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ID	Subject	WBS #	Responsible Person	FDR Panel Report ID	Urgency	Pre-requisite for Tech data release?	Recommendation / Comment	Project Response / Plan	Status
26	Design	1	Nelson	MCWF#9	Pre-first production casting	no	Evaluate methods to facilitate disassembly of the stellarator core should this ever be required, including possible modifications of the MCWF (such as access holes for diamond saw).	The primary issue is disassembly of the vacuum vessel field welds in order to separate the three field period assemblies. The second issue is removal of the port extensions to allow the modular coils to be separated from the vacuum vessel. All other disassembly processes are the reverse of the assembly process. The disassembly of the (6) VV sector assembly welds and the port extension welds will be performed by mechanical grinding of the welds from inside the vessel and will not require any changes to the winding forms to accommodate disassembly. The grinding operations will be tedious, but can be performed in parallel with other disassembly tasks.	**closed**
12	Design	1	Cole	VVSA#9	Post-Award	no	Define the interface of the magnetic diagnostics with the vacuum vessel and check for any interference with the He bake out tubes at an early stage.	The baseline design shows the bakeout tubes to be located over the envelope of the magnetic diagnostics. The layout of the diagnostics is not known, but there may be 130 loops on one sector. The [present design accommodates the magnetic diagnostic concept.	**closed**
14	Design	1	Cole	VVSA#11	Post-Award	yes	Assure that the instrument measurement errors are considered in the final tolerance budget.	Instrument errors have been noted and included to the extent possible. The basic premise is to provide shimming and adjustment at each subassembly and assembly step to avoid stacking of tolerances and/or measurement errors.	**closed**
4	Design	12	Goranson	VVSA#1	Pre-Award	yes	Assure that the product specification makes clear reference to the manufacturing tolerances and that all piece-part and sub-assembly tolerances are clearly specified.	All manufacturing tolerance requirements are on the drawings	**closed**
5	Design	12	Goranson	VVSA#2	Pre-Award	no	Finalize reference datums for sector final inspections and plans for metrology during final assembly. Only three primary datums should be used to inspect and locate parts.	Specification has been modified to include metrology targets, details of which will be negotiated during finalization of MIT plan. Project has specified more than three datums to ensure redundancy and provide a "best fit" approach to establishing a reference orientation for subsequent measurements.	**closed**
6	Procure-ment	12	Goranson	VVSA#3	Pre-Award	yes	Specify more clearly some of the test requirements, e.g. the scope of tests after the thermal cycling, the tolerable leak rate of the VV.	Specification has been modified to clarify tests and leak rate requirement.	**closed**
7	Procure-ment	12	Viola	VVSA #4	Pre-Award	yes	Describe more clearly the metrology strategy and the transfer of data between PPPL and the potential vendor to assure that proposed costs reflect the PPPL final inspection plans.	Methods for sharing metrology data have been developed via PVVS activity. See also ID 5 and 20. Statement has been added to the VV spec: "A minimum of four (4) fiducials on each end flange of the Period Assembly and six (6) fiducials on the Period Assembly wall (three in each half-period) shall be permanently installed to establish a reference system to be used for dimensional inspection. The wall mounted fiducials shall be accessible from both the exterior and the interior of the Period Assembly. Three (3) fiducials shall be provided on each port extension flange. The goal shall be to permit replication of Vendor measurements by the Laboratory. The fiducials may be mounts for removable tooling balls or some other system proposed by the Vendor. The nature, location, and installation of these fiducials shall be submitted by the Vendor for approval by the Laboratory."	**closed**

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8	Procure-ment	12	Viola	VVSA#5	Pre-Award	no	Clarify and agree on the type of metrology equipment to be used by the company as well as the involvement of PPPL in the measurements at the vendors workshop. Check whether the temperature in the vendors workshop is adequately controlled to ensure the measuring accuracy required.	Metrology equipment is part of the MIT/QA plans submitted for approval. PPPL will witness measurements made at the vendors workshop, but will not perform any measurements at that venue, **except for deformation measurements during pumpdown of the vessel (see ID 13)**. PPPL will repeat final metrology inspection at PPPL upon receipt of each VVSA. Temperature compensation is always included when using metrology equipment, either by calibration with standards at the ambient temperature, or by deriving the compensation factor from the best fit of known target locations.	**closed**
