

NCSX Risk Register

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No.	Affected Jobs (absorb the impacts)	Risk Description	Mitigation Plan (& job where budgeted)	Deadline to Retire Risk or Absorb Impact	Owner	Current Status (As of November 11, 2008)	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$k)	Critical Path Schedule Impact (mos)	Cost and schedule impact calculation basis			
<b>1. Mgmt-00 MANAGEMENT &amp; ORGANIZATION RISKS</b>																
1. Mgmt-01		Loss or prolonged unavailability of certain key personnel from the project could substantially impact the schedule.	See mitigation plans for individuals listed below.													
1. Mgmt-01a	1901	Mike Cole (ORNL)  Loss of "corporate memory" of stellarator core design intent, delayed turnaround on Title III issues and problem resolution might impact FPA schedule.	Brad Nelson is been budgeted (15%) on the project. Should Cole become unavailable, Nelson would step in and handle Cole's responsibilities until a suitable longer term solution was implemented. ORNL Mgt., Job 1901		Harris	DEFERRED RISK - Likelihood of risk occurring increases as time to restart NCSX is extended.	VU	Marginal	Low	Estimated impact is <0.5 months on the critical path.	\$0	+0.50				
1. Mgmt-01b	1810 7503	Tom Brown, Art Brooks, Bob Ellis  "Back office" support for FPA and final assembly becomes a chronic bottleneck, stretching out the time required to complete assembly operations	Additional support budgeted for Brown, Brooks, and Ellis providing "2 deep" back office support. Should be available to mitigate peak demands once training in key skills is completed. Jobs 8203, 8204, 8205.  Identify backup personnel for "two deep" back office support & provide duplication of critical skills needed. Eng. Mgt. (Heitzenroeder)		Heitzenroeder	DEFERRED RISK - although this was not an issue for MCHP #1 assembly operations, the likelihood of risk occurring increases as time to restart NCSX is extended.	VU	Significant	Low	Estimated impact is <2 months on the critical path. Cost impact covers up to 2 months of FPA/final assembly.	\$0	+2.00				
1. Mgmt-01c	8202	Phil Heitzenroeder (PPPL)	Larry Dudek can step in to assume Phil's responsibilities as Engineering Manager for Design and Procurement. Erik Perry can step into Larry's role as Construction Manager. As time goes on (and the field period assembly is completed), Mike Viola can continue (with Erik's help) with final machine assembly.	After final machine design and major procurement activities are completed.	Williams	DEFERRED RISK - Likelihood of risk occurring increases as time to restart NCSX is extended.	VU	Marginal	Low	Estimated impact is <0.5 months on the critical path. No impact on FPA cost because impacted personnel would be assigned to other activities.	\$0	+0.50				
1. Mgmt-01d	8101	Ron Strykowsky	Develop a succession plan Business Ops. Dept.		Winkler	DEFERRED RISK - Likelihood of risk occurring increases as time to restart NCSX is extended.	VU	Marginal	Low	Cost impact = 50% cost increment cost for 1 year spool-up time for another senior project controls person	\$115	+0.00	Loaded estimated annual cost = \$230k x 50% = \$115k			
1. Mgmt-01e	5301 5401 5501 5601	Loss of staff with experience in specialized software delays operation of Central I&C system.	Staff have recently been brought on board in anticipation of growing NCSX I&C needs. The planned shutdown of NSTX after FY10 will increase the availability of similar resources for NCSX.	NCSX Restart	Sichta Baumgartner von Halle	DEFERRED RISK - will need to reassess when NCSX restarted.	VU	Marginal	Low	Estimated impact is <0.5 months on the critical path. No impact on WBS 5 cost because impacted personnel would be assigned to other activities.	\$0	+0.50				

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1. Mgmt-01f	1901 8203	Design integration effort needs to increase to manage space allocations inside the cryostat and in the test cell	Staff has been increased recently. Periodically reassess adequacy.	Sept., 2008	Heitzenroeder	DEFERRED RISK - although this was not an issue for MCHP #1 assembly operations, the likelihood of risk occurring increases as time to restart NCSX is extended.	VU	Marginal	Low	1 person-year?	\$100	+0.00							
1. Mgmt-01g	12xx, 1601 7304	Paul Goranson (ORNL)  Loss of critical design engineering skills and "corporate memory" of vacuum vessel and coil services design intent, delayed turnaround on problem resolution might impact assembly schedule.	Develop succession plan. Job 8102		Harris	DEFERRED RISK - Likelihood of risk occurring increases as time to restart NCSX is extended.	U	Marginal	Low	Estimated impact is <0.5 months on the critical path.	\$0	+0.50							
