DESIGN REVIEW DOCUMENTATION – RESULTS

Title: **NSTX-U Repair – PFC: HHF PFCs** ______________________ **WP#:** 2317 __ (ENG-032)

Type of Review: ☐ **Peer** ☐ **CDR** ☒ **PDR** ☐ **FDR**

Cog Individual: Doug Loesser ____________________ **Date of Review: 11/15/17** ____________________

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Items Reviewed:	**Sat.**	**Unsat.**	**Comments or n/a if not applicable**
Appropriate requirements identified	☒	☐	________________________________
Development plans and schedules	☒	☐	________________________________
Regulatory compliance including USI/USID and NEPA	☐	☐	N/A ____________________________
Disposition of CHITS from previous reviews	☒	☐	________________________________
Cost objectives	☒	☐	________________________________
Other review objectives addressed (Attachment 4 of ENG-033)	☒	☐	________________________________

SUMMARY OF RESULTS:

The purpose of the PDR is to review the development of the NSTX-U high heat flux PFC design that has taken place since the exploratory studies presented at the CDR, and to confirm the selection of the option being pursued. The review covers the investigation and high heat flux testing of the thermal shock resistance of available isotropic graphite & CFC PFC materials. The objective of the review is the recommendation of the initiation of long-lead procurement of material.

This review covers the modifications to the High Heat Flux Plasma Facing Components. The areas covered are CSA, IBDV, IBDH and OBD12. The design addresses the changes in requirements, especially disruption and heat loads. The modification aims to facilitate access to 2 MA, 1T, 10MW and 5s.

Requirements
The function of the PFCs are to protect the metallic structures of the vessel (the vessel wall, passive plates, etc.) from damaging heat fluxes from the plasma and to protect the plasma from contaminating influx of medium- and high-Z impurities. The Full Requirements of the PFCs are specified in:
NSTX-U-RQMT-GRD-001-00
NSTX-U-RQMT-RD-003-00_Disruptions
NSTX-U-RQMT-SRD-003-00_PFCs

The application of the requirements to the analysis of this set of tiles was discussed in detail. For the disruption loads, a global model is used to set the background local loading conditions (amount and distribution of halo current, background magnetic field changes…) for each type of tile. The suitability of the definition of the peak halo loads was discussed. A TPF limited to 2 is used, which matches the measured fraction times toroidal peaking factor. In reality the peak in toroidally more localized. In the calculation resistive assumptions are made in calculating the eddy and halo current distribution in the tile, which is then used to estimate the Lorentz forces. It was questioned whether resistive assumption is conservative, possibly over-conservative. The resistive assumption might be for eddy currents. The resistive assumption does not affect the tile loads for halo currents, but it might affect the structure loads, e.g. crossing the bellows.

The application of the thermal requirements was translated in practical rules for all tiles designs, or example maximum surface temperature, minimum castellation radius… maximum acceptable error in the alignment of the tile supports. The choice of the 1600C temperature limit was discussed, based on literature, not necessarily to be applied to short transients. A clarification was asked on the assumptions on the strike point position: in all cases load amelioration to a static strike point have been taken into consideration to reach 5s at full power.
The castellation root minimum radius was found to be 2.5mm from calculations. The calculations were validated with a single test point, run with a tile with 10mm castellation roots, which broke at the maximum tensile stress.
The heat loads, especially at the lower perpendicular field line angels, are significantly affected by the misalignment of the tiles with respect to the field geometry.

Angular Section tiles
In the CSA (Center Stack Angular) section 48 Upper & 48 Lower tiles are replaced with altered attachment (to react 2MA and 1T loads) and improved material, and to match the poloidal silhouette at the increased thickness IBDV tiles. These tiles use existing supporting structure on center stack casing and existing diagnostic arrangements. These tiles have interfaces with CSFW & IBDV tiles.
Most diagnostics have not changed in this region, apart from the toroidally continuous Rogowski coil, which has moved from the IBDV to this section of the wall, only for the top of the vessel.

The under/over-laps have been removed from the interface with the IBDV. This is deemed acceptable because the gap is thin and long. In the same region a question was asked about the space availability to accommodate the Rogowski coil.
Increased heat flux due to a 5mm misalignment is not tolerable. This can be addressed by (1) full fish-scaling of tile surface and (2) revision of the misalignment.
The Hertzian stress at the end of the T-bar is above the allowable in the analysis because of the sharp end of the T-bar. In reality the end is chamfered. The amount of chamfer required to avoid exceeding allowable stresses will be determined using sub-modelling.

