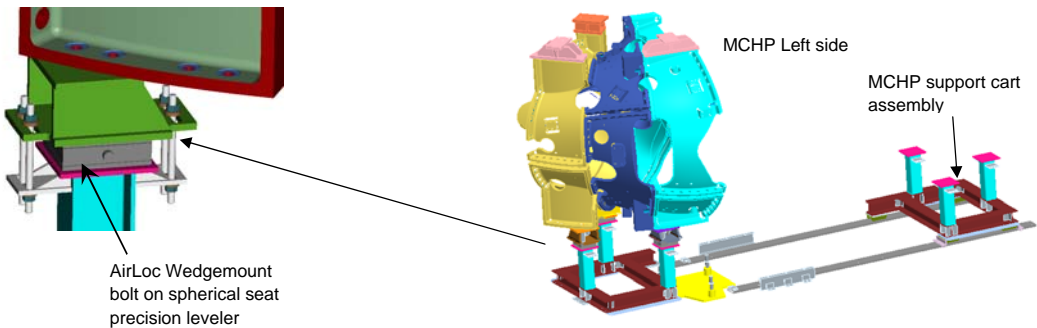


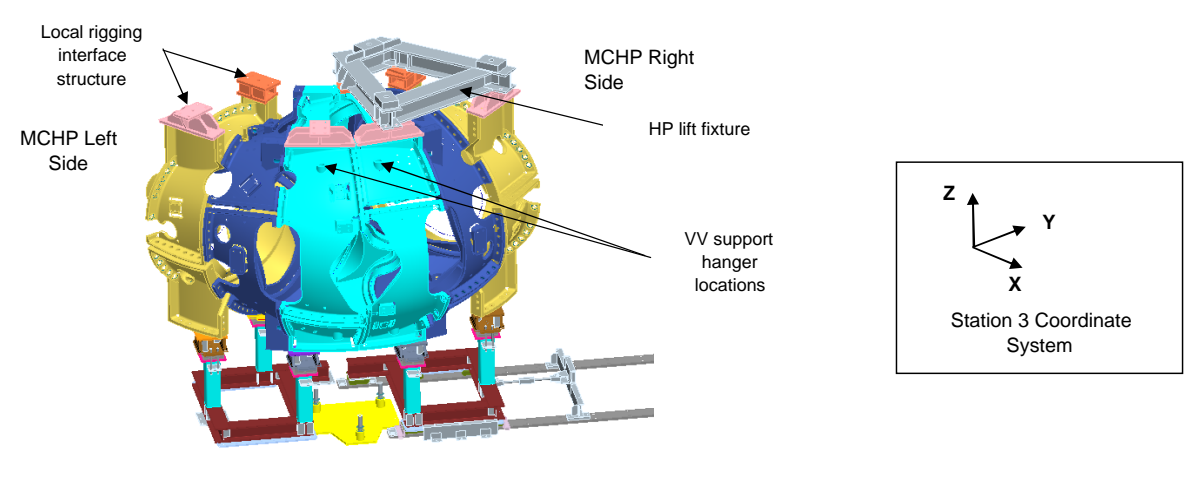
Station 3 (Assembly of MCHP over VV)