1. Mgmt-01h	1810 1815 7304	Kevin Freudenberg (ORNL)  Loss of critical engineering analysis skills and familiarity with the analytical models an design intent for the stellarator core, particularly the modular coils.	Develop succession plan. Job 8102		Harris	DEFERRED RISK - Likelihood of risk occurring increases as time to restart NCSX is extended.	U	Marginal	Low	Estimated impact is <0.5 months on the critical path.	\$0	+0.50							
1. Mgmt-02	4501	Loss of knowledgeable staff delays operation of legacy power supplies.	Train staff in legacy systems. Eng. Dept.	Power Systems ISTP	von Halle	DEFERRED RISK - will have to be reassessed when NCSX restarted.	VU	Marginal	Low	Estimated impact is <0.5 months on the critical path. No impact on WBS 4 cost because impacted personnel would be assigned to other activities.	\$0	+0.50							
1. Mgmt-03	8101	Labor rates may be significantly lower than projected  Opportunity	None		Strykowsky	DEFERRED RISK - will need to be reassessed when NCSX restarted.	U	Opportunity	Opportunity	Retirements / resignations replaced with younger lower-salaried staff	(\$1,000)	+1.00							
1. Mgmt-04	8101	GPP projects not completed in time to support project needs	The crane and the HVAC systems are the main GPP projects that would need to be completed. The GPP projects have strong Lab and DOE oversight. Ample float is provided in the schedule so project delays due to GPP delays are not considered credible (P<1%). Eng. & Infrastructure Dept.	End of FY-09	Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	NC	Significant	Low		\$0	+1.00							
1. Mgmt-05	8101	GR may delay funding to project.	None		Strykowsky	RETIRED for now since FY09 no longer applicable - may need to be reassessed when NCSX restarted.	U	Significant	Moderate	Expected increase in FY-09 may be delayed by CR.	\$0	+2.00							
2. Assy-00	<b>TECHNICAL RISK - Generic Assembly Risks</b>																		
2. Assy-02	1815	Station 5: cost and schedule grows when Assembly Sequence Plan fully matures.	Expedite Component Designs and Assembly Sequence Plan Jobs 1354, 1501, 1601, 8203	Station 5 & 6 PDR	Brown	DEFERRED RISK - updated models and assembly sequence plans, but did not get to updating cost and schedule impacts. Will have to be reassessed when NCSX is restarted.	VL	Significant	High	25% increase in time required for each F.P	\$500	+1.13	Station 5 estimate of \$1889k x 25% plus schedule stretchout for the time station 5 is on the c.p (4.5mo x 25% (stretchout cost quantified and added separately)						

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2. Assy-03	7503	Station 6: cost and schedule grows when Assembly Sequence Plan fully matures.	Expedite Component Designs, Plant Layout, and Assembly Sequence Plan Jobs 1701, 1702, 1803, 8215	Station 5 & 6 PDR	Brown	DEFERRED RISK - updated models and assembly sequence plans, but did not get to updating cost and schedule impacts. Will have to be reassessed when NCSX is restarted.	VL	Significant	High	15% increase in time required.	\$650	+2.18	Station 6 estimate of \$4,317k x 15%. plus schedule stretchout for the time station 6 is on the c.p (14.5mo x 15% (stretchout cost quantified and added separately)			
2. Assy-04	7503	Photogrammetry replaces laser tracker for some operations and saves time and money. (Opportunity)	Acquire equipment, develop experience, assess potential. New H/W in place & personnel being trained. 1810 / 1815	After Station 2 MCHP #2	Dodson / Dudek/Perry	DEFERRED RISK - although photogrammetry techniques successfully utilized in MCHP #1 assembly, this opportunity really was not realized when revised ETC for FPA determined. However, opportunity may be available for Station 6.	L	Opportunity	Opportunity	10-15% reduction in metrology tasks for Station 6?	(\$297)	(1.0)	50% reduction in metrology crew labor cost = \$2,729k x 50% . Reduction of metrology dependent tasks on the c.p. = 172 days x .5 = 86 dyas = 4 months. (stretchout cost quantified and added separately)			
2. Assy-07	1302/1352 1354	Permeability of components outside 3m from machine to test cell walls exceed the permeability limit of mu = 1.2.	Analyze existing conditions to determine if an issue exists. At worst case, may have to utilize more expensive low magnetic materials and/or utilize combination of rebaised trim and PF ring coils to mitigate field errors.	NCSX restart	Brooks Kalish Chrzanowski	DEFERRED RISK - work stopped on facility models needed to do this work. Will need to reassess when NCSX restarted.	U	Marginal	Low	Estimated cost of obtaining low magnetic materials.	\$200	+0.00				
