Modular Coil Assembly FDR

Presented by
David Williamson
July 26, 2007

Review Charge

- Are the coil assembly models and drawings complete?
- Have post-VPI coil mods and punch-list items been addressed?
- Is the model tree / BOM complete?
- Is the modular coil analysis documentation checked/complete?
- Have prior design review chits been addressed?

Scope

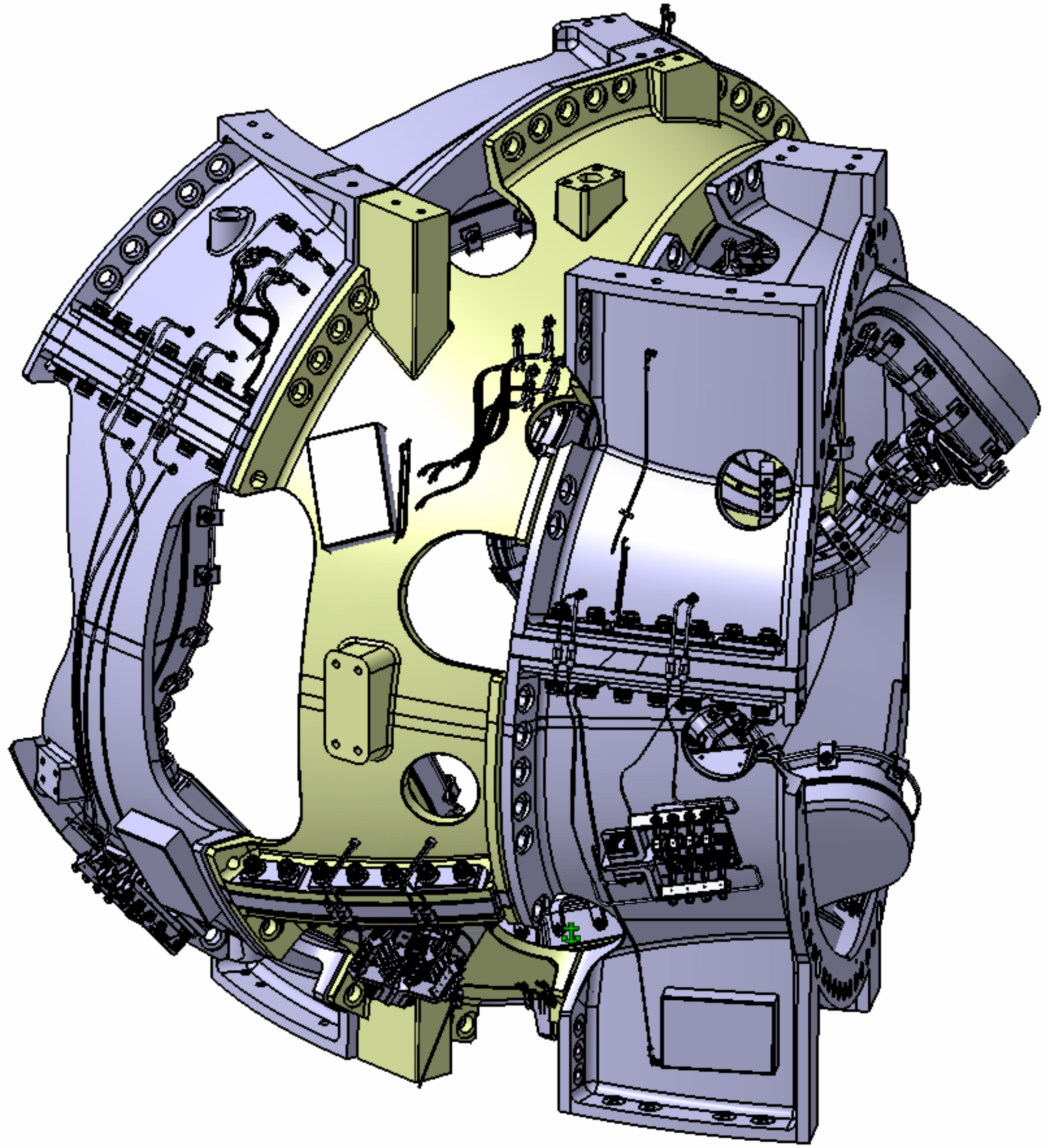
- This review-
  modular coil assemblies:

  SE140-101 (Type-A)
  SE140-102 (Type-B)
  SE140-103 (Type-C)

- Upcoming reviews:

