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NCSX Construction Feasibility Review, Oct. 31 – Nov. 1, 2007					
200710-1a		The committee recommends that project management review and acquire adequate effort from these key individuals [Reiersen, Nelson, Freudenberg] in support of component assembly through first field period assembly, Station-5.	81. Anderson, Lyon	Action as stated.	These individuals have time commitments to NCSX and ITER which evolve with the needs of the projects. NCSX draws on a large and diverse pool of capable PPPL and ORNL engineers, so is not overly dependent on a few key people. Reiersen's and Nelson's former management responsibilities have been taken over by new leaders, though we have enough of their time to get the benefit of their unique knowledge and insights. Freudenberg continues to have a central role in stellarator core design. **Closed**
200710-1b		We recommend that project management insure adequate engineering staffing of this unique resource ["back office"] is planned for in the project scope and available at PPPL.	82. Heitzenroeder	Action as stated.	Staffing changes including new hires have been made to strengthen system engineering, which includes the "back office" functions. These were documented in a letter to the F.B.D on Nov. 29, 2007. **Closed**
200710-2		The committee supports the effort to find a dedicated project integration officer.	81. Anderson	Action as stated	A Project Integration Manager has been appointed. **Closed**
200710-3		The work that Art Brooks does to adjust final positions based on measured coil positions is critical to the success of the final assembly accuracy. Mr. Brooks' calculations should be carefully reviewed and cross checked.	8. Zarnstorff 82. Heitzenroeder	Action as stated.	We agree and this is already the plan, consistent with Laboratory procedures for checking of analyses and calculations (ENG-033). An engineer (Mark Smith) has been assigned to review and check Art Brooks' calculations. The Physics team has performed independent checks of Broooks' island-width calculations and trim coil performance analyses. **Closed.**

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200710-4		The committee suggested that the coil deformations under electromagnetic and dead weight loading be included in the calculations of the final modular coil positions, and needed shim dimensions. The present dimensional adjustments are effectively for zero field. It was suggested that an average operational loading be used for this calculation.	82. Brooks	Consider	We have considered this but decided not to include these effects when we specify coil positions. The gravity effects are small and the EM effects vary with operating conditions. **Closed**
200710-5		The issue of disruptions was answered for vessel response, and was quickly estimated at the review, for the modular coil forms. The estimate is that the effect is low, but these calculations should be finalized and documented.	82. Brooks	Action as stated..	A simplified SPARK model was run to estimate the added shear forces across the MCWF joint from a plasma disruption. A 350 KA center plasma instantaneous disruption was considered (ie inductive solution) without the shielding effects of the VV. The maximum eddy currents are ~50 KA. The fields were assumed to be ~0.5 T based on trim coil calculations. If the currents are on either side of the flange and in opposite directions, a shear force of 25 KN/m (143 lb/in) or ~ 570 lb per bolt. This compares to the design load of 15,000 lb shear per bolt. **Closed.**

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200710-6		The anisotropic elastic properties of the casting need to be quantified and factored into the analyses of the modular coil forms. Requirements for two directional testing were part of the original casting contracts, but were relaxed. It is believed that this was for reasonable cause, but given the potential effect on the elastic motions under load, a better understanding of this issue is needed. The project should review literature and correspondence and should inventory the available test samples from the NCSX castings. Tests on actual cast shell samples would be best. The available spare casting is a candidate for metallurgical evaluation. This spare casting has not gone through a heat treatment used on the production castings. The possibility of heat treating a sample taken from the spare casting should be investigated.	82. Heitzenroeder	Review of literature and analysis appropriate to NCSX materials and conditions. Consider testing.	NCSX is reviewing ITER R&D report on 316 castings. There are some obvious differences in the material - the ITER casting used chromate sand for rapid cooling, which may have resulted in non-uniform cooling rate and the chemistry is close but not exactly the same. NCSX has performed a modulus sensitivity study. ANSYS was run with the E of all castings reduced from 145,000to 100,-000 psi . The max. displacement would increase from ~2.8 to 3.7 mm – a value that the trim coils could compensate for, even in this extreme case. In parallel, a cube of Stellalloy is being triaxially tested to determine its # in all three axes. **Closed.**
200710-7		While correction coils are being designed, the possibility of future additions of correction coils outside the cryostat should be evaluated. These will require more amp-turns, but can be "low tech" and can be easily added at a later date.	82. Brooks	Assess performance and risk mitigation benefits of such coils.	Provisions are being made to accommodate installation of trim coils on the outboard midplane between the TF coils. Trim coils outside the cryostat are possible but not attractive because of high power and limited functionality. It is more important to provide adequate capability, with margin, on the machine-mounted trim coil system. **Closed.**
200710-8		Have load cells on support posts – especially where the support is redundant. i.e. multiple posts instead of three.	17. Dahlgren	Consider	We have considered this but decided not to incorporate load cells. Although we have more than 3 support posts, there is no redundancy because the machine is not a rigid structure. We do not see any benefit to measuring the loads in operation. **Closed.**

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200710-9		In station 6, the final machine assembly, vertical support is transferred from the assembly carts to six stainless steel support posts. This load transfer may introduce new displacements that need to be qualified by an additional metrology step, and adds a small risk of difficulties at a time when the full investment in the stellarator assembly has been made.	82. Brown	Analyze	We agree that this must be analyzed and addressed in the design. It is in our Station 6 design plans. **Closed.**
200710-10		The committee recommends finite element analysis (FEA) analytic support at each step of the assembly process. The analytic models should be benchmarked at the vertical to horizontal repositioning step for each of the modular coil forms.	82. Brown	Action as stated	We agree, and this is in our plans. Some analyses have already been done (ex: single MCWFs and "3-packs"). Analyses of the torus assembly with various support conditions are planned. **Closed.**
200710-11		The committee expressed concern that the modular castings vary in thickness and weight, and this may affect the structural response. The project responded with an explanation that the electromagnetic deformations were predominantly caused by the flexibility of the machined parts, but the effect of non-uniform shell thickness should be addressed in the FEA benchmarks.	82. Heitzenroeder	Analyze and document.	Weight information on the winding form castings was provided to the committee. However, since the max. deflections are due to primarily to deformations of the T sections which are machined to a uniform thickness, we do not feel that this is an issue. **Closed**