3. Stat2-00	<b>TECHNICAL RISKS - Station 2 Assembly</b>															
3. Stat2-13	1810	Station 2. Modular coil damaged during assembly requiring significant rework to coil. (Complete coil re-fabrication excluded)	Equipment will be handled during FPA using carefully constructed procedures to minimize likelihood. Include provisions to guard against coil damage in FPA procedures. Job 1810	After Station 3	Viola	DEFERRED RISK - will need to be reassessed when NCSX restarted.	L	Negligible	Low	Nominally repaired with a 2-man crew within 2 weeks. Cost: 3-4 occurrence. No schedule impact	\$50	+0.00				
3. Stat2-14	1810	Station 2. Modular coil damage requiring coil re-fabrication.	Extreme care will be taken when transporting and handling coils. Develop and follow appropriate procedures. Job 1810	After Station 2	Viola	DEFERRED RISK - although two 3 packs assembled without incident, until all 3 packs assembled this risk cannot be retired		Negligible	#N/A	High impact-low probability event that has been excluded as a bounding assumption.						
4. Stat3-00	<b>TECHNICAL RISKS - Station 3 Assembly</b>															
4. Stat3-01	1810	Station 3: vertical weld distortion excessive. Have to take apart, modify design or procedure, re-weld.	Perform vertical welding R&D and careful monitoring during welding. Develop suitable weld procedures and train welders to minimize likelihood of unacceptable distortion. Refine welding capabilities on Station 2. Job 1810	After first A-A weld	Viola	DEFERRED RISK - will have to be reassessed when NCSX restarted.	L	Significant	Moderate	5 techs x 1 month	\$70	+1.00				

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4. Stat3-03	1810	Station 3. VV surface component (coolant tube, flux loop, or TC) damaged during FPA requiring significant rework. (Note: There is only 0.2" of clearance currently projected.)	Equipment will be handled during FPA using carefully constructed procedures to minimize likelihood. Include provisions to guard against coil damage in FPA procedures. Job 1810 8203	After Station 3	Viola	DEFERRED RISK - will have to be reassessed when NCSX restarted.	VU	Marginal	Low	Nominally repaired with a 2-man crew within 2 weeks	\$20	+0.50	Updated.			
4. Stat3-04	1810	Station 3. Interferences discovered during assembly; components don't go together as planned. Assemblies have to be taken apart, components moved or re-worked, re-assembled.	CAD modeling with as-built dimensions to find interferences off critical path. Do simulations carefully Job 1901 & 8203	NCSX restart	Brown Cole	DEFERRED RISK - studies completed for all but A-A joint. Will have to reassess when NCSX is restarted.	L	Marginal	Moderate	0.5 months on C.P.	\$0	+0.50				
4. Stat3-06	1810	Station 3. Assembly tooling allows too much deflection and has to be redesigned.	Exercise tooling off the critical path. Compensated by design, metrology, exercise tooling & follow demonstrated procedures. Assy steps allow for this. Demonstrated in Station 2 Job 1810	By start of Station 3	Viola	RETIRED - MCHP #1 assembly successfully demonstrated that this was not an issue.	VU	Significant	Low	Rough assessment of cost and schedule impact of reinforcing or redesigning tooling.	\$50	+1.00				
5. Stat5-00	<b>TECHNICAL RISKS - Station 5 Assembly</b>															
5. Stat5-01	1815	Station 5. Trim coils not available when needed in field period assembly sequence. Have to implement workaround.	Expedite design and procurement. Jobs 1354	When 10% of coils are wound.	Kalish	DEFERRED RISK - will not be able to reassess until NCSX restarted and trim coil procurements placed.	U	Marginal	Low	2 weeks on CP	\$0	+0.50				
5. Stat5-02	1815	Station 5. TF Coils cannot be aligned	Reexamine alignment criteria and potential impact. Job 1810	By start of Station 5	Perry	DEFERRED RISK - will have to be reassessed when NCSX restarted.	U	Significant	Moderate	Up to 4 week impact on FPA and critical path.	\$0	+1.00				
5. Stat5-03	1815	Station 5. TF coils become warped and have to be racked to restore proper geometry.	Two TF coils measured and found to be within tolerances.		Kalish	DEFERRED RISK - Only 2 coils measured and found to be within tolerances prior to project termination. Will have to reassess when NCSX is restarted.	U	Marginal	Low	2 weeks on CP & some retrofit of clamps. Have to do some re-design of clamps. Maybe 4 weeks of Fred & designer + hardware	\$60	+0.50				