Chit resolution:
- Thermal fatigue limits of graphoil: not an issue if only lightly loaded, test planned for FDR (limit to 4MPa, study needed to confirm this is not exceeded)
- Dishpans for front facing holes: study for FDR when the surface of the tile is fully defined.

Inboard Divertor Vertical tiles
The IBDV (Inboard Divertor Vertical) is divided in 2 regions, one of which has a slightly reduced heat flux. In the higher heat flux region of the IBDV 48 Upper & 48 Lower tiles are replaced with altered attachment (to react 2MA and 1T loads) and improved material. In this region, the studs will be removed from the CS Casing and reapplied at a different position. The front access mounting features have been eliminated. In the lower heat flux region of the IBDV 24 upper & 24 lower tiles are replaced with a modestly improved configuration. In this region the existing CS casing studs are used. These tiles interfaces with modified CSA & IBDH tiles.

New supporting ring for the higher heat flux tiles constrains the tiles toroidally and vertically but not radially. The radial position is based by the existing casing, which is built to tight tolerance. The supporting ring is divided in three grids. It needs to be clarified how each is attached to the casing: it needs to provide a known location for the tiles, while allowing relative thermal expansion. In general clear installation parameters, e.g. bolt torques, need to be worked out and listed.

Chit resolution:

- 12 (CDR) to 15 (PDR) degree width of the tile has reduced the loads on the grooves because the tile is held down by two rods. A method was developed to relieve the additional stresses due to over-constraint of the tile. This is going to be heat tested in a prototype.
- Dishpans to be fully developed for the FDR.

Inboard Divertor Horizontal tiles

In the IBDH (Inboard Divertor Horizontal) 24 upper & 24 lower tiles replace 48 upper & lower tile with altered attachment (to react 2MA and 1T loads) and improved material. The front access mounting features have been eliminated. The mount to new coolant plate supported on center stack casing provides a tight tolerance base for the installation of these tiles. The innermost row of these tiles has a lower heat flux. These tiles interface with IBDV-LHF & OBD12 and the modifications to these tiles and the OBD12 tiles achieve the closure of the CHI gap.

Under/over-laps are missing between the IBDH and the IBDV, this is not a thin and long gap and needs attention. Other gaps open to field line penetration exist between the IBDH and the OBD1 tile and where openings are provided for diagnostics lines of view. The gap still needs to be defined at the top, where the inner casing grows through the day by up to 5mm; initially this gap will be optimized for no grow of the casing. Even starting from this configuration, it is not clear how the relative vertical position can be controlled to avoid a step high enough to become a power handling challenge.
Vertical gaps for diagnostic line of sight also exposes toroidally facing edge, whose shadowing needs to be assessed.

Chit resolution:

- EM loads on vessel interface: axisymmetric simulation carried out for eddy currents which produce a small additional load in comparison with the halo current loads.

Outboard Divertor tiles (rows 1 and 2)

The Outboard Divertor tiles Rows 1 and 2 (OBD12) uses existing supporting structure on OBD rails. Here tiles (2x 48) tiles are replaced with tiles of altered attachment design (to react 2MA and 1T loads) and improved material. The front access mounting features have been eliminated. These tiles interface with modified OBD345 & IBDH tiles.

Several modifications from the CDR design. A single tile covers rows 1 and 2 and 7.5 degree. The tiles interface with the support via a metal (stainless steel) transition plate. The tile is keyed into the plate. The plate is slotted onto the outer divertor support plate. Its poloidal position is maintained by friction.
The transition plates will be bespoken to offer the tiles a higher tolerance surface than the outboard divertor support one.
Under/over-laps have been removed from this region too.

Chit resolution:

- Achieving assembly tolerances… in progress
- Accommodating holes for gas pipes without creating leading edges, this can be achieved by feeding between the tiles
- Other chits were on “small tiles” which are no longer part of the design after CDR
- No blind hole - OK

Interfaces

Global Heat balance

Analysis for normal operation and bake out has been carried out to determine the need for active cooling in the IBDV and to determine the increase in height of the inner casing. IBDH tiles now seem to be able to get to 350C without taking PF1B beyond its safe maximum temperature.

