

NCSX Risk Register

No.	Affected Jobs	Risk Description	Mitigation Plan	Responsibility	Current Status (As of November 26th)	Likelihood of Occurrence ^a	Consequences	Risk Class	Basis of Estimate	Cost Impact (\$k)		Schedule	
										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. Determine if additional trim coils need to be in MIE or if the configuration must accommodate a specific future set of coils.	M. Zarnstorff & M. Kalish	Trim coils being re-instated. Work underway to define design and cost and schedule estimate being developed .	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. No additional action required	M. Kalish	Quality improving - production mode established.	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.	M. Kalish	Future risk - N/A	VU	Negligible	Low	Increase PPPL Title III by ~1 man-month	+ \$15	+ \$35	+ 0.00	+ 0.00
4	1424	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 - expedite completion of modular coil interface design. Complete preliminary design ASAP.	M. Cole	RISK RETIRED - Successful FDR realized this risk and cost & schedule impact being incorporated into updated baseline.	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 (+/-	(\$100)	+ \$600	+ 1.00	+ 2.00
5	1810	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. Consider process improvements to minimize welding time w/o introducing additional distortion. Risk goes away at conclusion of ongo	M. Viola	Risk resulted during welding trials. However, additional costs and schedule impacts have been incorporated into most recent updated ETC => currently cost impact is ~\$100K and 2 months.	U	Negligible	Low	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 14 coils during which there were no fabrication mishaps requiring re-winding a coil	J. Chrzanowski	14 of 18 coils successfully wound. Additional 3 coils in winding process.	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
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	J. Chrzanowski	Future risk, has not occurred yet - N/A	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. Identify backup personnel for "two deep" back office support & provid	P/ Heitzenroeder - identify personnel T. Brown, A. Brooks, R. Ellis - provide training	Fred Dahlgren and a new hire will be assigned to work part time with Tom Brown.	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