9	Procure-ment	12	Viola / Heitzenroeder	VVSA#6	Pre-Award	no	Request a breakdown of the costs into engineering, manufacturing, tooling, and testing categories in the proposals to ease the evaluation of the proposals and identify cost drivers.	The VVSA proposals included this breakdown.	**closed**
13	R&D	12	Viola	VVSA#10	Post-Award	no	Measure the deformations and strains during the leak test of one sector and compare the measurements with the predictions of the structural calculation.	This loading condition is easily analyzed and deflections will be measured by PPPL personnel on site at the vendors, to avoid the expense of building this into the spec.	**closed**
1	R&D	12	Neilson	General	Long Term	no	The project should continue to place high priority on completion of R&D on the final vessel assembly weld process which is essential to reducing the risks associated with the final field weld joints.	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**
15	R&D	12	Viola	VVSA Comment		no	The team should consider using one of the prototype vessel sections to help develop techniques for maintaining dimensional control while making the large, circumferential poloidal welds that join the 60-deg vessel sectors together. This could help address supplier cost / schedule risks associated with final dimensional tolerances and vacuum integrity requirements.	PPPL has offered to ship the prototype sector back to the subcontractor. They could cut the sector in half and re-weld to develop the dimensional control techniques for large circumferential poloidal welds (ref. 15) or for evaluation of distortion effects associated with large one sided port welds (see 16 below)	**closed**
16	R&D	12	Viola	VVSA Comment		no	Alternatively, the team could consider using the prototype parts to evaluate distortion effects associated with the larger, one-sided vessel-vacuum port welds. (See Panel Report for details.)	See 15 above	**closed**
17	R&D	12	Viola	VVSA Comment		no	Dimensional control issues associated with final sector assembly and port extension weld joints and associated vacuum integrity issues represent a risk area that the panel feels have not been fully addressed in the risk reduction activities to-date. All meaningful ways to help mitigate these fabrication risks need to be considered.	The vessel must meet all dimensional requirements at time of delivery, which follows all supplier welding and all thermal cycling. The baseline plan calls for leak check after thermal cycling of all supplier-performed weld joints, including torus welds and port extension welds. There is another leak check and thermal cycle during field period assembly, after all the ports have been welded on.	**closed**
10	Spec.	12	Viola	VVSA#7	Pre-Award	yes	Require a complete vacuum leak check after 375C thermal cycling of the 120-deg VVSA. This should include all port extension interface welds in addition to the vessel.	Agree. This is the baseline plan.	**closed**
11	Spec.	12	Goranson	VVSA#8	Pre-Award	no	Consider increasing the VV tolerances in some local areas (where possible) in an effort to keep cost down. This could be addressed by asking vendors to provide an alternative quote to a more relaxed final tolerance specification in non-critical clearance areas of the vessel to determine the impact of dimensional control measures on the proposed fabrication costs.	This has been considered and rejected previously. The opportunity for VVSA cost savings was judged to be outweighed by the greater risk of the coils not fitting over the VV. It was decided the project will keep the option of relaxed zone tolerances in reserve for NCRs.	**closed**
19	Design	14	Williamson	MCWF #2	Pre-RFP	yes	Incorporate inflatable bladder details into the models and drawings.	Complete	**Closed**
21	Design	14	Williamson	MCWF#4	Pre-RFP	yes	Review details of the poloidal break shim including use of a taper to help insertion and/or machining as an integral part of the casting.	This was discussed by the project engineering team and rejected. The casting “spring constant” is consistent with the present “parallel” poloidal break design – ie, the bolts can readily clamp the break tightly. The tolerances of the shim and cut are consistent with the vendor bid and capabilities.	**Closed**

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23	Design	14	Nelson	MCWF#6	Pre-Award	no	Update the design criteria to reflect the appropriate maximum stress allowable for cast modified CF8M alloy.	Material requirements have been established in the MCWF product spec (NCSX-CSPEC-141-03) and are consistent with testing results and satisfy application requirements.	**Closed**