Diagnostics

The PFC Housed Diagnostics are not themselves part of the PFC system. Their design, fabrication, installation, feedthroughs, etc. are out of scope for this review. The scope of the PFC housed diagnostic effort, for both high and low heat flux regions, is primarily to preserve existing diagnostic capabilities. Some diagnostics need to be modified to match the new tile geometry and/or sustain higher heat fluxes. The new HHF designs, and in particular their support schemes, affects wire routing, typically where diagnostics are clustered toroidally and there is insufficient space behind the IBDV tiles. There are also some minor changes to improve capabilities: the number and locations of diagnostics and the allocation of port feedthroughs.

Manufacturing Plan, Cost and Schedule

Material availability: suitable graphite has been identified and tested; it needs to be procured promptly after the PDR to keep the PFCs compatible with the schedule.

Typically plasma facing tiles are procured on 3D models by CNC. First articles are made and inspected before the production tiles are made. Tiles are baked to a specific temperature waveform. Coupons are baked first to confirm the cleanliness of the oven. Tile and fixtures have been procured many times before and there is confidence in the time and cost for this procurement.

Material & tile fabrication costs are based upon past & recent procurement of many (1000's) of isotropic graphite & CFC replacement tiles on TFTR, NSTX, NSTX-U, W7-X, etc...Estimates were obtained recently from qualified vendors for tiles & attachment hardware.
Each tile WBS has a dedicated engineer, analyst and designer thru the FDR effort. Multiple CADD resources are applied post PDR on development of variants for diagnostics implementation. Engineering oversite during fabrication & sub-assembly period is at a 33% FTE rate, 50% during installation. NCR & rework efforts include 1 month of an engineer and of a designer. Procurement of the material is planned to run in parallel to FDR to minimize schedule. SPI and CPI were presented and have a large standard deviation (better than prediction for LHF and worse than prediction for HHF).

Material testing and Selection
Tests are needed because the heat load requirements for the NSTX-U plasma facing components have doubled as a consequence of the upgrade. Information for > 90 graphite grades was compiled and compared. Of these 8 were available for high heat flux (HHF) testing. Selection criteria were material properties, schedule compatibility and cost considerations.
Tests have been carried out at Applied Research Labs, Penn State. This is not a dedicated HHF testing facility, close collaboration with PPPL was necessary to define and execute the tests. The material samples were left free floating while loaded with electron beam power. No mechanical fracture was observed in any samples, even with the average heat flux taken far higher than it will experience in operation. No show stoppers have been identified to prevent the use of the preferred material, Sigrafine R6510.

Chit resolutions:

- Working on developing tests able to reproduce meaningful loading conditions.
- Cleaning graphite from lithium - on-going

Summary
The information provided is sufficient to pass a PDR, although the material testing has been less conclusive than intended before embarking in this exercise.
The design is sufficiently mature to proceed with the procurement of the long lead material and to establish a cost/schedule estimate suitable for baselining. However, there are a few design features to be defined including the following:

- Areas in need of shadowing confirmation: gaps not protected by under/over-laps, gap between inboard and outboard, organ pipe access cubes…
- End stops for T-bar pins – define and apply standard design
- Hertzian stresses at the end of T-bars – confirm chamfer specification
- IBDV support tray wall interface needs toroidal and vertical constraints compatible with relative thermal expansion
- Radial displacement of the OBD12 transition plates needs to be confirmed constrained and the method installable
- Diagnostic wiring routes need to be defined to fit in available spaces or spaces modified to accommodate wiring

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Disposition: [check one]

_______ **Acceptable**

___X___ **Acceptable pending resolution of concerns**- CHITS identified above must be resolved prior to installation.

_______ **Incomplete** - Additional design work is required prior to another design review.

_______ **Unsuccessful** – Corrective actions must be taken and another review process must be initiated.

RLM Concurrence: Charles L. Neumeyer Digitally signed by Charles L. Neumeyer DN: cn=Charles L. Neumeyer, o=PPPL, ou, email=neumeyer@pppl.gov, c=US Date: 2017.11.17 10:39:30 -05'00' Date: _______________

DR Chairperson Signature: Valeria Riccardo Digitally signed by Valeria Riccardo Date: 2017.11.16 23:27:44 -05'00' Date: _______________