Step	Assembly Step	Comments
1.00	Pre-Installation set-up	metrology procedure covering Station 3:
1.01	Work with back office to transfer CAD models that establishes a global coordinate system for Station 3 based on the Stellarator Core coordinate system.	
1.02	Install Station 3 site monuments as needed to perform metrology measurements.	Two coordinate systems must be established. One that defines the full period and one used for initial positioning and measuring the right MCHP when the support cart is moved to the far right.
1.03	Install floor mounted tracks and the VV base support. The alignment accuracy for these parts with respect to the Station 3 coordinate system is .050" RMS.	Grout beneath floor tracks as required.
1.04	Use rigging operations to establish the MCHP CG location.	DO NOT NEED TO LOCATE CG
1.05	Install MCHP left support stand. Position to .060" RMS.	
1.06	Install the MCHP right support stand; verify the cart motion and then move to the far right. Position the AirLoc Wedgemount in a lowered position.	Monuments on the cart shall be within .060" (true distance) of their desired position.
1.07	Install alignment brackets, jack screws and dial indicators for horizontal positioning on both support stands.	Brackets are similar to the system used for alignment in Station 2
1.08	Reconfirm Leica position used for measuring each MCHP target alignment monuments.	
2.00	Pre-assemble left MCHP	Reference drawing:
2.01	Install MCHP left support stand.	Moved up to Step 1.05
2.02	Verify cart motion. Move left cart to final assembly position to accept left MCHP and secure to the floor supports. Move right cart far to the right.	Left support is now in a fixed position.
2.03	Install adjustor bar support weldment on Left Side.	No longer needed on left side.
2.04	Using the SISSCO rigging and the base support lateral adjustment system (similar to approach used in Station 2), position left MCHP over the left support with respect to the period global coordinate system.	All three monuments shall be within .010" (actual distances) of the desired position.
2.05	While held by the SISSCO rigging bring the AirLoc Wedgemount leveler up to take the load. Secure left MCHP at three location to vertical support posts on support base.	
2.06	Measure all chosen monuments (from Station 2) on left MCHP with respect to the period global coordinate system.	All monuments shall be within .010" (actual distances) of the desired position. If this criterion is not met, review with back office and if directed disengage Wedgemount and repeat Step 2.04.
2.07	Set the positioning stop on the cart so it returns to the machine coordinate defined position in further assembly steps.	Left support is now in a fixed position.
2.08	Measure the Type-A and Type-C end flanges while standing in the vertical position.	
2.09	Allow time for the back office to review the metrology data	
2.10	Using the Type-A (A-flange) inboard shim template mark the nose shim locations and puck locations. Remove the template.	Use a thin equivalent washer of the puck diameter (or some other method) to provide a positional "feel" to allow measuring puck height in the A -B installed position. Attach the locating ring to the outside of the flange.

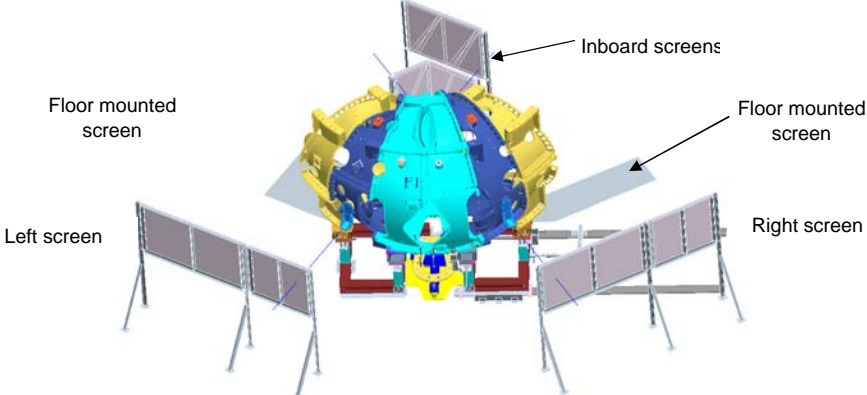
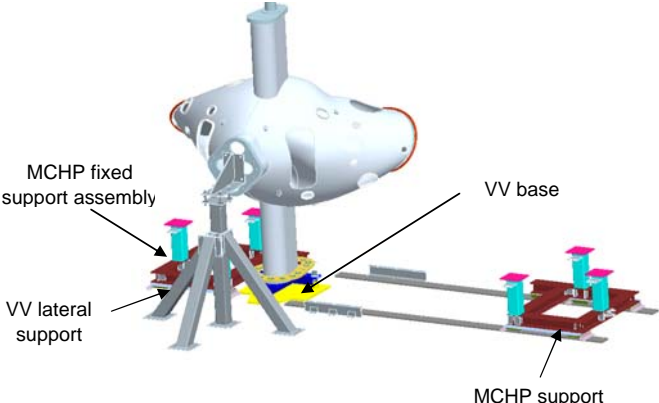
Station 3 (Assembly of MCHP over VV)