5. Stat5-05	1815	Station 5. Problems installing ports due to interferences. Have to move components or modify ports.	CAD modeling with as-built dimensions to find interferences off critical path. Job 1901	By start of Station 5	Brown Cole	DEFERRED RISK - initial study and reassessment of Cryostat design eliminated some ports, but a more comprehensive study will be needed when NCSX is restarted.	L	Marginal	Moderate	Cost, not schedule 3-4 techs. X 2 weeks x 5 occurrences	\$125	+0.00				
5. Stat5-06	1815	Station 5. Interferences discovered during assembly; components don't go together as planned. Assemblies have to be taken apart, components moved or re-worked, re-assembled.	Design integration during Title I & II design of components. Job 8203	Coil Services PDRs	Brown	DEFERRED RISK - will need to be reassessed when NCSX restarted.	VU	Negligible	Low	Trim coil - port interferences are biggest concern. Leads are a concern too??  4 techs. X 2 weeks X 1 occurrence	\$30	+0.00				
5. Stat5-07	1815	Station 5: Multiple vacuum leaks during initial pumpdown	Welds will be leak checked during FPA when leaks can be addressed without significantly impacting the critical path. Job 1810	After leak check of first FP.	Perry	DEFERRED RISK - will have to be reassessed when NCSX restarted.	L	Negligible	Low	Impact of having only a few leaks is covered in estimate uncertainty with present mitigation plan	\$25	+0.00				

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5. Stat5-09	1815	Station 5. Field period damaged during loading, transport, or unloading from TFTR TC to NCSX TC	Extreme care will be taken when transporting a field period. Additional reviews including external reviewers will be performed. Develop appropriate procedures for transporting field periods. Arrange for a peer review of the procedures prior to transport. Will replace rollup door in CS test cell. Job 1815	After first FP.	Perry	DEFERRED RISK - will have to be reassessed when NCSX restarted.		N/A	N/A	High impact-low probability event that has been excluded as a bounding assumption.									
5. Stat5-10	1815	Station 5. Difficulty of welders working inside VV in contorted positions may delay port welding or require additional measures to mitigate ergonomic & confined space hazards	JHA will be developed, a removable platform will be designed; and additional time for ergonomic allowances. Job 1815	After first FP.	Perry	DEFERRED RISK - will have to be reassessed when NCSX restarted.		Negligible	#N/A										
6. Stat6-00	<b>TECHNICAL RISKS - Station 6 Assembly</b>																		
6. Stat6-02	7503	Station 6. Original base structure vendor(s) unable to deliver on schedule; not available when needed in machine assembly sequence. Have to implement workaround.	Alternate vendors exist & sufficient float exists to engage an alternate vendor. We procure components and assemble on site. Job 1702	Coil structures FDR	Dahlgren	DEFERRED RISK - will need to be reassessed when NCSX restarted and these procurements are pursued.	VU	Negligible	Low	Base supports must be in place prior to the 3-period machine assembly	\$50	+0.00							
6. Stat6-03	7503	Station 6. PF 5L & 6L not available when needed in machine assembly sequence. Have to implement workaround.	Expedite design and procurement. Could put FP#1 in place if we had to. Could absorb 4 months delay Jobs 1302/1352	When 1st coil is wound.	Chrzanowski	DEFERRED RISK - will not be able to assess until NCSX restarted and PF coil procurements placed.	NC	Negligible	Low	Would impact CP. PF coils have ample float	\$0	+0.25							
6. Stat6-05	7503	Station 6. PF 4L, 4U, 5U, 6U not available when needed in machine assembly sequence. Have to implement workaround.	Expedite design and procurement. Jobs 1302/1352	When 1st PF is wound.	Chrzanowski	DEFERRED RISK - will not be able to assess until NCSX restarted and PF coil procurements placed.	NC	Negligible	Low	Would impact CP day for day, but PF coils have ample float	\$0	+0.25							
6. Stat6-06	7503	Station 6: Trim coils not available when needed in machine assembly sequence. Have to implement workaround.	Expedite design and procurement. Jobs 1354	When 10% of coils are wound.	Kalish	DEFERRED RISK - will not be able to reassess until NCSX restarted and trim coil procurements placed.	NC	Negligible	Low	Would impact CP day for day, but risk mitigated by design and float.	\$0	+0.25							
6. Stat6-07	7503	Station 6: Leads not available when needed in machine assembly sequence. Have to implement workaround.	Expedite design and procurement. Jobs 1601	Electrical leads FDR	Goranson	DEFERRED RISK - will not be able to assessed until NCSX restarted.	NC	Negligible	Low	Would impact CP day for day, but risk mitigated by design and float.	\$0	+0.25							