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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. Include provisions to guard against coil damage in FPA procedures.	M. Viola	Future risk - N/A	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. Include provisions to guard against coil damage in FPA procedures.	M. Viola	Future risk - N/A	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 rework	Likelihood of occurrence is very unlikely as a result of extensive welding R&D and careful monitoring during welding. Develop suitable weld procedures and train welders to minimize likelihood of unacceptable distortion.	M. Viola	See response to RR #5. Current weld trials dealing with options to control distortion.	U	Marginal	Low	Cut apart and re-weld two coils back together. Nominally a 2.5-man crew in 12 weeks.	+ \$25	+ \$70	+ 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. Develop appropriate procedures for transporting field periods. Arrange for a peer review of the procedures prior to transport	M. Viola	Future risk - N/A	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	M. Viola	Future risk - N/A	NC	Marginal	Low	Impact of having only a few leaks is covered in estimate uncertainty with present mitigation plan				
14	7503 1352 1361	Insulation on TF/PF coil fails during initial cooldown and testing requiring in situ repair	1st 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. In a	M. Kalish - Implement mitigation plan during TF/PF fabrication. M. Viola & E. Perry - implement mitigation plan during field period and final assembly.	Mitigation plan being implemented during TF fab. There was an issue with TF Coil #3, but this has now been resolved. 4 TF coils shipped and/or received.	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 1352 1361	Insulation on TF/PF coil fails during initial cooldown and testing requiring dismantling stellarator core	1st 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. In a	M. Kalish - Implement mitigation plan during TF/PF fabrication. M. Viola & E. Perry - implement mitigation plan during field period and final assembly.	Mitigation plan being implemented during TF fab. There was an issue with TF Coil #3, but this has now been resolved. 4 TF coils shipped and/or received.	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 temperature. 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	E. Perry - no additional action required.	Future risk - N/A	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 1451	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. In addition, routine field tests will be performed on each assembly station to ensure that the electrical	J. Chrzanowski - Implement mitigation plan during modular coil fabrication. M. Viola & E. Perry - implement mitigation plan during field period and final assembly.	14 of 18 coils successfully wound. Additional 3 coils in winding process.	NC	Crisis	Low	<i>High impact-low probability event not covered by contingency</i>				
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 when and if needed.	E. Perry .	Future risk - N/A	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.	<i>See mitigation plans for individuals listed below.</i>										
a	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 responsibilities until a suitable longer term solution was implemented. Ensure that contingency plan is in place for Mike Cole	J. Lyon	Oak ridge is securing additional engineering support for Mike Cole.	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
b	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.	T. Brown	Fred Dahlgren and a new hire will be assigned to work part time with Tom Brown.	VL	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
c	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.	P. Heitzenroeder - assign EA/EM engineer as backup to Art Brooks. A. Brooks - provide training to TBD EA/EM engineer.	New hire is being sought to work with Art and Mark Smith.	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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d	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.	P. Heitzenroeder - assign EA/EM engineer as backup to Bob Ellis. B. Ellis - provide training to TBD EA/EM engineer.	Mark Smith moving over to support Art Brooks. Craig Priniski and Tiana Dodson being assigned to augment metrology efforts.	VL	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			
e	1802 7404	Mike Viola (PPPL) Erik Perry (PPPL)	Viola and Perry will be cross-trained such that each could do the other's job.	M. Viola & E. Perry	RISK RETIRED - Viola and Perry both have continuing project assignments which keep them involved at a level sufficient to maintain familiarity with each other's assembly management responsibilities in the event a handoff were needed.	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.	E. Perry - test functionality of sled prior to final assembly. T. Brown - modify sled design if needed.	Future risk - N/A	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. Assess adequacy of TC floor.	E. Perry	Future risk - Will perform these tests after substructure is installed in TC and will then decide what is needed.	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			
22	7503	Modular coils are shorted across toroidal break between field periods causing problematic field errors	Need very low impedance, multiple shorts to get into trouble. Ensure that required electrical breaks are not compromised.	M. Viola - during field period assembly. E. Perry - during final assembly.	Future risk - N/A	NC	Crisis	Low	High impact-low probability event not covered by contingency							
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%).	E. Perry	Future risk - N/A	NC	Crisis	Low	High impact-low probability event not covered by contingency							
24	7503 8501	Coils are hooked up with incorrect polarity	Ensure that coils are connected with correct polarity during final assembly. Test during ISTEP and fix if necessary.	E. Perry	Future risk - N/A	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. Provide appropriate contingency	R. Strykowski	Current estimates have "best" info on SS and Inconel prices. Will revisit in semi-annual EAC update.	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. Provide appropriate contingency	R. Strykowski	Current estimates have "best" info on Cu prices. Will revisit in semi-annual EAC update.	VL	Negligible	Low	See separate sheet - assume 5% to 20% higher per year escalation rate	+\$11	+\$81	+0.00	+0.00			