Step	Assembly Step	Comments
		
3.00	Pre-assemble right MCHP	Reference drawing:
3.01	Move the right support cart in the far right location, and position it with respect to the second global coordinate system. Secure support cart in place.	Monuments on the cart shall be within .060" (true distance) of their desired position.
3.02	Using the SISSCO crane and the base support lateral adjustment system (similar to approach used in Station 2), position right MCHP over the right support with respect to the right global coordinate system.	
3.03	While held by the SISSCO rigging bring the AirLoc Wedgemount leveler up to take the load. Secure left MCHP to the support base.	
3.04	Measure the target monuments on right MCHP with respect to the right global coordinate system.	All three monuments shall be within .010" (actual distances) of the desired position. If the criterion is not met, review with back office and if directed disengage Wedgemount and repeat Step 3.04.
3.05	Measure the Type-A and Type-C end flanges while standing in the vertical position.	
3.06	Allow time for the back office to review the metrology data.	
3.07	Using the Type-A (A-flange) inboard shim template mark the nose shim locations. Remove the template.	
3.08	Based on flange surface measurements of left and now right MCHP Type-A mating flanges define all outboard shim thickness.	Hopefully this is a verification check of the "A" flanges measured at the end of Station 2.
3.09	If new shims are needed fab them and or compress alumina coated shims and sort by thickness the shim set that will be installed on the A/A interface.	
4.00	Pre-assemble left and right MCHP; Install nose shims	Reference drawing:
4.01	Place an initial set of alumina shims (4-8) on the left side Type-A MCHP in designated locations for the initial alignment of the mating coil. Temporarily secure the shims in place.	Local platforms will be needed to secure initial shim set on left MCHP.
4.02	Using the SISSCO rigging remove the right MCHP from the right support stand and move the support cart to the period installed position next to the Left MCHP. Secure in place.	
4.03	Using the SISSCO rigging and the base support lateral adjustment system (similar to approach used in Station 2), position right MCHP over the right support with respect to the period global coordinate system.	All three monuments shall be within .010" (actual distances) of the desired position. If the criterion is not met, review with back office and if directed disengage Wedgemount and repeat Step 4.03.
4.04	While held by the SISSCO rigging bring the AirLoc Wedgemount leveler up to take the load. Secure right MCHP to the support base.	
4.05	Measure the target monuments on left MCHP with respect to the period global coordinate system.	All monuments shall be within .010" (actual distances) of the desired position. If the criterion is not met, review with back office to see how we proceed.
4.06	Install temporary scaffolding to install flange hardware	
4.07	Install the remaining alumina coated shims; install studs and supernuts.	
4.08	Tighten flange fasteners to 50%	

Station 3 (Assembly of MCHP over VV)

Step	Assembly Step	Comments
4.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt .	
4.10	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .010" (actual distances) of the desired position. If the criterion is not met, review with back office to see how we proceed.
4.11	Measure the shim puck height (at a number of points around the puck surface) at each of the nose shim puck locations. Use the data to define each puck height.	
4.12	Unfasten all bolts, remove local platforms and roll the right MCHP to the far right position.	
4.13	Recheck the part alignment of the left MCHP to make sure it is still within alignment, remove puck locating ring and then weld all left MCHP Type-A flex shims to the plasma side of the Type A flange, following the weld sequence plan.	Use the template markings of Step 2.10 to position nose shims.
4.14	After welding the left MCHP nose shims recheck alignment to determine if the part still meets the metrology acceptance criterion.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls.
4.15	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
4.16	Measure the right MCHP fiducials to establish a reference coordinate system prior to welding the nose shims.	
4.17	With the successful left MCHP weld operation, weld all the right MCHP Type-A, A-flange (datum D) flex shims to the plasma side, following the weld sequence plan.	
4.18	After welding the right MCHP nose shims recheck the part to determine if it still meets the metrology acceptance criterion.	The acceptance criterion is .004" RMS deviation in alignment to the set of tooling balls. Consult Dimensional Control if this criterion is not met.
4.19	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
		