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200710-12		A long term test of the preload retention of the bolting should be made at the actual design configuration used; thermal cycling should be included. In-service, operational monitoring of preloads of highly loaded bolts is strongly recommended. It was noted that initial torque tests on modular coil flange connection bolts was only 50% for those studs located in threaded blind holes; this was done to prevent deformation of the base material threads. We recommend that a test on a spare modular coil with 100% of the required torque be applied to these blind hole studs to understand the impact of having to possibly disassemble a completed flange connection.	82. Dudek	Follow through on planned tests.	A summary of planned bolt tests, including cycling and long-term bolt tension stability, was presented to the committee. The tests for the stud tensioning were started on 11/15. The studs were tensioned to 85 kip and then rechecked on 11/19. They were found to have lost about 6% of their tension (as was expected) and were re-tensioned to 85 kip. They have held steady since that time. The next test was to chill the connections down to 77K using LN2 and recheck the tension. At the completion of these tension tests we checked the threads after the 100% load. In summary the planned tests have been completed with satisfactory results. **Closed**
200710-13		The difficulty in accessing some of the modular coil form bolts has been mocked-up. The mock-up will be useful during assembly and operation. It would be wise to retain these for future use in servicing.	8. Anderson, Lyon	Retain mock-up as recommended.	We will retain the mock-up. **Closed.**
200710-14		In-service, operational laser tracking of ample fiducials on the modular coil during operation is highly recommended.	82. Raftopoulos	Evaluate	Additional metrology fiducials are being installed on the outboard side of the modular coil winding form (MCWF) shells. They will be visible with the cryostat removed so their locations can be monitored during maintenance periods. **Closed**

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200710-15		Measurements of the alumina-to-steel friction coefficients should be made with more statistical rigor. The data scatter of the values presented raises the concern that the 2/3 allowable may not be sufficient to cover the uncertainties in assembled behavior. For design and construction the measured minimum values should be used to sufficiently account for uncertainties during shim production and assembly of modular coil flange connections.	8. Heitzen-roeder	Set allowable more conservatively	Agreed. The friction allowable is now based on the lower bound of the test data. **Closed**
200710-16		The use for aluminum for TF and PF structural supports should be considered only after the effects of thermal differ-ential contraction are analyzed. Alumi-num components inside the cryostat have had to be removed from C-Mod. Difficulties with the use of aluminum and stainless steel for Wendelstein's bus bar supports also support this rec-ommendation.	15. Dahlgren	Evaluate	The project has reconsidered its material choice in light of these comments from C-Mod and W-7X. Indeed the potential for the two materials to cool down at dif-ferent rates is an uncertainty which exac-erbates the risk of fasteners coming loose over repeated cooldown cycles. We have therefore decided to change the support structure material from aluminum to stain-less steel. **Closed.**
200710-17		The committee suggests that power lead routing, coolant line routing, etc. be determined as soon as possible to avoid downstream interferences.	82. Cole	Action as stated	These activities are currently under way; ORNL and PPPL keep in close contact on these routing activities. A typical inte-grated model was presented to the com-mittee. **Closed**
NCSX SC Project Review, August 15-17, 2007					
200708-1	3.1 Magnets	Accelerate specific engineering efforts such as: PF coil design and trim coil design	8. Anderson	Provide adequate staff-ing to ensure schedules are met, allowing for normal problems. **Modify BCP as ap-propriate.**	Staffing changes including new hires have been made to support the design and pro-curement schedules for PF coils, trim coils, coil support structures, and base support structure. These were documented in a letter to the F.B.D on Nov. 29, 2007. **Closed**

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200708-2	3.1 Magnets	Perform a cost/benefit analysis of installing additional trim coils	8. Zarnstorff, Neilson	Action as stated.	Project has completed the evaluation and determined that the benefits (field error control) justify the additional cost, so we have decided to include trim coils in the new baseline. Concept design was presented at Construction Feasibility Review on Oct 31, 2007. **Closed**
200708-3	3.2 Ancillary Systems- WBS 2, 3, 4, 5, 6	Start early conceptual design modeling with preliminary design reviews to immediately follow to catch any technical issues early in the design process.	8. Anderson	Assess impact of accelerating design. **Modify BCP as appropriate.**	Based on funding guidance received for re-baselining the project, we are moving design work forward. **Closed**
200708-4	3.2 Ancillary Systems- WBS 5	The Safety Interlocks System should interface, as early as possible, with the ES&H group to resolve any life safety and equipment protection issues or requirements.	5. Sichta	Contact ES&H to review usage of and qualification for a Safety PLC, prior to conducting the PDR.	This is in the WBS 5 plan. **Closed**
200708-5	3.2 Ancillary Systems- WBS 6	Further study the cryogenic system, GN2 system design for control and regulation of gas through multiple parallel paths.	16. Goranson	This will be studied as part of the preliminary design of this system. **Modify BCP as appropriate.**	Analyses were done to check pressure drop in the various LN2 manifolds and hoses. The MC coil hoses were found to be within an acceptable range of each other without flow control. The other manifolds i.e., the PF and TF coils will be supplied with flow control valves on their return legs. The trim coils will not be cooled. **Closed**
200708-6	3.3 Assembly- WBS 18 & 7	Scrub the Resource Loaded Schedule, Work Approval Forms, and Basis of Estimate documentation for accuracy traceability and completeness.	18. Viola, 7. Perry	Action as stated. **Modify BCP as appropriate.**	Basis of estimates are being expanded. An internal pre-EIR audit (with the job managers) will be performed by the project control office. We will perform an updated bottom-up estimate for the EIR. In progress.
200708-7	3.3 Assembly- WBS 18 & 7	Consider accelerating schedule of Preliminary Design Reviews and Final Design Reviews to encourage early design activity and solidify estimates.	8. Anderson	Action as stated. **Modify BCP as appropriate.**	We are doing this. See 200708-1 and -3. **Closed**