  AA/AB/BC Interface
  PDR 8/2/07
  FDR 9/4/07

  CC Interface
  PDR 8/7/07
  FDR 1/7/08



Past Design Reviews

NCSX National Compact Stellarator Experiment

Type-C Coil FDR
Apr-Jun 2005
1. Cladding
2. Lead Blocks
3. Spec, SubAsms

Leads (electrical) Review
Apr 2006
1. Joint Fabrication
2. Testing Reqmts

C1 Testing Prep Review
Jun 2006
1. Plumbing
2. Leads & Buswork
3. Instrumentation

Mod Coil Asm Review
Sep 2006
1. Clamps
2. Post-VPI Mods

TC & Strain Gage FDR
Jan 2007
1. Gage Layout
2. Testing, Calibration

Mod Coil Asm FDR
Jul 2007
1. Top-Level Dwgs
2. Spec (revision)
3. Analysis Docs

Mod Coil Closeout Review
Jan 2008
1. Coil-Coil Interface
2. Dwg Package / BOM
3. Analysis Data Archived

Chits Status(1)

NCSX National Compact Stellarator Experiment

Design Review [Cog Engr/RLM/Chair]	Rvw Date	#	Chit Finding [Originator]	Project Disposition	Status	Due Date	New Status 7/26/07
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	4/27/2005	5	Need to articulate procurement plan and incorporate into DMB for chill plates and cladding. Issues need resolution. [Reiersen]	Plan to fabricate first set of cladding and chill plates at PPPL, procure remainder.	Open pending completion of Type-C master bill of material and procurement pkgs	**8/5/2005**	Closed. Cladding and chill plate procurement complete.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	4/27/2005	9	Add a number to the parts that correspond to the web hole numbering scheme. [Nelson]	Cladding and chill plate asm drawings correlate part and tee hole numbers.	Open pending release of cladding and chill plate asm drawings.	**8/5/2005**	Closed. Hole numbers incorporated in part numbering.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	1	The clamps need to be wider. Other considerations that could be incorporated into the clamp design are: 1) beveled inner edges. 2) make pads 1/8" instead of 1/4" 3) don't use G-11 pads (clamp hardware) 4) use small G-11 pads and smaller diameter pre-load hardware on the vertical pre-load components 5) make clamps at least 1/2" wider. 6) make clamp cup deeper 1/8" to ensure that all the hardware stays trapped. [S. Raftopoulos]	Nelson to bring back marked up drawing with suggestions for clamp revisions.	Revision of clamp drawings is in progress. All recommended changes appear feasible.	**8/5/2005**	Closed. Clamp revisions incorporated in SE142C-270-R0.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	2	Recommend that Major Tool fabricate the lead block G-11 pieces and fit then to casting at or before for C1). [S. Raftopoulos]	Include MTM in bid process	Open.	**8/12/2005**	Closed. Lead blocks fabrication complete.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	3	For the clamp Bellville washer cup, have the piece masked so that there is no plating on the upper/outer surface on the TRC it had to be ground off spot welding the stainless shim locking tabs. [S. Raftopoulos]	Should be considered	Note will be added to drawing.	**8/5/2005**	Closed. Note included in drawing SE142C-275-R0.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	4	Change Kapton tape on chill plates to glass reinforced Teflon tape to improve toughness. (Due to short between cladding and tee on TRC). [P. Heitzenroeder]	Consider along with other options for reducing staking risk, out only in regions of staking.	Instructions to be added to winding procedure.	**8/12/2005**	Closed. Winding procedure approved.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	5	Consider alternatives to G-10 for bushings. Alternatively, need to make sure that laminate direction at glass- epoxy material is properly oriented to avoid fracturing. [P. Heitzenroeder]	Should be remember for all such bushings (not just Type-C coil)	Note will be added to drawings as required.	**8/5/2005**	Closed. Material selection has been finalized.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	6	Ensure that gap for kickless cable is controlled to guarantee proper contact for electrical interface could be note one assembly drawing to measure and field fit. [M. Kalish]		Design and assembly is under review to verify cable fitup.	**8/5/2005**	Open pending final design of coil buswork. Resolution by Jan-09.