Distribution: Review Board Members, Operations Center, Cognizant Design Engineer, System Engineer(s), Head, Office of Project Management, Attendees, QA, ES&H, Security, Requesting & Performing Dept. Heads, and Associate Director for Engineering and Infrastructure

Subject: (Check as Applicable)	Chit Code	Comment/Concern/Recommendation:
Requirements	concur	Diagnostic presentation, slide 11, the blue tile misses innermost cube, the load on the toroidally facing edge needs to be evaluated and shadowed if necessary.
Requirements	concur	Please add figures in NSTX-U-RQMT-SRD-003-00 which directly specify the fishscaling direction by region. (Figures 2.3-1 and 2.3-2 only show fish scaling direction for IBD-H, not IBD-V or OBD. Specifying field direction rather than fishscaling is likely to cause confusion)
Requirements, Analysis	concur but need better definition of scope	Halo analysis assumes peaking factor of 2 which is reasonable for typical conditions. However there are scenarios/conditions where the peaking factor at tile surface has been measured to be higher (presumably still within assumed peaking * halo fraction factor). Recommend looking at a few cases / spot-check with higher peaking factor - perhaps up to 5 - or whatever is a reasonable upper-bound from physics database to make sure the analysis assumptions we are using are conservative.
Analysis, Performance, Hardware	concur	Stress concentrations will occur in the castellated tiles due to heat flux. Determine what prior literature and experiments (preferably in graphite) can confirm this analysis and plan + execute tests on prototypes as necessary.
Hardware, Quality	concur	The tile sample circulated evidenced chipped edges along the interior machined corners and interfaces. Investigate/comment as to the impact of the sharp interfaces created by these chipped edges on fatigue properties and potential crack propagation. Is a different process needed to eliminate this chipping?
Analysis	concur	Lithium evaporation is aimed at lower divertor. The 0.02" tile gap will most likely be filled with lithium compound over the time. How this will affect tile analysis?
Reliability/Maintainability	see next	For CS-A, slide 6: Regarding the grafoil beneath the CS-A tiles, consider increasing the length of the "U" portion of the grafoil to decrease liklihood of grafoil tearing into 2 pieces.
Hardware	concur	Recommend adding length to grafoil gasket under the CSA tiles where the gasket is a single piece at the bottom of the U-shape to increase gasket survivability
Requirements, Analysis, Performance	concur	For the CSAS, the tile shaping was presented as a flattening of a curved surface. This creates a faceted heat flux enhancement. Show that the heat flux is still OK w/ faceting or adjust shaping to be rounded to avoid this. Request guidance from physics as necessary.
Analysis	concur	For the CS-A region: Several FEA results plots show compressive stresses with sharp gradients across a width less than a single element length. The mesh may not be resolving the minimum compressive stresses properly. If it has not been done already, please assess whether these are numerical artifacts or real contact stresses. (See slides #14, 18, 20, 24, etc.)
Confirguration	concur	HC Rogowski Coils, CS-A R5: Ensure that sufficient clearance exists for both the gas injection tubes and rogowski coil. Prefer to do this in a way which still holds the rogowski coil secure, w/o having too much "slop" at other poloidal angles.
Performance	concur	For CSA design, the tapped hole on t-bar is all the way through. The pin could end up at different