2	Procure-ment	14	Heitzenroeder	General	Pre-RFP	no	The delivery schedule for the production MCWF is aggressive and presents some schedule risk to the project critical path. The NCSX team in conjunction with procurement personnel should investigate the best strategy for structuring the RFP with an eye to mitigating this schedule risk.	The vendor is responsible for providing a plan that meets our schedule requirements as closely as possible. The vendor will orchestrate any needed teaming or sharing of responsibilities.	**closed**
24	Procure-ment	14	Heitzenroeder	MCWF#7	Pre-Award	no	The NCSX Team should investigate with the PPPL procurement department the best strategy for structuring the RFQ for the production MCWF's. Having an option for a split-order, or a backup vendor could provide schedule contingency.	See ID#2, above	**Closed**
3	R&D	14	Heitzenroeder	General	Post-Award	no	Additional effort and consultation is recommended to ensure an adequate materials testing database for characterization of the cast materials service requirements, especially for fatigue life qualification.	Agree. We have determined that fast fracture is not an issue for this material. We have done testing of vendor-supplied materials to determine material constants for fracture mechanics analysis. Further testing of the actual prototype casting material was performed. (See 22).	**closed**
27	R&D	14	Williamson	MCWF Comment	Pre-mod coil winding FDR	no	Conductor shear stresses along the conductor length are a concern because the individual strands may not be fully bonded to each other even though the interstitial spaces are filled. (See Panel Report for details.)	Bending and torsion tests for a beam with a typical coil cross-section have been completed. Preliminary results confirm assumptions regarding the winding pack properties and do not reveal any unusual shear behavior between the conductor and insulation. Complete documentation will be available by Sep 30.	**closed**
28	R&D	14	Chrzanowski	MCWF Comment	Pre-mod coil winding FDR	no	The process of sequential clamping of the conductor during winding appeared especially unwieldy. Freeing up tolerance constraints in a specific clamping direction might save a great deal of time and money. (See Panel Report for details.)	Based on R&D results, the following course of action shall be used during the manufacturing of the modular coils. First: The number of winding clamps [3-inch centers] will remain the same to help maintain the correct position of the conductors. Second: The side clamps shall be pre-shimmed to the anticipated final width of the coil bundle. Third: A constant torque of 35 inch-pounds shall be used to control the bundle height. Forth: Once the coil has been wound, the turns will be shifted to optimize the bundle's current center. This is accomplished by loosening and tightening groups of winding clamps. Fifth: Lacing [glass tape] bands will be pre-positioned prior to winding and secured around the bundle to hold the turns in position during the installation of the chill plates and vacuum bag. This procedure eliminates the need to continuously measure the position of the turns during winding.	**closed**
22	R&D	14	Heitzenroeder	MCWF#5	Post-Award		Consult a materials scientist and/or code expert to determine the appropriate materials testing database required to insure proper characterization of the cast materials for the service requirements, especially for the appropriate fatigue life qualification.	Agree. Dick Reed, a noted materials expert, has been providing advice on all materials topics related to NCSX. Fracture mechanics analysis is not addressed in the ASME code. NHFML performed fracture mechanics tests on CT specimens cut from prototype. Fatigue calculations based on results indicate satisfactory fatigue life. (See #3 above)	**closed**
18	Spec.	14	Heitzenroeder	MCWF#1	Pre-RFP	yes	Perform full dye penetrant inspection of the MCWF after machining (note: already agreed by NCSX project team).	Agree.	**Closed**
20	Spec.	14	Williamson / Heitzenroeder	MCWF#3	Pre-RFP	yes	Establish a set of hierarchical fiducials. The primary fiducials to set up the casting for machining should be located in regions where they will not be machined away at a later time. Secondary fiducials should be inserted with each change of machining set up.	Agree, See ID#7, above. The number and type of fiducials has been established with the vendor. Additional target locations and types will be developed during final design of the field period assembly and final assembly tooling.	**Closed**
25	Spec.	14	Heitzenroeder	MCWF#8	Pre-first production casting	no	Cut material and test samples from the body portion of the finished prototype forms to confirm that samples taken from the casting fill riser tubes correctly represent the bulk casting properties.	PPPL will request that the vendor cut sample material from the prototype casting. PPPL will have compact tensile specimens made from this material and tested. See ID#3 and ID#22.	**closed**