QA Plan Summary
NCSX Modular Coil Winding Form Machining

Spec Ref	Activity	Visual Mfg Ref.	Ref Procedure	Witness/Hold Point	Reporting/Documentation Req
	Manufacturing Planning- QA planning- Production Support	65707/1.0 -Sub:0 Op#:10			
	Final Inspection----Prepare part for source inspection.----Review and complete QA data package per QAP and the requirements of the product specification NCSX-CSPEC-141-03.--Contact CFT to review data package prior to notifying source inspection.	65707/1.0 -Sub:0 Op#:20			
	Source Inspection	65707/1.0 -Sub:0 Op#:30		Hold Point	
5.1; 5.3; 5.4	Package and Ship----Build a box/crate suitable for protecting the part from the environment.----Weigh the finished part and metal stamp the value in pounds on the casting in the area marked on the customer drawing.----Part must be protected and wrapped in plastic prior to inserting into the crate. Refer to PS583.----Part is to be shipped to PPPL in Princeton- NJ per QAP shipping address.----Crate must be marked/stenciled per the MTM drawing.	65707/1.0 -Sub:0 Op#:40			
4.2.1; 4.2.2; 4.2.2.3; 4.2.2.4	Receive customer supplied material. --Verify the receipt of quality documentation for the casting.--Check off IDC noting receipt of material and receipt of quality documentation.----Part Number: SE141-116 Rev: 3--Part Description: PRODUCTION WINDING FORM TYPE-C	65707/1.0 -Sub:1 Op#:10			Material Certification / IDC:1
	Setup the machining fixture on the rotary table. Load casting into the machining fixture with the initial pickup pads facing up. Indicate the .-pickup pads and orient the casting for machining. ----Rough machine the top flange face and the outer periphery leaving .25- +.060/-.000 Install pickup holes. The outside surfaces of the flange and the pickup holes will serve as qualifiers for the next operation.----Install the lifting holes per the MTM drawing.----Rough machine the top side of the -T- section leaving .25- +.060/-.000-.----Remove the casting from the machining fixture and flip over with the bottom flange facing up. Re-load into the machining fixture. Pickup the qualifiers and orient the casting for machining.----Rough machine the bottom flange face leaving .25- +.060/-.000-. ----Rough machine the poloidal break leaving a minimum of .25- of stock per side.----Install temporary shim filling in the poloidal break and hold together with temporary eclamps.----Rough machine the bottom side of the -T- section leaving .25- +.060/-.000-.----Finish machine both sides of the entire casting with the exception of .the -T- section. This section will .be finished machined in the next operation	65707/1.0 -Sub:1 Op#:20			
4.2.5	Perform an in-process inspection of the magnetic permeability of the material using the Severn Permeability Indicator Gage. Inspect a minimum of (8) points on the rough machined flange face and an additional (8) points on the rough machined -T- section. Record the upper and lower range values on the IDC's. Values that exceed 1.02 must be documented with a non-conformance record and dispositioned prior to continuing.	65707/1.0 -Sub:1 Op#:40	PS584		/ IDC:1
	Finish machine the -T- section and wings. Run a probe pass to inspect the surface for stock.----Remove the casting from the machining fixture and flip over with the bottom flange facing up. Re-load the casting into the machining fixture. Pickup the qualifiers and orient the casting for machining.----Finish machine the -T- section and wings. Run a probe pass to inspect the surface for stock.--	65707/1.0 -Sub:1 Op#:70			
	Setup the machining fixture with the casting installed. Machine the inspection fiducials per the MTM drawing. Finish machine the poloidal break to drawing requirements. Remove the casting from the machining fixture.	65707/1.0 -Sub:1 Op#:80			
	Handwork both side "L"s of the "T" to achieve 125RMS or better surface finish. Inspect surface finish and record on IDC. While handworking, only use disks and paper that have not previously been used on any other materials. Part must be clean per PS583.	65707/1.0 -Sub:1 Op#.85			/IDC:1
4.2.5	Inspect the magnetic permeability of the entire casting using the Severn Permeability Indicator Gage. Refer to PS584. All as cast surfaces must be inspected on a 6- x 6- grid. Record range of actual values on IDC. All machined surfaces must be inspected on a 2- x 2- grid. Record range of actual values on IDC. Permeability measurements shall be per supplementary requirements S24 of ASTM A703/A703M and S1 of ASTM A800/800M except the results will be expressed as relative permeability (μ) rather than ferrite content (FN). Values that exceed 1.02 must be documented with a non-conformance record and dispositioned prior to continuing.	65707/1.0 -Sub:1 Op#:90	PS584	Hold Point	/ IDC:2