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200708-8	3.3 Assembly-WBS 18 & 7	Include objective experts external to the project on design review teams.	8. Heitzenroeder	Action as stated.	We will do this from now on. Outside experts were included in welded MC interface PDR (10/18) and FDR (11/27) and the Construction Feasibility Review (10/31-11/1), and are planned for future reviews. **Closed**
200708-9	3.3 Assembly-WBS 18 & 7	All integration issues associated with related assembly tasks should be included in design reviews.	8. Heitzenroeder	Action as stated.	Physical interfaces are addressed by Design Integration. Design review participants include QA, ES&H, construction managers, and representatives of affected systems. **Closed**
200708-10	3.3 Assembly-WBS 7	Add vacuum vessel welding (in Station 6, Final Assembly) to the Risk Registry and develop appropriate mitigation activities.	7. Perry	Consider. **Modify BCP as appropriate.**	We do not agree that this belongs in the risk registry because the welding is similar to previous work. Allowance has been made in the estimate for new problems that may arise because of the unique configuration. **Closed**
200708-11	3.3 Assembly-WBS 7	Continue to include dry-run fit-ups of the Final Assembly of Modular Coils in the Resource Loaded Schedule, and plan to perform these tasks even if metrology results appear to "close" properly.	7. Perry	Action as stated.	This is what exists in current plan. **Closed**
200708-12	3.3 Assembly-WBS 18 & 7	Continue to look for opportunities to validate assembly design concepts early in the design process.	18. Viola 7. Perry	Ongoing effort.	Every opportunity is utilized as appropriate. For example, weld trials have spawned several parallel opportunities for evaluation of assembly techniques. We have prepared for MC half-period assembly off the critical path by completing some production tasks including modular coil punch list items and coil pre-measurements, and becoming proficient in critical assembly operations (e.g., positioning, metrology, bolting, bushing installation, welding). We will continue to do this. **Closed**

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200708-13	3.3 Assembly-WBS 18 & 7	Ensure that engineering integration across WBS tasks occurs at a high level including interface design consistency, definition and scheduling of design reviews, and engineering resource management. This will require the focus of the responsible engineer as his/her primary activity.	8. Anderson, Heitzenroeder	Action as stated.	Project organization has been revised to ensure adequate integration, as documented in a detailed white paper (J. L. Anderson, 6 Sept. 2007) The NCSX Engineering Manager is responsible for system integration. System engineering functions have been strengthened as documented in a letter to the F.B.D on Nov. 29, 2007. Responsible Line Managers are responsible for integration of their activities. **Closed.**
200708-14	3.4 Research Scope	Investigate the cost and benefit of inclusion of four additional trim coils into the upgrade plans. Present plans will augment the two coils in the MIE with two additional coils, so that n=1 and n=2 fields can be applied. The addition of two more would provide for control over natural (n=3) islands.	8. Zarnstorff	Evaluate options for adding trim coils to MIE and benefits, e.g., flexibility, tolerance relaxation.	See 200708-2. **Closed.**
200708-15	3.4 Research Scope	Coordinate cost and schedule planning between NCSX and NSTX.	8. Anderson	Action as stated. Work with NSTX and Lab management to agree on funding profiles.	Planning discussions with NSTX, Laboratory management, and OFES are ongoing. **Closed.**
200708-16	4.0 Cost Estimate	Institutionalize the new cost and schedule methods and tools (ongoing)	8. Williams	Action as stated.	The improvements in estimating methodology and cost and schedule management tools will be documented in the Laboratory's Engineering Procedures and Project Control Systems Description document..
200708-17	4.0 Cost Estimate 5.0 Schedule and Funding	Improve the documentation and traceability of the basis of estimate (well before the External Independent Review).	8. Strykowsky	Action as stated. **Modify BCP as appropriate.**	In progress. See 200708-6

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200708-18	4.0 Cost Estimate	Ensure the machine capabilities in the FY 2005 baseline and the new proposed baseline are consistent.	8. Strykowsky	Action as stated. **Modify BCP as appropriate.**	Scope will be added to the baseline to restore capabilities as requested. Scope restoration plan has been developed and reviewed with PSO. Estimates are being developed and will be included in the new baseline. **Closed**
200708-19	5.0 Schedule and Funding	Improve the quality of bases of estimates (well before the EIR)	8. Strykowsky	Action as stated. **Modify BCP as appropriate.**	In progress. See 200708-6
200708-20	6.0 Management	Evaluate and quantify the cost and schedule benefits of optimizing the remaining BA profile by September 15, 2007.	8. Neilson, Strykowsky	Action as stated.	Analyses were completed and submitted to PSO and OFES in early November. **Closed.**
200708-21	6.0 Management	Provide strong leadership in the systems engineering and integration area as soon as possible.	8. Anderson, Heitzenroeder	Action as stated.	See 200708-13. In addition, a Project Integration Manager has been appointed. **Closed**
NCSX SC Project Review, December 19, 2006					
200612-00	Executive Summary	Prepare a bottoms-up estimate-to-complete and update the resource-loaded schedule after more data on field period assembly is collected (i.e., Summer, 2007) Re-baseline the project as appropriate, based on the above information, in order to include adequate contingency for achieving Critical Decision (CD) 4, Approve Start of Operations.	8. Anderson	1. Revise project plans for Q2-3 of FY07. **Done** 2. Develop new ETC, including contractor reviews. **done** 3. Post review materials for DOE review. 4. DOE on-site reviews.	A new ETC has been developed as the basis for a baseline change proposal to DOE. It will be presented at the August, 2007, SC Project Review. The assembly estimates have been updated based on recent modular coil half-period assembly development trials, a more detailed assembly sequence plan, and experience with past NCSX fabrication jobs. The ETC incorporates improved approaches to job estimating, risk management, and risk-based contingency analysis. Job estimates were reviewed and approved by the PPPL Engineering Dept. Two external reviews, sponsored by Princeton University, guided the development of the new estimate. DOE reviews will be conducted in the August-September timeframe. **Closed**

