was found to be within tolerance limitations. We have placed an order for a laser scanning CMM arm that includes metrology software capable of performing the "Part to CADD" comparison. The order was placed in April, 2004, following a competitive source selection process, and we have already received most of the hardware components.. The new tools will be first applied to the prototype vacuum vessel sector that has already been received. Further procurements of metrology equipment and integrating software are planned for FY-05.</p> | <p>Closed</p> |

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| 16 | WBS 8 Neilson, Strykowski | <p>Comment, Section 3: Develop summary analyses of project cost information such as EDIA, to serve as reasonableness tests.</p> <p>Comment, Section 5: Track performance metrics such as EDIA, %-complete for design, fab. installation, etc., distribution of cost information source (vendor info., eng. estimates, firm bids and/or actual costs.)</p> | <p><i>Project Response/Plan:</i> Agreed. The project will evaluate and establish additional metrics to supplement current project performance reports. Results will be routinely reported to project management as well as DOE, starting with the next semi-annual Lehman review (about May, 2004).</p> <p><i>FDR Update (May, 2004):</i> The following metrics are in place and being reported.</p> <ol style="list-style-type: none"> 1) % complete by phase – COMPLETE, Included in quarterly report & posted on web site. 2) Contingency drawdown analysis– COMPLETE & posted on web site 3) CPI/SPI trend plots - COMPLETE & posted on web site 4) Milestone tracking profile & log - COMPLETE & posted on web site 5) Independent EAC - COMPLETED & input to PARS 6) Vendor contract cost status- (for large critical procurements)- COMPLETED -not posted due to cost sensitive information. 7) Management reserve spend plan -COMPLETED & posted on web. | Closed. |

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| 17 | WBS 8 Templon | <p>Comment, Section 5: Compile a procurement plan identifying planned procurements, type, start date of process, etc.</p> | <p><i>Project Response/Plan:</i> Agreed. <i>FDR Update (May, 2004):</i> Planning started with a meeting between project management and procurement on 12/1/03. The project has compiled a comprehensive list of known procurements, and assigned desired award dates. PPPL Procurement has an action item to assign lead times and due dates for procurement packages, based on individual procurement requirements. Procurement's markup including layout of procurement lead times, was emailed to NCSX Project Control mgr. on April 16. The Project Control manager will work with WBS managers to develop post-award schedule milestones for each listed procurement. Procurement and the Project will collaborate in developing a standard report format. The Procurement Plan is envisioned as a dynamic project document that will become part of the NCSX PMS system, and be updated routinely. The plan is targeted to be in place and functional prior to the Lehman Independent Project Review on June 8-9, 2004.</p> | In progress |

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| 18 | WBS 8 Neilson | <p>Recommendation 1, Section 3: Re-evaluate the planned contingency profile and coordinate any revisions to the profile with the DOE Princeton Area Office before CD-2.</p> <p>Comment, Section 5: Confidence in the overall project schedule would be significantly enhanced if the funding profile provided higher BA in FY05, on the order of \$2 to 4M, with corresponding reduction in FY06 and/or FY07. DOE and PPPL management should consider this matter.</p> <p>Recommendation 1, Section 4: Re-evaluate adequacy of contingency amount and funding level for FY 2005 prior to CD-2.</p> <p>Recommendation 2, Section 4: Reexamine the proposed total project funding profile in concert with Office of Fusion Energy Sciences prior to CD-2.</p> | <p><i>Project Response/Plan:</i> Although the FY05 project funding was <i>reduced</i> following the review because of limits on available funds in that year, the project has responded positively to this recommendation by <i>increasing</i> the FY-05 contingency budget. In the revised baseline, the contingency profile is more evenly distributed throughout the project period, in contrast to that presented at the review, which was strongly peaked in the last year.</p> <p>The decision to adopt the recommendation for a second winding line (#2.1-1), is also responsive to the spirit of this recommendation because it improves schedule flexibility.</p> <p><i>FDR Update (May, 2004):</i> The status of available contingency and future funding will be discussed at the Lehman Independent Project Review on June 8-9, 2004.</p> | Closed |
| 19 | WBS 8 Neilson | <p>Recommendation 2, Section 3: Evaluate the Committee's comments and recommendations and consider any proposed changes to project base costs or contingency before CD-2.</p> | <p><i>Project Response/Plan:</i> Agreed. All recommendations impacting cost and schedule have been acted upon and are reflected in the CD-2 baseline.</p> | Closed |

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| 20 | WBS 8 Zarnstorff | <p>Recommendation 1, Section 5: Assure that senior DOE management and fusion physics community clearly understand the limitations on the physics productivity of early NCSX operations that derive from the existing definition of CD-4.</p> | <p><i>Project Response/Plan:</i> The project provided material in support of follow-up discussions within the Office of Science (SC) concerning NCSX CD-4 criteria. As a conclusion of these discussions, SC management determined that the CD-4 criteria should be modified to add a flux surface mapping campaign to the in-scope startup plan and require cryogenic operation of the coils at first plasma. This change, which is incorporated in the CD-2 baseline, improves the facility's expected physics productivity immediately following CD-4. The changes have been discussed with Prof. David Anderson, chair of the NCSX Program Advisory Committee and a member of the PBR panel, who expressed strong approval. The wider physics community will be updated on the NCSX project plans and program implications via presentations at the OFES Budget Planning Meeting and future meetings of the NCSX Program Advisory Committee.</p> <p><i>FDR Update (May, 2004):</i> The next PAC meeting is being planned for July, 2004.</p> | <p>Closed (for senior DOE mgt.)</p> <p>Planned (for physics community)</p> |
| 21 | WBS 8 Neilson | <p>Recommendation 2, Section 5: Based on the overall assessment of status against requirements for this stage of the project, NCSX is ready to proceed with CD-2, after appropriate response to this committee's recommendations</p> | <p><i>Project Response:</i> The project thanks the review panel and believes this disposition plan is the appropriate response. The project reported the status of its responses at the time of CD-2 to all the panel members.</p> | <p>Closed</p> |