Subject: (Check as Applicable)	Chit Code	Comment/Concern/Recommendation:
		positions during installation. Suggest to machine a stopper feature in t-bar so that when bottomed out the pin will end up the same position at all locations.
Analysis	concur	Has the effect of thermal growth of the tile further compressing the graphfoil been accounted?
Requirements, Confirguration	concur	The CSAS tiles have gaps that are ~0.060" between tiles, corresponding to ~1.5 mm. Section 3.3-d of the PFC requirements says any gap > 1 mm must be approved. Either close gap to below 1 mm (beware of tolerances to prevent tile interaction) or get 'sign-off' on this gap.
Hardware	concur	IBD-H/IBD-V Frame/Ice Cube Tray: Consider plating (copper/silver) the contact surfaces b/w the frame and the CS Casing, to enhance thermal/electrical contact and minimize galling due to differential thermal expansion.
Requirements, Confirguration	as 15	The toroidal gaps on the LHF IBDV tiles also appear to be 1.5 mm in violation of 3.3-d (see CSAS CHIT). The HHF tiles have the ring to block line of sight to casing. Assume all gaps should be double checked so I don't keep writing this CHIT.
Hardware	see below	IBD-V Frame/Ice Cube Tray: Mechanical fixation of frame shows slotted bolts to allow fine adjustment during installation, but this would require high preloads to develop frictional tractions sufficient to react shearing side loads. Consider adding a few small welds to the frame near the center, to provide a fixed shear reaction point from which the frame can expand outwards.
Hardware	concur	Bolting scheme needs one two directional pin plus a second sliding restraint - More work needed on mounting
Hardware	concur	The "ikea" toggle bar works well on the flat plastic prototype tile. Next step should be to prototype a full inconel arched frame with graphite tiles to test full range of tolerances and measure the tension in each pin. Purpose is to verify smooth operation in round condition with brittle graphite tile, in full range of tolerances. Can also use to develop method to extract a tile when fastener galls or welds tight.
Hardware	concur	IBD-V Ikea Connector Prototype: 1. Two tiles on 1 rod may not have even load distribution. Consider checking this with pressure paper. 2. I can rotate the two tiles(about an axis normal to their surface) by hand so that their corners touch. Is this OK? Does tolerance stack need to be investigated to prevent this?
Performance, Reliability/Maintainability	similar	Prototype the two-bar mounting scheme for castellated tiles and consider testing in relevant environments to confirm design (e.g bake, under high heat flux) and demonstrate tolerance build-up for fishscaling.
Confirguration	concur	At the gap between the IBDH and the OBD1, with minimum relative movement between the two tile assemblies, there can be a line of sight hitting the metal fixing rod.
Requirements, Confirguration	concur - define what to change	The IBDH tiles are thicker and could impact cutouts in low heat flux region. For MGI, this should not be an issue. For spectroscopy this may impact FOV. Ensure cutouts are consistent with requirements for these systems.
Requirements, Performance	concur	The gap between the IBDV LHF and the IBDH is not a high aspect ratio gap. The gap is greater than 1 mm (1/16"?) [PFC SRD 3.3d] so it must be evaluated.

Subject: (Check as Applicable)	Chit Code	Comment/Concern/Recommendation:
Confirguration	concur	Seems to me that the "Access holes" on the IBDH tiles that were shown will allow large access to the diagnostic wire cavity...like an open barn door. This should be closed off.
Analysis	close	Same as chit #11, only for IBD-H: FEA plots on slide #33 show compressive stresses (after pulse) which looks like the mesh density may not be fully resolving the peak stress (which is a combination of the soak through thermal displacements with the mounting supports preload). If it has not been done already, please assess whether these are numerical artifacts or real contact stresses.
Requirements	consider	CASE #1 Requirements for IBDH imply 8.5 MW/m2 which would not meet surface temperature requirements w/ shaping and perfect coil alignment although are well within stress allowable. Coil alignment requirements need to be specified, and a combination of CASE #1 heat flux requirement needs to be reduced, impact angle needs to be increased and surface temperature requirement needs to be increased.
Confirguration	concur	The IBDH tiles should not have viewing holes if they are over organ pipes associated with electrical feedthroughs. The diagnostics RD has information about how the organ pipes are used.
Analysis	final design for FDR - concur	Please perform a self-check of the global EM model when applied to actual PFC mountings. e.g. Do changes in path resistivities through the bolts or by using a frame with many more holes change the current distributions on a global level. Are the applied global EM BCs still valid in the final configurations?
Analysis	already CDR chit - concur / combine	Are studies underway for cleaning dust and debris from castellation gaps, etc.?
Analysis	concur	Andrei did not shown stress results for metal frame nor the interface with the HTP. Do the interface components (bolted connection?) meet design criteria?
Performance	concur	Are halo current forces in the direction to slide the transition pieces toward the open end of the keyhole if the clamping force is insufficient?
Requirements	concur	Define a tolerance for the radial vertical step between the IBD-H and IBD-V. If this tolerance is small, and there is not a capability to adjust the height of either the IBD-H or IBD-V (e.g., shimming), this will have implications on the assembly level positioning of the CS within NSTX-U Vessel.
Requirements	see above	The target and achievable relative vertical position of the IBDH and the OBD1 tiles (at the bottom and at the top of the machine) needs to be defined.
Performance	concur	ODR1-2, consider add feature to lock transition plate onto copper plate after find the right position of the tile, instead of rely on two bolts at one end in slots. Also how to prevent hardware get loosened over the heat cycles?
Hardware	concur	The OBD12 multi Keyhole fastening scheme will be a challenge to properly engage in all positions. Recommend building a full size mockup replicating all materials and features to test the ease of installation.
Requirements	consider	CASE #1 Requirements for OBD R1/R2 imply 9.0 MW/m2 which would not meet surface temperature requirements w/ shaping and perfect coil alignment although are well within stress allowable. Coil alignment requirements need to be specified, and a combination of CASE #1 heat flux requirement