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200612-01	Technical (Mod Coils- 1)	Restrict the use of overtime to only when necessary for continuity of work.	14./18. Dudek	Continue to carefully manage overtime.	Overtime has been eliminated except for special situations, for example during VPI. Second shift work has also been discontinued to apply more resources on the FPA work. **Closed**
200612-02	Technical (Mod Coils- 2)	Work to optimize the limited amount of repetition available in production to realize efficiency through learning, reduced tooling changeovers, etc.	14. Dudek	Continue to seek and implement process improvements that benefit schedule and cost efficiency.	Opportunities for process improvement continue to be investigated, however the winding process is now fairly mature and most of the significant cost and schedule improvements have been implemented. **Closed.**
200612-03	Technical (Mod Coils- 3)	Review staffing plan. Verify that new staff is adequately trained, staffing levels are not excessive, work is consistently planned, etc.	14. Dudek	Continue to carefully manage staffing.	Staffing of modular coil winding operations has leveled off and been stable for almost a year. A detailed day-by-day work plan is issued every week. Training is conducted when new operations are introduced, recent examples being lead termination and thermocouple installation. As the FPA work is ramping up excess labor from the coil winding area are being reassigned to support FPA. **Closed**
200612-04	Technical (TF Coils- 1)	Continue to provide direct oversight throughout the [TF coil] contract to ensure that Everson is aware of and supporting all technical and schedule requirements.	13. Kalish	Action as stated.	Close oversight has been maintained through site visits on at least a weekly basis. PPPL keeps a close watch to ensure that technical issues are resolved in a manner consistent with technical requirements. The supplier is kept aware of schedule and quality requirements through constant reinforcement by PPPL. Despite delays, the TF coils remain far off the critical path. With TF Coil Assembly manufacturing well along the updated schedule is now based on experience. **Closed**

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200612-05	Technical (PF Coils- 1)	Complete the investigation of a commercial [PF coil] vendor in time to build capability in house if necessary without adversely affecting the overall program schedule.	13. Kalish	Establish PF coil acquisition plan.	Interested vendors have submitted budgetary quotes. We are expediting completion of the PF design in order to solicit proposals as soon as possible. **Closed**
200612-06	Technical (FPA- 1)	Validate all proposed technical changes [in Field Period Assembly] off critical path.	8. Heitzenroeder	Build validation activities into the schedule.	Validation of proposed technical changes and refinement of procedures and tooling for Field Period Assembly has been a strong area of focus in the last few months. During this period, interface details were refined and a robust assembly configuration featuring welded joints between the inner legs of the modular coils intra-field periods, high friction alumina coated shims, and reliable stud tensioning techniques were tested and are well on their way to being fully valuated and adopted. In addition, alignment trials were undertaken which are focusing on improving the methods of achieving the required dimensional accuracy and reducing the time required. Future development activities are built into the schedule in Job 1810. **Closed**
200612-07	Technical (FPA- 2)	Develop integrated daily manpower assignments including all workstations to smooth out manpower requirements to an achievable level and to ensure that labor will be available when needed.	18. Dudek	Continue to carefully manage staffing. Update staffing projections as part of on bottoms-up estimate.	Field Period Assembly tasks and staffing are integrated in the new schedule, which is resource-leveled. A daily FPA coordination meeting has been instituted to plan tasks and work assignments on a day-to-day basis. The Engineering Dept. manages labor availability to meet the project's needs. **Closed**

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200612-08	Technical (Final Assy.-1)	Validate all proposed technical changes [e.g., in structures design] off critical path.	8. Heitzenroeder	Build validation activities into the schedule.	Validation of proposed changes off the critical path has been implemented. . For example, an option for a simplified TF and PF support structure (WBS 15) using a much less expensive aluminum alloy instead of Inconel was validated in a PDR that was held on July 20. The remaining work is scheduled well off the critical path. **Closed**
200612-09	Cost Estimate	Develop a bottoms-up estimate of the project's work to complete that is integrated into the project schedule and identifies required contingency by the next review.	8. Anderson	See 200612-00	See 200612-00. **Closed**
200612-10	Schedule & Funding	Develop an updated resource-loaded schedule to complete the project as part of any Level 0 re-baselining proposal. It needs to be consistent with the amount of additional cost contingency being proposed.	8. Anderson / Strykowsky	See 200612-00	See 200612-00. **Closed**
200612-11	Management	Make a final decision regarding the cryogenic testing of the modular coils.	8. Makiel	Further consultation with technical experts by DOE.	After further consultation, DOE accepts the project's position as documented in the white paper presented at the December Lehman review. **Closed**
200612-12	Management	Refine the estimated cost to complete including a rational contingency estimate in preparation for a re-baseline in the summer.	8. Anderson	See 200612-00	See 200612-00. **Closed**
NCSX SC Project Review, May 9-10, 2006					
200605-01	Technical (Mod Coils-1)	The project should continue its aggressive behavior to track and control in-house costs and work to improve winding speed without sacrificing quality.	14. Dudek	Track coil winding and field period assembly costs. Review at weekly meetings. Use the data to support decisions on staffing, tooling, overtime, etc.	Cost trends continue to be tracked and reviewed with DOE. Cost performance metrics improved after the May, 2006 review. Updates were presented at PSO interim review (Sept., 2006) and the Dec., 2006 SC Project Review. **Closed.**