4.2.7	PT 100% of the part as-cast surfaces as well as finished machine surfaces. See PS582 for processing instructions. During the inspection also perform a visual inspection of the casting surface per ASTM A802/A802M and accept per the same. Include reference to ASTM A802 on the certification.----Specification: ASTM A903/A903M----Method: ASTM E165----Acceptance Criteria: ASTM A903/A903M Level II for as cast surfaces----Acceptance Criteria: ASTM A903/A903M Level I for machined surfaces including the entire -T- section (high stress areas)----Certification: MTM certification to include the information per Supplementary Requirements S1 of ASTM A903/A903M--MTM NDT Cert: LPI CERTIFICATION	65707/1.0 -Sub:1 Op#:100	PS582	Hold Point	MTM NDT Cert
4.2.8	The -T- areas defined as -High Stress- are to be RT 100%. See PS581 for process instructions.----Hand sketch a layout of all film locations on sheet (1) of the customer drawing SE141-116 to maintain shot and film traceability.----All film is to be doubled up in order to supply the customer with a complete set of film.----Specifications: ASTM A703/A703M Supplementary Requirement S5----Procedure/Method: ASTM E94 and ASTM E142 (use of a wire penetrameter may be necessary instead of the hole type to ensure objective 2% of thickness resolution/sensitivity)----Acceptance Criteria: Thickness < 2- ASTM E446 comparative plates----Acceptance Criteria: Thickness > 2- but < 4.5 ASTM E186 comparative plates----In addition to the acceptance criteria above no defect greater than .180- in the base of the tee or .060- in the web region of the tee is acceptable.----Scan RT certification- and hand sketched map and link in QAP to this operation.----Certification: RADIOGRAPHIC INSPECTION--Map(s): CUSTOMER DRAWING Rev: --Part Number: SE141-116 Rev: 3--Part Description: WINDING FORM TYPE-C--Material Type: 316 SST--Material Thickness: VARIES--Serial Number: C-1	65707/1.0 -Sub:1 Op#:110	PS581	Hold Point	Certification / Map(s)
4.2.4; 4.2.6	Setup and inspect the part 100% per the drawing requirements. Refer to PS593.--Surface profile dimensions are to be taken on a 2- x 2- grid for machined surfaces and 4- x 4- grid for as cast surfaces.--Record dimensions as required per the IDC's.--	65707/1.0 -Sub:1 Op#:120	PS593	Hold Point	/ IDC:98
5.2	Clean the casting thoroughly to remove all coolant- oil- tapping fluid etc... Rinse the part thoroughly and wipe down with isopropyl alcohol to remove any residue or film. Refer to PS583.----Install the poloidal break shim assembly and accompanying hardware and insulation per the assembly drawing.	65707/1.0 -Sub:1 Op#:130	PS583		
4.2.3; 4.2.3.1; 4.2.3.2	Perform electrical resistance test.----Wire all of the bolts together. Set one jumper directly on casting flange and one on the bolts. Record resistance between the bolt and casting combination and the mid-plane shim in kohms on IDC.----Set a jumper between the poloidal joint midplane and the casting. Set one jumper on the poloidal joint midplane and one on each of the bolts. Record range of resistance in kohms on IDC.	65707/1.0 -Sub:1 Op#:140		Hold Point	/ IDC:2
	Receive customer supplied shim casting	65707/1.0 -Sub:2 Op#:10			Material Certification
	Machine the shim complete per the drawing and CNC programs	65707/1.0 -Sub:2 Op#:20			
	Assemble all of the insulating sleeves into the shim and bond using Loctite 411.	65707/1.0 -Sub:2 Op#:30			Certificate of Conformance
	Saw off 16" and move to the next work center.	65707/1.0 -Sub:3 Op#:10			Material Certification
	Machine per the drawing for a slip fit with mating detail. Obtain finished machined casting shim before final sizing the O.D. of the sleeve.	65707/1.0 -Sub:3 Op#:20			
	Receive material -- Notify CFT and forward material to stores.	65707/1.0 -Sub:4 Op#:10			Material Certification
	Saw off 30" length and move to the next work center.	65707/1.0 -Sub:5 Op#:10			Material Certification
	Machine per the drawing for slip fit with mating detail. Check finished machined casting before final sizing the O.D. of the sleeve.	65707/1.0 -Sub:5 Op#:20			
	Saw 13" length and move to next work center.	65707/1.0 -Sub:6 Op#:10			Material Certification
	Machine complete per drawing.	65707/1.0 -Sub:6 Op#:20			
	Receive material.	65707/1.0 -Sub:7 Op#:10			Certificate of Conformance
	Machine the profile leaving stock per program.	65707/1.0 -Sub:7 Op#:20			