6. Stat6-09	7503	Station 6. Interferences discovered during assembly; components don't go together as planned. Assemblies have to be taken apart, components moved or re-worked, re-assembled.	CAD modeling with as-built dimensions to find interferences off critical path. A Pro E model/sterolithography of the three period assemblies and mechanism for positioning the FPA will be fabricated to evaluate the assembly of the coils. Job 1901 / 8203	By start of Station 6	Cole	DEFERRED RISK - will not be able to assessed until NCSX restarted.	L	Significant	Moderate	1 month on C.P.  4 techs x 1 mont	\$50	+1.00							



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6. Stat6-10	7503	Station 6. Problems making up vacuum vessel field joint. Have to re-machine spool piece.	Careful metrology in FPA, back office analysis and CAD modeling. Job 8202 (Eng. Mgr.)	After first VV joint successfully made up.	Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	U	Critical	Moderate	3 joints @ 1 month C.P. each	\$0	+3.00				
6. Stat6-11	7503	Station 6. Retainer and pucks do not stay on flange during assembly and moving of half field periods. Potential safety risk if individuals are under the machine.	Pucks will be held in place by Nomex felt and is being demonstrated to show feasibility. Stud assembly sequence will be developed in model studies Job 1901	By start of Station 6	Cole	DEFERRED RISK - will not be able to assessed until NCSX restarted.	U	Significant	Moderate		\$30	+1.00				
6. Stat6-12	7503	Station 6. Problems making up C-C joint. Interferences, bolt access problems.	A Pro E model/sterolithography of the three period assemblies and mechanism for positioning the FPA will be fabricated to evaluate the assembly of the coils. Also CAD modeling Job 1901 / 8203	By start of Station 6	Cole	DEFERRED RISK - will not be able to assessed until NCSX restarted.	U	Negligible	Low	Risk is mitigated in the estimate	\$0	+0.25				
6. Stat6-13	7503	Station 6. Pourable insulation installation problems; can't get what we need, don't know if it fills all the voids, leaks out all over the place; have to invent methods to ensure complete fill and seal.	Perform R&D. Design special tooling for installation and verification. Job 7503 & 1901	At least 1 year before start of Station 6	Cole	DEFERRED RISK - will not be able to assessed until NCSX restarted.	U	Negligible	Low	Risk is mitigated in the estimate	\$0	+0.25				
6. Stat6-14	7503	Station 6. Modular coils are shorted across toroidal break between field periods causing problematic field errors	Ensure that required electrical breaks are not compromised. Check carefully during assembly. Job 1810, 1815, 7503		Viola (FPA) Perry (MA)	DEFERRED RISK - will have to be reassessed when NCSX restarted.	NC	Negligible	Low		\$25	+0.25				
6. Stat6-15	7503	Station 6. Assembly sled for final assembly is not adequately stiff or does not provide repeatable motion	Functionality of sled will be determined with first FP. Ample time to make design modifications between arrival of the first and third FPs. Job 7503	By start of Station 6	Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	U	Negligible	Low	Nominal cost impact is 1 man-month of engineering design and up to half the fabrication cost of the sled	\$75	+0.00				
6. Stat6-16	7503	Station 6. Vacuum leaks occur. Takes time to locate and repair.	Leak check each field period independently in FPA. Job 1815	After final VV weld	Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	U	Negligible	Low	Risk is mitigated in the estimate	\$0	+0.25				
6. Stat6-17	7503	Welding of the Vacuum Vessel pieces to the spool pieces may require the addition of thin Inconel plates to bridge gaps caused by radial and/or angular out-of-tolerance conditions of either the VV or spool pieces.	Add Inconel plates to extend the vessel flange if radial out-of-tolerance and add flange plates to spool pieces and then bridge to vessel flange extension if angular out-of-tolerance.		Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	VU	Critical	Moderate		\$50	+4.00				
7. S/U-00	<b>TECHNICAL RISKS - Startup</b>															
7. S/U-01	8501	Unanticipated problems with cryostat penetrations (icing, excessive condensation). May require warming up the stellarator core to effect repair with consequent impacts to critical path activities.	Careful cryostat design, including consultation with experts and R&D. Job 1701	Cryostat FDR	Raftopoulos	DEFERRED RISK - will have to be reassessed when NCSX restarted.	U	Significant	Moderate	Nominally repaired with a 4-man crew in 1 week with 3 weeks for warmup/cooldown (if required)	\$30	+1.00				