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200605-02	Technical (Mod Coils-2)	Assess whether an additional station is necessary for post-potting activities based upon realized delivery rates of the modular coil winding forms.	8. Neilson	Perform cost-benefit analysis.	The project decided to acquire an additional winding station. It went into operation in January, 2007. **Closed.**
200605-03	Technical (Mod Coils-3)	Perform a cost/risk analysis to determine whether there is any advantage or risk mitigation gained by cold-testing a coil of the "B" and "A" types in addition to the planned testing of "C1".	8. Reiersen	Re-visit cold testing plans after C1 test results are analyzed	Cost / risk analysis was completed with the conclusion to do no further cold testing. Decision was documented in a white paper dated Oct. 12. Excerpt: Given 1) the success in testing the C1 coil; 2) the design similarities between all coil types; 3) the fact that even at full current, a single coil only experiences half of its peak stress compared to operation in the complete modular coil assembly; and 4) we would still want to measure the structural behavior of the complete modular coil assembly, the expected benefits of additional cold testing on individual coils appear to be limited. **Closed**
200605-04	Technical (Assy/Test-1)	PPPL should expand the verification matrix as described above [Sect. 2.4.1] and present the expanded matrix at the next review.	8. Reiersen	Develop a data base to facilitate tracking of flowdown and verification of requirements	A requirements database is being developed.
200605-05	Technical (Assy/Test-2)	Every effort should be made to perform those tests that are considered conventional for wound copper magnets.	14. Reiersen	Investigate test equipment that use transient techniques for testing turn-to-turn insulation.	Tests that are considered conventional for wound copper magnets are being performed on the modular and TF coils. Coil resistance, insulation resistance, polarization index, inductance, and capacitance are measured on the modular coils. On the TF coils, coil resistance, insulation resistance, inductance, and Q values are measured. In addition, a ring test is performed to reveal turn-to-turn shorts. **Closed**

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200605-06	Technical (Assy/Test-3)	PPPL should also consider the benefits of structural analysis modeling verification during the cold-test despite the fact that the loads are different than in the final system configuration. Any verification of the structural model adds validity to the model and the design process overall.	14. Nelson	Agreed. Analysis results will be compared to strain and displacement measurements from testing.	Structural model verification is one of the key objectives of the cold testing. The Type C coil has been analyzed under test conditions for comparison with strain gauge data when available. **Closed**
200605-07	Cost -1	Analyze and report on the status of the contingency risks and opportunities identified currently and at the next review.	8. Strykowsky	Action as stated	Risks and opportunities were documented in the interim report to DOE-PSO on 9/19/06. **Closed**
200605-08	Cost - 2	Present at the next DOE review an update of demonstrated project productivity improvements, cost savings, fabrication activities, and other efficiencies.	1. Dudek	Continue detailed cost tracking for coil winding and extend to field period assembly.	Cost trends continue to be tracked and reviewed with DOE. Cost performance metrics improved after the May, 2006 review. Updates were presented at PSO interim review (Sept., 2006) and the Dec., 2006 SC Project Review. **Closed**
200605-09	Cost - 2	Explore the possibility of reducing the overhead rate applied to NCSX if it could be justified through a causal-/beneficial analysis.	1. Winkler	Review opportunities to modify PPPL's overhead rate structure in order to reduce the indirect costs allocated to the NCSX MIE project.	PPPL was able, on a causal-beneficial basis, to exempt the NCSX MIE project from being assessed the Laboratory's new LDRD overhead rate (will save the NCSX MIE project approximately $400K). **Closed**
200605-10	Schedule - 1	Conduct an external peer review of the field period and machine assembly process. Present at the next DOE review the detailed schedule and plans for carrying out field period and machine assembly.	18. Reiersen	Focus on one station at a time and invite experts from outside the project to participate, as appropriate. Present the detailed schedule and plans (including plans for design reviews) at the next Lehman Review.	Review was conducted Oct. 11-12, with participants from W-7X (Germany), HSX (U. Wisc.), and SNS (ORNL). The review resulted in 85 chits containing very valuable input. The project is folding it into the plans. **Closed**

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200605-11	ES&H – 1	Provide a plan for proper safety precautions for the coil and personnel protection during the initial operation and first plasma prior to approval of the project change proposal, which would modify/simplify these systems.	8. Gentile	Document safe startup plan as stated.	Safe startup plan was drafted and approved, incorporating DOE comments. **Closed.**
200605-12	Mgt. – 1	Determine the best procurement approach for the poloidal coils.	13. Kalish	Explore collaboration with ASIPP. Update procurement plan during FY-07 as part of PF design activity.	Collaboration with ASIPP was discussed but does not appear to be an option at this time. Baseline is to fabricate in industry, with award scheduled for FY-08. **Closed.**
200605-13	Mgt. - 2	Remain vigilant in controlling project cost and continue value engineering.	1. Neilson	Cost control emphasis on coil winding and field period assembly. Pursue value engineering in in-house and outside fabrication activities.	Cost control measures implemented: • Continue to track & manage coil winding and FPA costs. • Address FPA Stage 1 process development issues ("learning") with minimum staff. • Acquire additional winding fixture to improve efficiency. • New outside source for chill plates eliminates re-work. • Outside source reduces cost of autoclave components cleanup. Cost performance metrics improved after the May, 2006 review. Updates were presented at PSO interim review (Sept., 2006) and the Dec., 2006 SC Project Review. **Closed**
200605-14	Mgt. - 3	Present a draft transition to operations plan by next DOE review.	8. Reiersen, Strykowsky	Incorporate tasks and milestones from TEP and SSP into the Performance Measurement Baseline.	Tasks and Milestones are documented in the NCSX Test and Evaluation Plan (TEP). Safe Startup Plan (SSP) documents engineered safety controls. Coordination of NCSX and PPPL infrastructure schedules was presented at Dec., 2006 SC Project Review. **Closed.**

