

NCSX Risk Management Update

April, 2005

Risk management is the key to successful execution of the NCSX project. The Integrated Project Team ensures that critical project risks are kept in view and that plans for their mitigation are implemented. A Critical Issues tracking list is maintained as a risk management tool and is reviewed at every IPT meeting. The project's major risks and its plans for mitigating them were presented at the OECM External Independent Review and SC Performance Baseline Review in November, 2003. This document reviews the major risks that were identified and the mitigation plans that were in place at that time, and reports progress and current status against those plans. In summary, good progress has been made in reducing the major project risks and in understanding the remaining work needed to retire them completely. No new risks of comparable significance have emerged.

WBS 12, Vacuum Vessel Fabrication

Identified Risk (Nov., 2003): Lack of capable supplier, or excessive cost.

Mitigation Plan (Nov., 2003): Have two suppliers fabricate prototypes, then competitively award a fixed-price contract for production.

Update: (April, 2005): Two suppliers fabricated prototypes in 2004. Both submitted qualified proposals for production and a fixed-price contract was awarded to Major Tool and Machine, Inc. (MTM), in September, 2004. Their price substantially exceeded the amount budgeted by the project, but the increase was accommodated through planning changes in other work packages in order to maintain adequate overall contingency.

A few months after award, MTM determined that forming dies constructed during the prototyping phase could not be re-used as originally planned. This was due to specification changes that the project made during final design and incorporated in the request for proposals, but which were not fully analyzed by the suppliers during the short bid-award period. The project accepted financial responsibility for fabricating new dies and covered the price increase with contingency. Otherwise, there have been no changes affecting price since contract award. MTM has secured material commitments from its suppliers, alleviating concerns that surfaced in mid-2004 due to market conditions.

Summary Assessment: With the tooling preparations now largely complete and production proceeding, vacuum vessel fabrication risks are substantially reduced.

WBS 12, Vacuum Vessel Field Joint

Identified Risk (Nov., 2003): Welding of the vacuum assembly joint results in excessive distortion or vacuum leaks.

Mitigation Plan (Nov., 2003): R&D.

Update: (April, 2005): Small-scale tests of weld prep and procedures have been successfully performed and will soon be completed.

Summary Assessment: Vacuum vessel field joint assembly risks have been alleviated

WBS 14, Modular Coil Winding Form Fabrication

Identified Risk (Nov., 2003): Lack of capable supplier, excessive cost, or delivery schedule that prolongs the critical path.

Mitigation Plan (Nov., 2003): Have two suppliers fabricate prototypes, then competitively award a fixed-price contract for production.

Update: (April, 2005): Two suppliers fabricated prototypes in 2004. Both submitted qualified proposals for production and a fixed-price contract was awarded to Energy Industries of Ohio, Inc. (EIO), in October, 2004. Their price was significantly higher and their proposed delivery schedule significantly later than the project's plans at the time. The increase and the delay were accommodated through planning changes in other work packages in order to maintain adequate overall budget and schedule contingencies. The delivery order of the winding forms was also adjusted to better match assembly requirements.

Since contract award, EIO has made good technical progress in both tooling preparation and production. They and their sub-tier contractors have managed cost, schedule, and technical risks in a balanced manner, and have been responsive to project questions and concerns. Delivery of the first MCWF has been delayed a few weeks because post-processing of the casting took longer than expected. The EIO team made tooling changes which are expected to reduce future post-processing times and enable the order to be completed on schedule. Moreover, the new NCSX project schedule (April, 2005) is more robust against potential MCWF delivery delays downstream. There have been no changes affecting price since contract award.

Summary Assessment: With the tooling preparations now largely complete and production proceeding, modular coil winding form fabrications risks are substantially reduced.

WBS 14, Modular Coil Windings

Identified Risk (Nov., 2003): Excessive cost or prolonged schedule to fabricate the modular coils, or inability to meet requirements.

Mitigation Plan (Nov., 2003): Design, supported by a multi-step manufacturing R&D program.

Update: (April, 2005): The modular coil manufacturing R&D program is nearly complete. The results have been incorporated into the design. Highlights of accomplishments:

- Epoxy impregnation program resulted in selection of the resin system and process.
- Conductor development program addressed conductor manufacture, conductor handling, and keystoneing, supported conductor design.

- Mechanical and thermal tests on single- and multi-conductor potted samples supported the design of the insulation system and winding pack configuration.
- Simple racetrack coil incorporating copper cladding provided relevant fabrication experience. Power tests of this coil at cryogenic temperatures provided confidence in gross cooldown performance and structural integrity.
- Twisted racetrack coil assembly activity produced improved designs and processes for the production coils, partial development of dimensional control methods, and an experience base useful for improving production cost and schedule estimates. (Epoxy impregnation and performance testing of the twisted racetrack remain to be completed.)

The modular coil risks have been substantially reduced through R&D, the results of which are incorporated in the component drawings, specifications, and procedures. There are no outstanding risks which would delay start of production, but further process development in areas such as metrology and dimensional control is planned as part of the production program in order to ensure quality while reducing cost and schedule uncertainties.

Summary Assessment: The modular coil fabrication risks have been substantially reduced, and there are no outstanding risks which would delay start of production.

WBS 18, Field Period Assembly

Identified Risk (Nov., 2003): Interferences or tooling inadequacies prevent assembly of the modular coils over the vacuum vessel.

Mitigation Plan (Nov., 2003): Design, supported by multiple analyses.

Update: (April, 2005): CAD modeling of the field-period assembly process was performed to support the final design of the modular coils and vacuum vessel. An optimum assembly sequence and component trajectories were determined through analyses and used to establish component space envelopes, now frozen, that avoid interferences during assembly. Compatible assembly fixture concepts were developed concurrently. These were significant steps in the reduction of field-period assembly risks, though more remains to be done.

The main remaining risk is the potential for the field period assembly scope to exceed the budget due to the close tolerances which must be maintained. The fixtures must be designed and fabricated and the procedures must be developed in an integrated fashion before the critical field-period assembly operations begin in 2007. A working group that includes the cognizant individuals responsible for tooling design and process development, for dimensional control, and for the actual assembly activities has begun meeting to address the remaining risks.

Summary Assessment: Field period assembly feasibility risks have been substantially reduced and the main remaining risk, cost growth, is being addressed.