NCSX Risk Register

No.	Job	Risk Description	Mitigation Plan	Likelihood of Occurrence [a]	Consequences	Risk Class	Basis of Estimate	Cost Impact ($k)		Schedule Impact (mos)	
								Low CI	High CI	Low SI	High SI
1	1354 7503	Additional trim coils may be required to suppress field errors from n>1 modes	Analysis being performed to firm up requirements	U	Marginal	Low	Costs could more than double the present estimate	+ $200	+ $400	+ 0.00	+ 0.00
2	1361	TF vendor produces a non-compliant coil requiring fabrication of an additional coil	Conductor for extra coil already procured. Ample float in schedule to avoid critical path impact.	VU	Negligible	Low	Increase PPPL Title III by ~1 man-month	+ $15	+ $35	+ 0.00	+ 0.00
3	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. Float in schedule appears adequate to avoid critical path impact.	VU	Negligible	Low	Increase PPPL Title III by ~1 man-month	+ $15	+ $35	+ 0.00	+ 0.00
4	1421	Modular coil interface design needs to change significantly from the baseline for unforeseen technical reasons	Task forces formed to expedite resolution of feasibility issues. Development activities are underway.	VU	Critical	Moderate	Design of the MC interface is on the critical path. Potential impacts include [1] additional design and development (4 engineers for 1-2 months) plus $100K M&S and [2] a change in the cost of field period and final assembly to a change in the design (+/- $300K).	($100)	+ $600	+ 1.00	+ 2.00
5	1421	As a result of the development trials for weld distortion, the welding time increases significantly above present allowance	Welding time estimates consistent with time requirements for first R&D article which appeared to have very low distortion. Risk goes away at conclusion of ongoing weld R&D.	U	Significant	Moderate	Nominal welding time may double. Estimate based on $300K/mo for FPA activities.	+ $0	+ $600	+ 0.00	+ 2.00
6	1451	Damage or loss of modular coil during VPI or testing requiring the conductor to be stripped off and re-wound	Continue to use same rigorous process used for first 12 coils during which there were no fabrication mihaps requiring re-winding a coil	U	Significant	Moderate	~$35K in materials; ~$380K in labor. 7.5 months to do work with the potential for a 2 month impact on the critical path.	+ $400	+ $450	+ 0.00	+ 2.00

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7	1451	Failure of major piece of winding equipment (e.g., motor, gear box, etc.) resulting in extended downtime in a winding station	Use three remaining winding stations to continue MC fabrication while fourth station is being repaired	U	Negligible	Low	~$10K for equipment plus repair costs	+ $10	+ $30	+ 0.00	+ 0.00
8	1810 7503	"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.	VU	Significant	Low	Estimated impact is <2 months on the critical path. Cost impact covers up to 2 months of FPA/final assembly.	+ $0	+ $600	+ 0.00	+ 2.00
9	1810	Modular coil damaged during assembly requiring significant rework to coil	Equipment will be handled during FPA using carefully constructed procedures to minimize likelihood	VU	Negligible	Low	Nominally repaired with a 2-man crew within 2 weeks	+ $10	+ $20	+ 0.00	+ 0.50
10	1810	VV surface component (coolant tube, flux loop, or TC) damaged during FPA requiring significant rework	Equipment will be handled during FPA using carefully constructed procedures to minimize likelihood	VU	Negligible	Low	Nominally repaired with a 2-man crew within 2 weeks	+ $10	+ $20	+ 0.00	+ 0.50
11	1810	Unacceptable distortion in a field period when welding modular coil shims requiring	Likelihood of occurrence is very unlikely as a result of extensive welding R&D and careful monitoring during welding.	VU	Marginal	Low	Cut apart and re-weld two coils back together. Nominally a 2.5-man crew in 12 weeks.	+ $25	+ $35	+ 0.75	+ 1.25
12	1810	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.	NC	Crisis	Low	*High impact-low probability event not covered by contingency*				
13	1815	Multiple vacuum leaks during initial pumpdown	Welds will be leak checked during FPA when leaks can be addressed without significantly impacting the critical path. Likelihood of many leaks appearing during initial pumpdown is considered extremely unlikely with this mitigation plan.	NC	Marginal	Low	Impact of having only a few leaks is covered in estimate uncertainty with present mitigation plan				

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14	7503	Insulation on TF/PF coil fails during initial cooldown and testing requiring in situ repair	Ist of each kind will be tested at cryogenic temperature at elevated (50% higher than routine field tests) voltage for faults to ground. All coils will be tested at RT at elevated (50% higher than routine field tests) voltage for faults to ground . Ring tests are performed to reveal low resistance turn-to-turn shorts at RT. These tests will be performed as part of the mfg acceptance testing. In addition, routine field tests will be performed on each assembly station to ensure that the electrical insulation was not compromised during assembly operations.	VU	Marginal	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).	+ $50	+ $150	+ 1.00	+ 2.00
15	7503	Insulation on TF/PF coil fails during initial cooldown and testing requiring dismantling stellarator core	Ist of each kind will be tested at cryogenic temperature at elevated (50% higher than routine field tests) voltage for faults to ground. All coils will be tested at RT at elevated (50% higher than routine field tests) voltage for faults to ground . Ring tests are performed to reveal low resistance turn-to-turn shorts at RT. These tests will be performed as part of the mfg acceptance testing. In addition, routine field tests will be performed on each assembly station to ensure that the electrical insulation was not compromised during assembly operations.	NC	Crisis	Low	*High impact-low probability event not covered by contingency*				