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NCSX SC Project Interim Assessment, February 22, 2006					
200602-01	Technical (TF Coils)	Contact Mike Zisman of LBNL at 510-486-5765 on lessons learned regarding procurements from China.	8. Neilson	Action as stated.	Telecon with Zisman on 2/22/06, resulted in valuable suggestions which the project will follow up on if a contract is awarded to ASIPP. **Closed**
200602-02	Management	Provide a critical assessment of project status at the May Lehman review	8. Neilson	Prepare for the review so as to support this objective.	The project presentations and documentation for the May 9-10 SC review support this objective. **Closed.**
NCSX SC Project Review, November 2-3, 2005					
200511-01	Technical (Mod Coils-1)	Continue to place high priority on MC winding activities with the goal to minimizing fabrication time while maintaining high quality.	14. Dudek	Follow through on process improvement plans as presented.	Numerous examples were presented in the interim report to DOE on Feb. 22, 2006. Trends in cost and schedule metrics will be presented at the May 9-10 SC Project review. **Closed**
200511-02	Technical (Mod Coils-2)	Continue to work proactively with EIO for delivery of the MCWFs to the most recently developed schedule.	14. Heitzenroeder	Action as stated.	The project, working with EIO and its subcontractors, implemented a new MCWF production plan, that is technically sound and meets the project's schedule requirements. The contract and project baseline (ECP-043) were modified based on this new plan. **Closed.**
200511-03	Technical (Mod Coils-3)	Closely re-examine the schedule and costing for the modular coil systems after the fabrication of the first three articles and provide an interim report to DoE on these results and progress with all aspects of the modular coil fabrication.	14. Dudek	Keep detailed cost and schedule records versus estimates. Update at FY06 1Q quarterly and at SC Lehman review.	Interim report of coil fabrication cost and schedule was presented on Feb. 22, 2006. Cost and schedule metrics are being tracked and reviewed by management weekly. They will be presented at the May 9-10 SC Project review. **Closed**

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200511-04	Technical (Conv. Coils-1)	Pursue the option of having all TF and PF coils fabricated in China leading to a decision by second quarter 2006. Based on the uncertainty with the winding time required for the MCs, the Committee did not recommend that additional PF winding be undertaken as an in-house activity.	8. Neilson	Action as stated	An NCSX team visit to ASIPP in December, 2005 led to a positive assessment of their capabilities. While the TF contract was awarded to another supplier, the option of having the PF coils fabricated in China is still being pursued. **Closed.**
200511-05	Technical (Conv. Coils-2)	Investigate further the feasibility to have the TF and PF coils fabricated in industry with high quality if sufficient oversight personnel can be provided at the necessary level.	8. Neilson	Action as stated. (Regarding the PF, fabrication in industry is the baseline.)	The project re-visited its make-or-buy analysis for the TF coils and concluded that procuring the coil assemblies could reduce cost risks without increasing quality risks. A procurement action was initiated and a contract was awarded to industry. The project budget was adjusted to increase engineering oversight. **Closed.**
200511-06	Technical (Conv. Coils-3)	Apply further effort to reducing the cost of the TF wedge castings, so procurement can proceed without schedule impact.	13. Kalish	Action as stated	The project modified its specification to allow a wider range of fabrication methods and materials for the wedge pieces, and included them in the SOW for the TF procurement. The project budget has been adjusted to reflect the fixed price of the TF contract just awarded, so the cost risk associated with the wedges is retired. **Closed.**
200511-07	Technical (Conv. Coils-4)	Analyze the modified design of the correction coils to insure adequate performance for plasma quality and confirm the cost reduction credit.	8. Zarnstorff 13. Kalish	8. Analyze performance. 13. Analyze cost	A configuration consisting of only two identical coils can target the 1/2 resonance, providing important functionality. The coils could be wound in place with flexible conductor at very low cost. Engineering design is scheduled for FY-07. **Closed**

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200511-08	Technical (Field Period Assy.-1)	Pursue further the development and refinement of the assembly procedures using the crane method for installation of the MC over the VV sectors. Pay particular attention to safety in developing these procedures due to the heavy lifts and critical nature of the procedure.	18. Viola	Action as stated.	Ongoing effort. Progress in Field Period Assembly procedures and tooling development were presented at the Oct. 11-12, 2006 peer review. See Item 200605-10. **Closed.**
200511-09	Cost-1	The project should analyze and report on the status of the contingency risks and opportunities identified in this review at the next review.	8. Strykowsky	Action as stated	Will report at the May 9-10 SC Project Review. **Closed.**
200511-10	Schedule and Funding-1	The project should re-evaluate the schedule uncertainties after more performance history is gained with the MCWF vender and the Modular Coil winding operation and present results at the next scheduled DOE Review.	8. Strykowsky	Action as stated	See 200511-01, -02, and -03. Interim report to DOE was presented on Feb. 22, 2006. Full report will be presented at the May 9-10 SC Project Review. **Closed.**
200511-11	Management-1	Continue ongoing efforts to outsource TF and PF coils (decision by 2nd Qtr 2006).	8. Neilson	Action as stated	A contract to fabricate the TF coils has been placed. Procuring the PF coils remains the baseline. **Closed.**
200511-12	Management-2	Assure continuity of engineering leadership and effective oversight in the face of internal project demands (multi-shift strategies) and external project influences (ITER)	8. Neilson Dudek	Action as stated	Oversight of in-house manufacturing operations and transition plans of key design engineers with newly-acquired ITER responsibilities will be reported at the May 9-10 SC Project Review. **Closed**
NCSX Mini-Review, December 7, 2004					
200412-1	2. Recommendation	Test the proposed coil cooling system [modular coil chill plates] as quickly as possible in the twisted racetrack coil to ascertain its effectiveness.	1. Nelson	Ensure that this issue is addressed in the test program for the twisted racetrack coil.	The external chill plate method of cooling was previously tested in two R&D tests (the UT coil and the flat racetrack coil). Now the twisted racetrack coil has also been tested, including measurements of the coil temperature vs time, coil resistance vs time, and coolant flow rate. The cooling scheme performed as expected. **Closed**