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7. S/U-02	8501	Coil cooling system fails to cool coil structure down to cryogenic temperature	Expedite cooldown analysis. Robust design with excess capacity. Job 6201	Cryo. System PDR	Heitzenroeder	DEFERRED RISK - preliminary analyses performed by Bagley Associates indicated reliable performance. Will have to be reviewed in greater detail when NCSX restarted.	U	Marginal	Low		\$0	+0.50				
7. S/U-03	8501	Insulation on modular coil fails during initial cooldown and testing requiring in situ repair.	C1 tested at full current at cryogenic temperature. All modular coils will be tested at RT at elevated (50% higher) voltage for faults to ground. Job 1421  In addition, routine field tests will be performed on each assembly station to ensure that the electrical integrity is OK. Job 1810	After Station 3	Chrzanowski (MC) Viola (FPA)  M. Viola & E. Perry - implement mitigation plan during field period and final assembly.	DEFERRED RISK - will not be able to assessed until NCSX restarted and completed.	VU	Significant	Low	Insulation fault in lead area is considered the most likely failure scenario. Repair in situ is assumed recovery scenario taking 2-3 months. 1 month to warmup and cooldown the stellarator core. 3 techs/1 engr for duration of active repair )1-2 months).	\$150	+2.00				
7. S/U-04	8501	Insulation on modular coil fails during initial cooldown and testing requiring stellarator core disassembly	C1 tested at full current at cryogenic temperature. All modular coils will be tested at RT at elevated (50% higher) voltage for faults to ground. Job 1421  In addition, routine field tests will be performed on each assembly station to ensure that the electrical integrity is OK. Job 1810	When cooldown of all coils completed	Chrzanowski (MC) Viola (FPA)  M. Viola & E. Perry - implement mitigation plan during field period and final assembly.	DEFERRED RISK - although one coil successfully tested, until all coils are cooled down, this risk cannot be retired.		N/A	N/A	High impact-low probability event that has been excluded as a bounding assumption.						
7. S/U-05	7503 1352 1361 8501	Insulation on TF/PF coil fails during initial cooldown and testing requiring in situ repair	1st TF coil will be tested at cryogenic temperature at elevated (50% higher than routine field tests) voltage for faults to ground.  Since the PF and TF coil insulation schemes are identical. PF coils will not be pre-tested if TF tests are successful.	After 1st PF Coil	Kalish (TF) Chrzanowski (PF)	DEFERRED RISK - Mitgation plan being implemented during TF fab. First three TF coils tested at cryogenic temperature by the vendor. There was an issue with TF coil #3, but that was resolved. All 18 TF coils now received at PPPL remaining coils have now been tested electrically at the vendor and witnessed by and or tested by PPPL with no significant issues.	VU	Significant	Low	Insulation fault in lead area is considered the most likely failure scenario. Repair in situ is assumed recovery scenario taking 2-3 months. 1 month to warmup and cooldown the stellarator core. 3 techs/1 engr for duration of active repair )1-2 months).	\$150	+2.00				

NCSX Risk Register

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No.	Affected Jobs (absorb the impacts)	Risk Description	Mitigation Plan (& job where budgeted)	Deadline to Retire Risk or Absorb Impact	Owner	Current Status (As of November 11, 2008)	Likelihood of Occurrence	Consequences	Risk Ranking	Basis of Estimate	Cost Impact (\$k)	Critical Path Schedule Impact (mos)	Cost and schedule impact calculation basis			
7. S/U-06	7503 1352 1361 8501	Insulation on TF/PF coil fails during initial cooldown and testing requiring dismantling stellarator core	1st TF coil will be tested at cryogenic temperature at elevated (50% higher than routine field tests) voltage for faults to ground.  Since the PF and TF coil insulation schemes are identical. PF coils will not be pre-tested if TF tests are successful.	After 1st PF Coil	Kalish (TF) Chrzanowski (PF)	DEFERRED RISK - All TF coils received at PPPL & 3 TF coils tested at cryo temperature by vendor. All TF coils were tested electrically at the vendor and witnessed by and or tested by PPPL with no significant issues. Will have to reassess when NCSX restarted, PF coils received, and cooldown occurs.		Negligible	N/A	High impact-low probability event. Exclude as a bounding assumption.						