In the event that a tool gouge is encountered, a non-conformance report will be submitted to the customer documenting the size, depth and location of the gouge. If the customer disposition calls for weld repair then it will be performed per the assigned WPS433-PPPL per MTM internal WLD-SOP-02 through WLD-SOP-06. MTM WLD-WI-003 through WLD-WI-008 also apply. Per MTM weld SOP's, only welders that have been qualified to run the WPS can weld on the casting.
The WPS and the supporting PQR used will have been previously submitted and approved to be used for the Modular Coil Winding Forms.

QA Plan Summary
NCSX Modular Coil Winding Form Machining

In the event that a casting defect is encountered during machining or NDE that is larger than the specified size limitation in the product specification, a non-conformance report will be submitted to the customer documenting the size, depth and location of the defect. If the customer disposition calls for weld repair then it will be performed per the following summary. All of MTM's internal SOP's and WI's referenced above will be adhered to when performing welding operations:

Spec Ref	Activity	Visual Mfg Ref.	Ref Procedure	Witness/Hold Point	Reporting/Documentation Req
	Fully excavate the defective area and prepare for weld buildup.				
	PT 100% of the excavated area. See PS582 for processing instructions. Specification: ASTM A903/A903M----Method: ASTM E165----Acceptance Criteria: ASTM A903/A903M Level II for as cast surfaces----Acceptance Criteria: ASTM A903/A903M Level I for machined surfaces including the entire -T- section (high stress areas)----Certification: MTM certification to include the information per Supplementary Requirements S1 of ASTM A903/A903M--MTM NDT Cert: LPI CERTIFICATION	TBD	PS582	Hold Point	MTM NDT Cert
	Perform weld repair using WPS433-PPPL. Only welders whose qualification to WPS433-PPPL has been approved by PPPL are authorized to perform the weld procedure. This is ensured by MTM's weld wire check out procedure which restricts welders to their approved qualifications.	TBD	WPS433-PPPL		
	Inspect the magnetic permeability of the area welded using the Severn Permeability Indicator Gage. Refer to PS584. Inspect a minimum of 2" x 2" grid on the weld and adjacent to the weld surfaces. Permeability measurements shall be per supplementary requirements S24 of ASTM A703/A703M and S1 of ASTM A800/800M except the results will be expressed as relative permeability (μ) rather than ferrite content (FN). Values that exceed 1.02 must be documented with a non-conformance record and dispositioned prior to continuing.	TBD	PS584	Hold Point	/ IDC:1
	PT 100% of the welded area. See PS582 for processing instructions. Specification: ASTM A903/A903M----Method: ASTM E165----Acceptance Criteria: ASTM A903/A903M Level II for as cast surfaces----Acceptance Criteria: ASTM A903/A903M Level I for machined surfaces including the entire -T- section (high stress areas)----Certification: MTM certification to include the information per Supplementary Requirements S1 of ASTM A903/A903M--MTM NDT Cert: LPI CERTIFICATION	TBD	PS582	Hold Point	MTM NDT Cert
	All welded areas are to be RT 100%. See PS581 for process instructions.----Hand sketch a layout of all film locations on sheet (1) of the customer drawing SE141-116 to maintain shot and film traceability.----All film is to be doubled up in order to supply the customer with a complete set of film.----Specifications: ASTM A703/A703M Supplementary Requirement S5----Procedure/Method: ASTM E94 and ASTM E142 (use of a wire penetrameter may be necessary instead of the hole type to ensure objective 2% of thickness resolution/sensitivity)----Acceptance Criteria: Thickness < 2- ASTM E446 comparative plates----Acceptance Criteria: Thickness > 2- but < 4.5- ASTM E186 comparative plates----In addition to the acceptance criteria above no defect greater than .180- in the base of the tee or .060- in the web region of the tee is acceptable.----Scan RT certification- and hand sketched map and link in QAP to this operation.----Certification: RADIOGRAPHIC INSPECTION--Map(s): CUSTOMER DRAWING Rev: --Part Number: SE141-116 Rev: 3--Part Description: WINDING FORM TYPE-C--Material Type: 316 SST--Material Thickness: VARIES--Serial Number: C-1	TBD	PS581	Hold Point	Certification / Map(s)