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16	7503	Insulation on modular coil fails during initial cooldown and testing requiring in situ repair	C1 tested at full current at cryogenic temeprature. All modular coils will be tested at RT at elevated (50% higher) voltage for faults to ground. In addition, routine field tests will be performed on each assembly station to ensure that the electrical insulation was not compromised during assembly operations.	VU	Marginal	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).	+ $50	+ $150	+ 1.00	+ 2.00
17	7503	Insulation on modular coil fails during initial cooldown and testing requiring stellarator core disassembly	C1 tested at full current at cryogenic temeprature. All modular coils will be tested at RT at elevated (50% higher) voltage for faults to ground. In addition, routine field tests will be performed on each assembly station to ensure that the electrical insulation was not compromised during assembly operations.	NC	Crisis	Low	*High impact-low probability event not covered by contingency*				
18	7503	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.	Rapid repair materials will be on hand.	U	Marginal	Low	Nominally repaired with a 4-man crew in 1 week with 3 weeks for warmup/cooldown (if required)	+ $15	+ $30	+ 0.25	+ 1.00
19		Loss or prolonged unavailability of certain key personnel from the project could substantially impact the schedule.	*See mitigation plans for individuals listed below.*								
	1901	Mike Cole (ORNL)	Brad Nelson is been budgeted (15%) on the project. Should Cole become unavailable, Nelson would step in and handle Cole's responsibilties until a suitable longer term solution was implemented.	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	+ 0.00	+ 0.50

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	8203	Tom Brown (PPPL)	Bob Ellis has been budgeted along with a designer to provide support to Tom Brown in Design Integration during peak demands and pick up the slack for Brown if he became unavailable.	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	+ 0.00	+ 0.50
	8204	Art Brooks (PPPL)	An EA/EM engineer has been budgeted to provide support to Brooks in Systems Analysis and Technical Assurance during peak demands and pick up the slack for Brooks should he became unavailable.	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	+ 0.00	+ 0.50
	8205	Bob Ellis (PPPL)	An EA/EM engineer has been budgeted to provide support to Ellis in Dimensional Control Coordination during peak demands and pick up the slack for Ellis should he become unavailable.	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	+ 0.00	+ 0.50
	1802 7401	Mike Viola (PPPL) Erik Perry (PPPL)	Viola and Perry will be cross-trained such that each could do the other's job	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	+ 0.00	+ 0.50
20	1803 7503	Assembly sled for final assembly is not adequately stiff or does not provide repeatable motion	Functionality of sled will be determined first with concrete blocks and later with first FP. Ample time to make design modifications between arrival of the first and third FPs.	U	Negligible	Low	Nominal cost impact is 1 man-month of engineering design and up to half the fabrication cost of the sled	+ $25	+ $75	+ 0.00	+ 0.00
21	7503	TC floor is not adequately rigid for present metrology plan	Copper sheet and spongy surface removed from TC floor. Fiducials will be placed. Concrete blocks will be placed to see if floor is adequately stiff.	VU	Marginal	Low	Nominal cost impact is 2 man-months of engineering design and $50-150K for local reinforcement of building structures	+ $50	+ $200	+ 0.00	+ 0.00

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22	1421 7503	Modular coils are shorted across toroidal break between field periods causing problematic field errors	Need very low impedence, multiple shorts to get into trouble	NC							
23	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%).	NC							
24	8501	Coils are hooked up with incorrect polarity	Test during ISTP and fix	U	Negligible	Low	*Covered in estimate uncertainty with present mitigation plan*				
25	8101	Escalation of Stainless Sheet and Inconel higher than base escalation rates	Funding limits preclude early procurements to avoid escalation impacts	VL	Marginal	Moderate	See separate sheet - assume 3% to 20% higher per year escalation rate	+ $37	+ $266	+ 0.00	+ 0.00
26	8101	Escalation of Copper higher than base escalation rates	Funding limits preclude early procurements to avoid escalation impacts	VL	Negligible	Low	See separate sheet - assume 5% to 20% higher per year escalation rate	+ $11	+ $81	+ 0.00	+ 0.00
27	8101	Labor rates may be significantly lower/higher than projected		L	Marginal	Moderate	Escalation rate may be anywhere in the range of 2-5% instead of the nominal rate of 3.4% for labor. Schedule impact is due to annual funding constraints.	($500)	+ $500	(0.50)	+ 0.50
28	1810 1815 7503	Metrology equipment and general purpose tooling/ lifting equipment (e.g.cranes) not available to support the schedule	Maintenance contract mitigates impact of metrology equipment. Additional $200K budgeted for a 3rd laser tracker and/or spare metrology equipment. Should result in improved efficiency as well as failure mitigation.	U	Marginal	Low	Up to 2 week impact on FPA and critical path. FPA cost impact assumed to be $300k/mo.	+ $0	+ $150	+ 0.00	+ 0.50

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29	1352	No suitable PF coil vendor submits bid. PF coils need to be built in-house.	PF is last major, special procurement. Sources sought received two qualified respondants. Capability to build at PPPL (and overseas) exists if needed. Plan developed to expedite PF procurement by 3 months. Plan is under project reivew.	U	Marginal	Low	Cost impact estimated to be up to $300k (1/3 of fabrication costs) for potentially higher labor rates at PPPL. No impact on critical path expected.	+ $0	+ $300	+ 0.00	+ 0.00
30	8101	Funding profile may not match assumptions which in turn could impact cost and schedule		U	Significant	Moderate	Cost impact derived from stretchout	+ $0	+ $0	(2.00)	+ 2.00
31	8101	Overhead rates may change signficiantly which in turn could impact cost and schedule		U	Significant	Moderate	Overhead rates are determined by institutional funding and are outside the project's control. +/- 2% on the rates are representative of variation in three-year institutional averages over the past 10 years.	($900)	+ $0	(1.00)	+ 0.00

[a] VL= Very Likely (P>80%), L=Likely (80%>P>40%), U=Unlikley (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)