7. S/U-07	8501	Coils are hooked up with incorrect polarity	Ensure that coils are connected with correct polarity during final assembly by specifying testing in the assembly procedure. Job 7503  Test during ISTP and fix if necessary. Job 8501		Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	NC	Negligible	Low	Covered in estimate uncertainty with present mitigation plan	\$0	+0.25				
7. S/U-08	8501	Ground faults delay coil testing.	Machine Techs will be trained to search out / identify and correct ground faults. Implement ground fault detection system before other systems are installed in test cell. WBS 4401	Start of installation	Ramakrishnan	DEFERRED RISK - will have to be reassessed when NCSX restarted.	VL	Negligible	Low	Experience on NSTX S/U	\$10	+0.25				
7. S/U-09	8501	Loop faults delay coil testing.	Machine Techs will be trained to search out / identify and correct ground faults.	Start of installation	Ramakrishnan	DEFERRED RISK - although allowances made in current S/U plans, will have to reassess when NCSX restarted.	L	Negligible	Low	Experience on NSTX S/U	\$10	+0.25				
7. S/U-11	8501	Loss of a key component or system delays testing - e.g., pump failure	Comprehensive PTP's will be conducted prior to implementing the ISTP. WBS 1-6	Start of installation	Gentile	DEFERRED RISK - although allowances made in current S/U plans, must be reassessed when NCSX restarted and installation occurs.	U	Marginal	Low	Experience on NSTX S/U	\$50	+0.50				
7. S/U-12	8501	Islands detected in e-beam mapping require troubleshooting and repair; delay CD-4.	Control sources of field error and maintain inventory. WBS 8204	Completion of e-beam mapping	Brooks	DEFERRED RISK - Allowances made in current S/U plans - if islands deemed to be unacceptable, would have to adjust coils.		N/A	N/A	High impact-low probability event that has been excluded as a bounding assumption.						
7. S/U-13	8501	Loss of a key component or system delays testing - e.g., turn to turn failure	Comprehensive PTP's will be conducted prior to implementing the ISTP. WBS 1-6	Start of installation	Gentile	DEFERRED RISK - although allowances made in current S/U plans, must be reassessed when NCSX restarted and installation occurs.		N/A	N/A	High impact-low probability event that has been excluded as a bounding assumption.						



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7. S/U-14	3801	E-beam mapping diagnostic is not installed and ready for use during start-up. Risk is possibly complex and challenging interface of hardware borrowed from Auburn University.	Start design of needed hardware early. Bring the work forward to mitigate the risk	Completion of installation	Fogarty	DEFERRED RISK - will not be able to assessed until NCSX restarted.	VU	Significant	Low		\$50	+1.00					
7. S/U-15	8501	Marginal breakdown loop voltage (1V) delays First Plasma.	Identify and secure commitment of a pre-ionization system (filament and/or rf),	NCSX restart	Zarnstorff	DEFERRED RISK - will have to be reassessed when NCSX restarted.	VU	Significant	Low	Schedule impact if we don't have a ready solution	\$0	+1.00					
8. Sys-00	<b>TECHNICAL RISKS - Components &amp; Systems</b>																
8. Sys-02	1352	PF vendor produces a non-compliant coil requiring fabrication of an additional coil	Conductor for extra coil will be procured in advance and available to wind a new coil if required. Job 1352 Float in schedule appears adequate to avoid critical path impact.	Completion of Last Coil	Chrzanowski	DEFERRED RISK - will not be able to assess until NCSX restarted and PF coil procurements placed.	VU	Negligible	Low	Increase PPPL Title III by ~1 man-month	\$35	+0.00					
8. Sys-08	4301	Legacy power supplies unexpectedly require modifications or additional protection as a result of failure modes analysis.	Complete failure modes analysis and/or testing. WBS 4401	Power Systems PDR	Ramakrishnan	DEFERRED RISK - will have to be reassessed when NCSX restarted.	U	Negligible	Low		\$50	+0.00					
8. Sys-09	4401	Coil protection system costs grow when requirements fully mature.	Establish requirements Job 4401.	Power Systems PDR	Ramakrishnan	DEFERRED RISK - will have to be reassessed when NCSX restarted.	U	Negligible	Low		\$35	+0.00					