5.00	Re-assemble left and right MCHP	Reference drawing:
5.01	Using the SISSCO rigging remove the right MCHP from the right support stand and move the support cart to the period installed position next to the Left MCHP. Secure in place.	
5.02	Using the SISSCO rigging and the base support lateral adjustment system (similar to approach used in Station 2), position right MCHP over the right support with respect to the period global coordinate system.	Using three selected monuments on the right MCHP, the positional alignment shall be within .010" RMS
5.03	While held by the SISSCO rigging bring the AirLoc Wedgemount leveler up to take the load. Secure right MCHP to the support base.	
5.04	Measure the target monuments on left MCHP with respect to the period global coordinate system.	All three monuments shall be within .010" (actual distances) of the desired position.
5.05	Bond all inboard shim pucks to the right MCHP Type-A, side A-flange (datum D).	
6.00	Install laser screens	Reference drawing:

Station 3 (Assembly of MCHP over VV)

Step	Assembly Step	Comments
6.01	Establish a global coordinate system based on the full period geometry. Measure the monuments on the MCHP's and on the walls.	This is now done in Step 1.
6.02	Using period global coordinate system place all of the laser screens as called out in the Stage 3 drawings. Position to .060" RMS.	Record position of the laser screens from the metrology measurements.
6.03	Turn each lasers on and measure each laser source and the end point on the screens. Measure fiducial points on each screen to identify their position.	Edited the wording here.
6.04	Based on metrology measurements of the screens and laser the screens path can be defined by the back office. Print the path on milar paper and using metrology mount the milar on the screens.	
6.05	Disengage the right MCHP's and move it to the far right (on its support stand) and secure in place.	Edited the wording here.
6.06	Remove the left MCHP using the SISSCO rigging and follow the laser path to test that this can be done within assembly tolerances.	Edited the wording here.
6.07	Place left MCHP in temporary location where crane can be detached.	
		
7.00	Install vacuum vessel	Reference drawing:
7.01	Remove the adjustor bar support from left side.	No longer needed as left side is fixed.
7.02	Install VV NBI port support stand. Locate with respect to period coordinate system.	Measurements shall be based on positioning monuments on the assembled parts to be within .060" (actual distances) of the desired position.
7.03	Install VVSA to base support and make the connection to the NBI port attachment.	
7.04	Using metrology take tooling ball readings off the VV shell to properly position the VVSA to the global coordinate system. Secure the VVSA to the base and at the NBI port support stand.	Position three tooling balls on the VV to within .050" (actual distances) of the desired position.
7.05	Scan VV surface and compare data with earlier surface data scanned when VV was on Station 1 fixture. Back office input is involved here.	
		

Station 3 (Assembly of MCHP over VV)

Step	Assembly Step	Comments
8.00	Install right MCHP over VV	now dealing with right side first
8.01	Install any bumper protection components on the VV (left and right side) before manipulating right MCHP over the VV.	This activity could be done in Station 1.
8.02	Move the left base support cart to the far left so it will not interfere with the MCHP installation. Position the AirLoc Wedgemount in a lowered position.	MCHP and cart should already be on the right side
8.03	Install MCHP lift fixture, disengage leveler connections and lift the MCHP off the right support stand. Move the right support stand to its final position and secure in place.	now dealing with right side
8.04	Re-install the right adjustor bar	
8.05	Using the SISSCO actuators with laser guidance move the right MCHP over the VV.	
8.06	Using the SISSCO rigging and the base support lateral adjustment system (similar to approach used in Station 2), position right MCHP over the right support with respect to the period global coordinate system.	Using three selected monuments on the right MCHP, the positional alignment shall be within .010" (actual distances) of the desired position.
8.07	While held by the SISSCO rigging bring the AirLoc Wedgemount leveler up to take the load. Secure right MCHP to the support base.	
8.08	Measure the target monuments on right MCHP with respect to the period global coordinate system.	If the positional alignment accuracy is greater than .010" (actual distances) of the desired position. Review with back office and if directed disengage Wedgemount and repeat Step 8.06.
8.09	Using the adjustor bar on the left side move the MCHP to the right 1/2".	This will allow the right MCHP to be position without wing interferences.
9.00	Install left MCHP over VV	left side now comes second
9.01	Move the right base support cart to the far right so it will not interfere with the MCHP installation. Position the AirLoc Wedgemount in a lowered position.	
9.02	Using the SISSCO actuators with laser guidance move the left MCHP over the VV TO WITHIN 1/2" OF ITS FINAL POSITION and pause. Go to the next step.	
9.03	Using the adjustor bar on the right side move the right MCHP back to its installed position.	We will have a floor mounted system to act as an alignment stop for repositioning the right MCHP.
9.04	With the left MCHP in place, move the right side MCHP using the CISSCO crane and position it to be ready to engage the preinstalled Type-A flange guide bushings.	You will be bring together pre-fit-up Type-A MC's with alignment bushings installed.
9.05	Using the SISSCO rigging and the base support lateral adjustment system (similar to approach used in Station 2), position left MCHP over the left support with respect to the period global coordinate system	Using three selected monuments on the right MCHP, the positional alignment shall be within .010" RMS
9.06	While held by the SISSCO rigging bring the AirLoc Wedgemount leveler up to take the load. Secure right MCHP to the support base.	
9.061	Measure the target monuments on right MCHP with respect to the period global coordinate system.	If the positional alignment accuracy is greater than .010" RMS review with back office and if directed disengage Wedgemount and repeat Step 8.06.
9.07	Remove the laser screens to provide more floor space for scaffolding.	
9.08	Install temporary scaffolding to install flange hardware	
9.09	Install bolts and all outboard alumina shims.	
9.10	Tighten flange fasteners to 50%	
9.11	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
9.12	Perform metrology measurements of all alignment fiducials on both MCHP's. The maximum deviation from the reference points should be .015" or less.	The maximum deviation from the "realigned" points should be .015" or less (true distance). If the deviation is greater that .015", Project input is needed to determine how to proceed.
9.13	Perform position adjustments on the left side MCHP if tolerance is not met. Loosen all studs, adjust AirLock Wedgemounts as needed; install alternate sized shims. Re-torque all studs to 50% and recheck.	Back office support will be used in identifying revised shim thickness.
9.14	Remove SISSCO actuator from left MCHP.	