Subject: (Check as Applicable)	Chit Code	Comment/Concern/Recommendation:
		needs to be reduced, impact angle needs to be increased and surface temperature requirement needs to be increased.
Analysis	concur - define scope	Global Thermal Analysis: Emissivity of .8 is very high for lithium coated PFCs. It may be reasonable to assume that lithium "boils off" in divertor regions, but maybe not for lower heat flux area
Requirements	concur - set the relevant worst temperature for each case	Multiple presentations listed temperature requirements for bakeout as 300C - 325C. While the minimum temperature for the bakeout system is 300C there is also a high limit of 350C to accommodate imbalances in the system. Design requirements for components exposed to bakeout should use the 350C as a design point as the operating temperature will on average range between 300C and 350C. Review and ensure that analysis involving bakeout (thermal expansion etc) is based off of the 350C maximum and not the 300C minimum bakeout temperature.
Confirguration	consider	Consider offsetting LHF IBDV tiles 7.5 deg from HHF IBDV tiles to align center of HHF with clear center and double hold downs away from single T-bar in center of LHF tiles to facilitate wire routing
Confirguration	concur	For the OBDR1/R2 tiles, it would be very very nice to have two 2D mirnov coils over that poloidal extent, as in the previous design. And it is necessary to orient them so that they do NOT measure toroidal field.
Other	concur	Look into terminal strips or connections with feeds to the other side built into IBDV frames that can be built into frames to allow for easy in vessel connection/repair
Requirements, Performance, Reliability/Maintainability, Cost/Schedule	consider developing the list	Develop clear list of goals for high heat flux testing of prototypes necessary for the FDR and ensure resources (schedule, $ and personnel) will allow those to be completed prior to FDR.
Quality	concur	Consider drafting the oversight plan(s) soon as they help in the procurement planning. It would be a good idea to have generic drafts, not yet including supplier info, ready by the FDR.
Other	concur	High Heat Flux Test: The HHF testing results show a qualitative sorting of different material's relative performance. However, as compared to pre-testing FEA scoping, ATJ failure occurs right at expectation, but Sigrafine R6510 fails at less than expectation. This may be an indication that we are not meeting the criteria document's requirement of a FOS of 2x on stress.
Analysis	as above	Regarding the sample tests, I recommend computing/tabulating, as best we understand, the internal stresses and likely surface temperatures. ANSYS runs I presume. And then correlate the "damage" observed with proximity to compressive (or other) stress limits.
Cost/Schedule	concur	Keep the IBDV low heat flux tiles the HHF schedule. The design of these tiles are impacted by interfacing and diagnostic routing and we risk being forced into design decisions on HHF tiles that are impacted by a fixed LHF IBDV.
Requirements, Hardware	consider (might not be PFC)	An upper divertor gas injection system (symmetric with and identical to the existing lower diverter gas injection system) should be considered as high priority to address divertor heat flux mitigation by divertor radiation. Additional poloidally distributed diverter gas systems, such as the proposed PFR system, are desirable for physics studies but not required.
Analysis, Hardware	part of normal process	Detail design and analysis need to be performed, in the next project phase, for hardware (i.e. T-Bars, supports), fasteners (i.e. bolts, pins and washers), and welded joints.

Subject: (Check as Applicable)	Chit Code	Comment/Concern/Recommendation:
Analysis, Safety	cooling plate is in different WBS	The cooling plate and other components (that require cooling/heating fluids) design shall comply with Mech-015 to ensure their safety as pressurized components.
Confirguration	part of normal process	Procedure shall be developed to explain technical and configuration priorities for assembly, installation and testing.
Other	concur	PFC team should craft response on material question raised in EOC (or other) previous recommendation to evaluate R6510 and R6710 based on knowledge to date.