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200412-2	2. Recommendation	As the Toroidal Field (TF) coils cannot be replaced without disassembly of the machine, the Committee urged the project to investigate ways to reduce risk/mitigate failure of the TF coils.	13. Kalish	Address via the design process. Strict attention to performer qualifications as well as QA and QC during coil fabrication will be the first line of defense.	Preliminary design was completed. The design was modified eliminating the necessity to cut through the insulation to achieve the wedged configuration making the design both easier to manufacture and decreasing the probability of a manufacturing defect. A make-or-buy analysis in conjunction with the PDR led to a decision to have PPPL wind the TF coils. The main reason is to reduce quality control risks that could lead to a coil failure. The tooling has been prepared and adequate fabrication and oversight labor is budgeted in the FY-06 work plans. **Closed.**
200412-3	3. Recommendation	Update the ETC semi-annually.	81. Strykowsky	Action as stated. ETC will be updated in conjunction with semi-annual SC project reviews.	ETC for all jobs were updated in March and September, 2005, in preparation for Lehman reviews and planning for the new fiscal year. The results are used to make budgeting decisions and plan resource needs. The project will continue to follow this practice. **Closed.**
200412-4	4. Recommendation	The Office of Fusion Energy Sciences is still encouraged to accelerate the funding profile to allow for contingency to be used in the years when the project will need it the most.	81. Neilson / Strykowsky	Follow-up with OFES on an on-going basis.	Increased funding was provided in FY-05, improving the project's contingency position for that year. If additional BA were provided in FY-06, benefits would be: additional contingency margin, accelerate tasks postponed to FY-07 reducing schedule risks (as recommended in 200409-4) and speeding up issue resolution. The project will continue to balance planned work with reasonable contingency set-asides within the baselined BA profile. **Closed**

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200412-5	5. Recommendation	The project needs to have a more specific plan on staffing for the remainder of the project, especially the technical craft labor that will be needed in future years.	81. Strykowsky	Address as part of FY-07 FWP process. Reduce the technician "spike" in the last year of the project.	Manpower loading is leveled on a rolling wave basis. A more detailed and realistic staffing plan has been developed as part of the 2005 re-baselining. Additional term and subcontract personnel continue to be hired to supplement PPPL staff. **Closed**
NCSX Mini-Review for CD-3, September 1, 2004					
200409-1	2. Comment	The project needs to insure that the C-site power supplies can achieve conditions needed for mapping. Specifically configurations that are sensitive to errors may require introduction of certain rotational transform values.	82. Reiersen Physics Fredrickson	82: Document that GRD field mapping scenario is satisfied. Physics: Develop field mapping plans consistent with C-site power supplies.	The field mapping scenario requirements are enveloped by the first plasma scenario. **Closed**
200409-2	3. Comment	To ensure that these fabrications stay within budget and to maintain the cost, controlling the changes to the MCWF and VVSA is essential.	1. Nelson	Ongoing attention.	To date, there have been only minimal project-directed changes, e.g. a requirement for final heat treat of the MCWF before machining. The majority of changes have been made in response to supplier requests, or to reduce cost and schedule risks. **Closed.**
200409-3	4. Comment	Contingency funding is backend loaded thus the project lacks flexibility with moving activities around.	Project and PPPL Management	Addressed in 200412-4	Addressed in 200412-4. **Closed.**
200409-4	4. Comment	The project needs to ensure that activities that will be delayed (i.e., PF/TF coils) are not pushed back too far that they become critical path items or interfere with assembly of the components.	81. Strykowsky	Ongoing attention.	This is managed by the Project Control office on an ongoing basis. **Closed**
200409-5	4. Comment	Finally, the committee identified that there may still be some optimization possible with the schedule.	81. Neilson	Follow-up with committee.	Discussed with committee member David Anderson. It was concluded that the possibility identified by the committee was precluded by the design. **Closed.**

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200409-6	5. Comment	The current funding profile is not optimized. There is inadequate BA in early years which limits the rate at which work can be completed and thus has direct impacts on the cost and schedule.	81. Neilson	Addressed in 200412-4	Addressed in 200412-4. **Closed**
SC Independent Project Review (IPR), June 8-9, 2004					
200406-1	2.2 Comment	The NCSX project is especially encouraged to follow through on its plans for R&D on the field weld joint that will be used to join the three 120 degree VVSA sectors.	12. Dudek	Action as stated	The project placed high priority on completing the weld R&D tests early so that if the results had indicated a need for design changes, they could be more readily accommodated. Small-scale tests of the weld prep and procedures for making the final assembly joint were completed. These tests successfully demonstrated a solution for making up the joint as designed, and the R&D activity is now complete. **Closed**
200406-2	2.2 Comment	Fracture mechanics/fatigue analysis issue identified during FDR must also be investigated and resolved	14 Williamson Heitzenroeder	Bias the gating design to promote high casting quality in critical areas; specify higher level of inspection in those areas. Test alloy samples to determine fracture properties. Additional analysis and design to reduce stresses.	We initially determined that fast fracture is not an issue for this material. Fracture mechanics evaluations were made from specimens cut from the shell of a prototype winding form. The results of these evaluations indicate that the winding form is capable of withstanding four times the number of full power pulses required by NCSX's Design Criteria at 215 MPa, which is the peak stress in the winding form, with initial flaws as large as 2 x 6 mm. **Closed**