Station 3 (Assembly of MCHP over VV)

Step	Assembly Step	Comments
9.15	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck	
9.16	Tighten nuts 100%. Re-verify adequate MCHP alignment.	
10.00	Weld all inboard shims and fill bushing gaps	Reference drawing:
10.01	Follow a predefined weld sequence at all MC's and weld the inboard shims, solenoid side, following weld procedures.	
10.02	Measure the positions of all monuments per the process defined in the Metrology Plan, steps 2.3.3 through 2.3.7.	The maximum deviation from the "realigned" points should be .020" or less (true distance). If the deviation is greater than .020", Project input is needed to determine how to proceed
10.03	Fill all lose bushings with Stycast 2850FT	
10.04	Measure the monuments on all coils. Save the data file and back it up. Print reports of all alignments used, and nonconformance reports, and keep with run copies of the assembly procedure.	The maximum deviation from the "realigned" points should be .020" or less (true distance). If the deviation is greater than .020", Project input is needed to determine how to proceed.
11.00	VVSA attachment to MC.	Reference drawing:
11.01	Remove MCHP lift fixture and attach germinate VV supports to the MC at the two outboard connection points at the top and bottom of each Type-A MC.	
11.02	Attach temporary VV vertical supports to the MC at the two connection points at the top and bottom of the Type-B MC.	
11.03	Disconnect base support and transfer load to VV vertical supports.	
11.04	Install VV lateral supports and align VVSA to modular coils	This is a trial alignment to ensure there are no problems. Final alignment and scanning of the flanges will not be performed until after port welding on Station 5 is completed because of distortion concerns.
11.05	Prepare VVSA for transport. Install blocking as required to prevent any motion relative to the modular coils.	
12.00	Transfer Period to NCSX test cell.	Reference drawing:
12.01	Install crane rigging to MCWF and transfer the unit to the transfer support frame. Secure Period /support frame to the transporter.	
12.02	Transfer completed Period to Station 5 located in NCSX test cell.	

Change in 9.3

- 1 Includes Bob Ellis's final dimensional control inputs (highlighted in red).

Change in 9.2

- 1 Updated a number of sections due to welding of nose shims and fixing of left MCHP support.

Change in Rev 9.1:

- 1 Eliminated Step 1.03
- 2 Eliminating the A-A pre-alignment step in Station 2 resulted in added Steps needed in Station 3.