8. Sys-10	1260	NB Transition duct design is vintage and revisit could result in criteria changes, i.e. diagnostic requirements, number of ports, NB alignment, further design review, etc.	Conduct peer review of interfaces well in advance of PDR.	NB Transition duct PDR	Cole	DEFERRED RISK - although a new design was developed that seems to resolve this issue, a more complete assessment will be required when NCSX is restarted.	L	Negligible	Low	Engineering hours to redo models and hold design review.	\$60	+0.00					
8. Sys-13	1550 1701	Escalation of Stainless Sheet and Inconel higher than base escalation rates or due to foreign exchange rates. Base structure and coil structures are at risk.	None	After structure materials procured.	Dahlgren	DEFERRED RISK - will need to be reassessed when NCSX restarted.	VL	Marginal	Moderate	See separate sheet - assume 3% to 20% higher per year escalation rate	\$495	+0.00	total cost of stainless components assuming 50% of which is material cost x 20% per year escalation rate. (see conr=tingency model tab esclation)				
8. Sys-14	13XX 4, et al.	Escalation of Copper higher than base escalation rates or due to foreign exchange rates.	None	After all conductor procured.	Strykowski	DEFERRED RISK - will need to be reassessed when NCSX restarted.	VL	Marginal	Moderate	See separate sheet - assume 5% to 20% higher per year escalation rate	\$225	+0.00	total cost of copper components assuming 50% of which is material cost x 20% per year escalation rate. (see conr=tingency model tab esclation)				
8. Sys-17	1701	Cryostat costs grow once design matures and requirements are better understood, including seal design uncertainty.	Expedite design and R&D	Cryostat CDR.	Raftopoulos	DEFERRED RISK - will have to be reassessed when NCSX restarted.	L	Significant	Moderate	Cost: 50% impact on design & fab. Schedule: none	\$500	+0.00					
8. Sys-22	1501 1353	Coil structure designs may have to be modified after FDR to accommodate fault modes.	Decide on fault modes and expedite failure modes analysis.	After fault mode analysis completed	Dahlgren	DEFERRED RISK - Fault mode analysis was started (H. M. Fan), but not completed at time of project termination. Will have to be completed when NCSX is restarted.	U	Negligible	Low	Cost: 20% impact on design. Schedule: none	\$30	+0.00					

NCSX Risk Register

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8. Sys-23	3801	E-beam mapping may require opening vs. a retractable design.	Consider retractable design as the baseline.	By completion of PDR in April 2009	Fogarty	DEFERRED RISK - will not be able to assessed until NCSX restarted.	U	Significant	Moderate	Based on time to cooldown, break vacuum, install equipment and restore temperature and vacuum.	\$100	+1.00	
8. Sys-26	6201	Cryostat cooling performance inadequate to reach cryogenic temperatures. Flow balancing requires significant number of control valves.	Investigate cooling of structures with liquid not gas, possibility of using chill plates on MC, & cooling tubes attached to other structures.	Cryostat/Cryo system CDR.	Heitzenroeder	DEFERRED RISK - preliminary analyses performed by Bagley Associates indicated reliable performance. Will have to be reviewed in greater detail when NCSX restarted.	L	Marginal	Moderate	Cost: 100% impact on cryostat cooling, 20% on fab.	\$200	+0.00	
8. Sys-27	6401	Bakeout system requires more substantial controls driving up complexity and cost	SRD will finalize requirements and retire risk. Perform flow test measurements on installed system and use data to update SRD. Expedite PDR.	Bakeout System PDR	Goranson	DEFERRED RISK - Development of necessary facility models stopped. Will not be able to be reassessed until NCSX restarted.	U	Negligible	Low	Cost: 20% of design costs thru PDR, 10% on fab.	\$60		
8. Sys-28	2, 3, 4, 5, 6	Permeability limits outside the cryostat (1.05 for bulk materials, 1.20 for small hardware) may drive costly solutions for equipment in the test cell.	Identify main at-risk objects and estimate impact on field error inventory. Confirm or change requirement. 8101, 8204	June, 2008	Neilson Brooks	DEFERRED RISK - will have to be reassessed when NCSX restarted.	VU	Negligible	Low				
9. Ops-00	TECHNICAL RISKS - Research Operations (post-CD4) => NOT PART OF MIE PROJECT												
9. Ops-02	7503	Shield walls found to be inadequate. Limits operation conditions	Calculate doses, assess hazards and needed controls, peer review results. If necessary, re-grout open gaps.	1 year before start of Station 5.	Perry	DEFERRED RISK - will need to be reassessed when NCSX restarted.	VU	Marginal	Low		\$150	+0.00	