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200406-3	2.2 Comment	Procurement action [for MCWF] should continue with the understanding that the project team and the DOE contracting officer will assess adequacy of vendor progress and results prior to final award action.	8 Templon Heitzenroeder	Project will keep FPD informed of progress and issues throughout the proposal evaluation and selection process.	The adequacy of the vendors has received significant attention during the procurement process. Both the DOE Contracting Officer and OFES have accepted the project's assessment that the proposals are technically sound. **Closed**
200406-4	2.3 Recommendation 1	Consider offering an incentive fee for on-schedule delivery of the VVSA.	12 Templon Viola	Consider during VVSA procurement.	Incentive fee was considered during proposal evaluation and rejected due to constraints on project funds, **Closed**
200406-5	2.3 Recommendation 2	Develop a split-order options strategy for the MCWF procurement prior to receipt of bids. Consideration should be given to possible impact on cost and funding profile	14 Templon Heitzenroeder	Consider during MCWF procurement.	A split-order was considered during negotiations and judged to be too expensive. **Closed**
200406-6	3.2 Comment	Cost estimates and contingency for the remainder of the project may need to be updated after the proposals for MCWF and VVSA are submitted, especially if the costs are dramatically different from what was planned.	8 Strykowsky	Evaluate based on proposal contents.	The contingency and costs for other work scope have been updated as part of the project re-planning that was done following receipt of MCWF and VVSA proposals. The new plan provides adequate contingency. **Closed**
200406-7	3.2 Comment	The project has other high-risk activities besides the MCWF and VVSA procurements. As a result, ensuring adequate contingency is important for successful completion of the project.	8 Neilson	The project will, on a continuing basis, identify work efficiencies and value improvements in order to conserve contingencies needed for high-risk scope.	The contingency has been updated as part of the project re-planning that was done following receipt of MCWF and VVSA proposals. The new plan provides adequate contingency. **Closed**
200406-8	3.2 Comment	The project needs to pay close attention to adequacy and availability of funding during FY05 and FY06 since most of the high risk work described above will be performed during this timeframe.	8 Neilson	Will discuss with DOE.	Funding adequacy was addressed in re-planning the project. Various measures were taken to ensure adequate BA in FY-05 to fund the MCWF and VVSA contracts. **Closed**

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200406-9	3.2 Comment	The project is evaluating options such as moving non-critical items activities for later work, rearranging the order of work to be performed, and finding work efficiencies to minimize the impact of the funding limitations in FY 2005-2006. The Committee felt that the project should continue to evaluate these methods.	8 Reiersen	Will continue to pursue cost savings. Schedules can be re-arranged to some degree if necessary in order to manage within the funding constraints.	Schedule re-arrangements were made as part of the re-planning to address cash flow issues and delayed delivery of the MCWF. **Closed.**
200406-10	3.2 Comment	The project should consider evaluating the limitations of current schedule acceleration plan [for the modular coil windings, i.e. second shift and overtime] and reexamine the cost impacts of various options available.	14 Chrzanowski	Will consider as part of future MC planning.	In re-planning the project it was found to be advantageous to add a third winding line, use 2-shift operation for the last 6 coils, and take modest credit for a learning curve. **Closed.**
200406-11	3.2 & 4.2 Comment	The committee is also concerned about the increase in price of commodities. (3.2) Demand, and hence cost, for many construction commodities (e.g., steel, Inconel, copper, electrical equipment) has substantially increased. Availability of some of these items for NCSX could potentially become a schedule issue. (4.2)	8 Templon, Strykowsky	Commodities issue, should it arise, will be addressed on a case-by-case basis. Will address as part of procurement planning.	Continuing to address as part of procurement planning. Materials price increases impacted the costs for the VVSA and MCWF procurements, but that risk is retired with fixed-price agreements. Availability has not been an issue. **Closed.**
200406-12	4.2 Comment 4.3 Recommendation 1	Comment: Flattening the project BA profile (reducing FY 2005 funding by $4.5M) has significantly limited management flexibility to address the component fabrication, assembly, and testing issues that will inevitably arise. Recommendation: OFES should give high priority to sustaining the project's BA funding profile, especially in FY 2006.	8 Neilson	Addressed in 200412-4	The constraints imposed by flat funding in FY-05 were taken into account in the CD-2 baseline. Continuing attention addressed in 200412-4. **Closed**

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200406-13	4.3 Recommendation 2	Update project baseline schedule to reflect actual MCWF and VVSA vendor delivery schedules as soon as they become known.	12, 14, & 8 Goranson Williamson Strykowsky	Will update when vendor selected.	The schedule has been updated. **Closed**
200406-14	5.2 Comment	The MCWF and VVSA procurements are planned as "best value" procurements. Care should be taken in specifying the detailed procurement process to assure that management has the flexibility to meet the intent of the best value process.	8 Templon	Will pursue as part of RFP development and procurement process.	This was integrated into the RFP development process. The selection process satisfied both the letter and the intent of the best value process, without any difficulty. **Closed**
200406-15	5.2 Comment	Management should ensure that the critical issues list stays current with project status and other events that could be important. For example, the nationwide shortage of basic materials and commodities could impact NCSX, but was not recognized in the critical issues list..	8 Reiersen	Will keep the critical issues list up to date. Commodities issue, should it arise, will be addressed on a case-by-case basis.	Critical issues list has been updated to recognize the commodities issue and reflect the issues currently facing the project. The primary concern in this area has been in the VVSA and MCWF procurements. Receipt of the fixed price bids for the production articles has largely retired this risk with respect to these major procurements. **Closed**
200406-16	5.2 Comment	The project should develop a critical spares plan; including whether to buy a spare casting of each of the three types of mod coil winding structure. Such a spare could help minimize the time necessary to recover from a potential problem that might arise in fabrication or operations.	8 Neilson	Develop a critical spares plan.	Have documented the plan for ensuring that spares needed to support startup will be available. **Closed**
200406-17	5.3 Recommendation 1	Consider instituting regular (e.g., monthly) project specific status telecons among PPPL/ORNL, PSO and OFES.	8 Neilson Pitonak Nardella	DOE decided that Laboratory staff will be included in future monthly status briefings for OFES.	Laboratories' participation started with the June 30 monthly. **Closed**
200406-18	5.3 Recommendation 2	Pending successful outcome of the VVSA and MCWF procurement process, CD-3 approval should be granted.	Davies	Brief OFES on source selection decisions and project impacts.	CD-3 was approved on Sept. 16, 2004. **Closed.**

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