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27	8101	Labor rates may be significantly lower/higher than projected	Provide appropriate contingency.	R. Strykowski	Current estimates reflect latest labor rates. Will revisit in semi-annual EAC update.	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	Additional \$200K budgeted for a 3rd laser tracker and/or spare metrology equipment. Based on trip to CERN/W7X, exploring photogrammetry. Purchase additional metrology equipment as need becomes apparent.	L. Dudek	Reqn submitted to purchase photogrammetry equipment.		Significant	High	Up to 2 week impact on FPA and critical path. FPA cost impact assumed to be \$300k/mo.	+\$0	+\$150	+0.00	+0.50
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 respondents. Capability to build at PPPL (and overseas) exists if needed. Plan developed to expedite PF procurement by 3 months. Plan is under project review.	M. Kalish	Future risk - N/A	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.	+\$145	+\$770	+0.00	+0.00
30	8101	Funding profile may not match assumptions which in turn could impact cost and schedule	Provide appropriate contingency.	R. Strykowski	Current estimates reflect latest OFES guidance. Will revisit in semi-annual EAC update.	U	Significant	Moderate	Cost impact derived from stretchout	+\$0	+\$0	(2.00)	+2.00
31	8101	Overhead rates may change significantly which in turn could impact cost and schedule	Provide appropriate contingency.	R. Strykowski	Current estimates reflect latest OFES guidance. Will revisit in semi-annual EAC update.	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
32	1421 1810	Welding the inboard shims could result in gaps opening up at the plasma-side end of the shims which in turn might introduce unacceptable cyclic loads on the weld. Gaps that open up when the outboard bolted joint assemblies are torqued also have the poten	Welded shim design has changed to include a tightly fitted limiter and flex shim to react shear loads; these ensure against relative motion of flanges during operation and minimize cyclic loading of welds (Jobs 1421 & 1810).	M. Viola	MIG Weld trials underway. When trials completed (October time frame), will reassess. Likelihood of occurrence changed to Likely.	L	Significant	Moderate	Rough assessment of cost and schedule impact of slipping the FDR.	+\$0	+\$600	+0.00	+3.00
33	8205 1355	Present machine assembly dimensional control goals may prove to be extremely difficult to achieve.	Researching expanded trim coils capabilities. Also considering use of photogrammetry (in collaboration with CERN) as another dimensional measurement tool. Develop a realistic Physics plan (trim coils) that can work within the dimensional control capabilit	A.. Brooks & Mike Zarnstorff - Trim Coils S. Raftopoulos - Photogrammetry	Implementing mitigation plan - too early to assess any impact on Likelihood of Occurrence, etc.	L	Significant	Moderate	Rough assessment of cost and schedule impact of slipping the FDR.	+\$0	+\$700	+0.00	+3.00

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34	1810 1815 7503 8205 1355	Intermittant instability has been noted in the metrology equipment and analysis software.	An 18 point study has been completed. This resulted in a number of software, hardware, and procedural changes have been made. The level of accuracy and repeatability is now acceptable.		RISK RETIRED		Significant	High	Rough assessment of cost and schedule impact of slipping the FDR.	+\$0	#####	+0.00	+5.00
35	1810	Station 2 - shim bag rupture & requires replacement	Pre-qualify shim bags. Use wing chair in compression. Could require taking coil apart in worse case.	M. Viola	Considered unlikely due to other mitigation plan options.	VU	Significant	Low	Rough assessment of cost and schedule impact of disassembling/re-assembling coils.	+\$0	+\$700	+0.00	+3.00
36	1810	Station 3 - tooling/assy structures not sufficiently rigid.	Reinforce/redesign tooling/structures.	M. Viola	Current experience on Station 2 has shown this is unlikely to be an issue.	UL	Significant	Low	Rough assessment of cost and schedule impact of reinforcing or redesigning tooling.	+\$0	+\$150	+0.00	+1.00
37	1815	Station 5 - Trim coil/routing details significantly more complex than anticipated in conceptual phase.	Where appropriate, increase contingency to envelop uncertainties	M Viola	Just now developing concepts - not fully supported by detailed drawings in most instances.	L	Significant	Moderate	Rough assessment of cost and schedule impact of detailed design being more complex.	+\$0	+\$700	+0.00	+3.00
38	1810 1815 7503	316LN Inboard Shim material is not available to meet project schedule	Alternate Material for Shim if vendor not found	Heitzenroeder/Dudek	RISK RETIRED - 10/30 Analysis shows that 316L will be adequate (See Engr Minutes of 10302007)	VL	Significant	High	Rough assessment of cost and schedule impact of delayed procurement.	+\$0	+\$400	+0.00	+3.00
39	1810 1815 7503	Rework/replacement of high permeability components	Explore annealing and alternate materials.	Viola/Perry	Assessing impact of annealing and machining on permeability	L	Marginal	Moderate	Initial impact assessment based on VVSA experience	+\$0	+\$200	+0.00	+1.00
40	1354	Trim coils still in very conceptual stage of design. Likely will be required to "baseline" cost and schedule prior to even reaching a preliminary design stage.	Expediting design effort, but unlikely to have significantly more information prior to "baseline" => apply appropriate contingency to reflect this.	Kalish	Applying resources to expedite development of design to permit more accurate cost and schedule estimate.	VL	Significant	High	Rough assessment of cost and schedule based on very conceptual design.	#####	#####	+0.00	+1.00

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