Chits Status(2)

Design Review [Cog Engr/RLM/Chair]	Rvw Date	#	Chit Finding [Originator]	Project Disposition	Status	Due Date	New Status 7/26/07
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	6	Ensure that gap for kickless cable is controlled to guarantee proper contact for electrical interface could be note one assembly drawing to measure and field fit. [M. Kalish]		Design and assembly is under review to verify cable fitup.	**8/5/2005**	Open pending final design of coil buswork. Resolution by Jan-09.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	7	What is the status of all Type C Coil ICD's? Are they all completed and signed? [B. Simmons]		Revision of interface control documents is in progress.	**8/12/2005**	Open. To be resolved by Jan-08.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	8	Add to charge that all previous applicable design review chits PDR and FDR have been resolved. [B. Simmons]		Open. Status of previous review chits is being reviewed.	**8/5/2005**	Closed. Previous chits have been reviewed.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	9	List items to be procured and use as checklist that drawings and, where needed, specification are ready [F. Malinowski]		Master BOM is in progress.	**8/5/2005**	Closed. BOM has been updated.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	10	Close the loop with Chrzanowski on additional drawings needed in fabrication. [W. Reiersen]		Closed. List of needed asm drawings has been prepared. (Chrzanowski email 7/1/05)	---	Closed. Additional part and subasm drawings have been provided.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	11	Need to trim bottom of chill plates behind lead block. [W. Reiersen]		Revision of flat pattern in progress.	**8/5/2005**	Closed. Revision made.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	12	Geoff Gettelfinger recommended using closed loop cooling for the lead block chill plate. Bring in another source of Gn2 or mixed flow for the	Consider	Design revision is in progress.	**8/5/2005**	Closed. Included in final design.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	13	Details of how to seal the terminal block for VPI need to be worked out. [W. Reiersen]		Review TRC approach, add details to coil asm drawing.	**8/12/2005**	Closed. Defined in winding procedure.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	14	Indicate which of the studs need to be removed after VPI. [R. Reiersen]		Additional views and notes added to top-level asm drawing.	**8/12/2005**	Closed. Included in coil asm drawings.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	15	Requirement is two co-wound loops with twisted leads being routed to the Pomona box. [W. Reiersen]		Revision of coil asm drawing is in progress.	**8/12/2005**	Closed. Box for flux loops defined in coil asm drawings.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	16	Still need to work out details of electrical isolation of coolant tubes, especially round poloidal bread. [W. Reiersen]		Design is in progress.	**8/12/2005**	Closed. Included in final design.

Chits Status(3)

Design Review [Cog Engr/RLM/Chair]	Rvw Date	#	Chit Finding [Originator]	Project Disposition	Status	Due Date	New Status 7/26/07
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	17	Assembly procedure should required removal of the copper tubing in the bag mold assembly [W. Reiersen]		To be added to coil post-VPI procedure.	**8/12/2005**	Closed. Included in post-VPI procedure.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	18	Resolve clamp details based on TRC experience (see back). Issues: Washer procured were thicker. Cup may need to be longer to retain washers 2) The screw that retains	**Did Tom Brown's model change to reflect taller clamps?**	Revision of clamp drawings is in progress. All recommended changes appear feasible.	**8/5/2005**	Closed. Changes incorporated in production clamps.
Modular Coil Type C Cladding FDR Williamson/Nelson/Reiersen	6/30/2005	20	Make the coil clamps uniform for all Coil Types c and A, B - more economical. [J. Chrzanowski]	Good idea if do-able.	Design approach appears feasible and will be incorporated in the next revision of the clamp asm drawings.	**8/12/2005**	Closed. Standard clamp design developed.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	1	Basic performance of nominal joint needs to be understood. What is current density distribution at joint, considering unbalance between parallel windings? What is max. local temperature rise? What is expected resistance? What is impact of thermal and mechanical effects? [Neumeyer]	**Soft solder should fix this concern, but current sharing among parallel paths still an issue**			Open pending further analysis. Resolve by Jan08.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	2	Need more precision in R measurements. [Neumeyer]	**Soft solder should fix this concern**			Open?
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	3	Consider making male part fluted (with ridges) to promote high pressure contact regions plus paths for solder flow. [Neumeyer]	Should be evaluated			Closed. Fabrication procedure w/ solder established.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	4	Consider sanding longitudinal strips on pins to ensure solder flow. [Heitzenroeder]	See chit #3			Closed. Fabricrication procedure w/ solder established.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	5	Use non-corrosive flux. [Neumeyer]				Closed. Fabricrication procedure w/ solder established.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	6	Consider > 10ft. - lbs. torque and alternate Belleville washers (flatten at initial load) [Neumeyer]				Closed. Leads assembly procedure defined.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	7	Determine temperature of epoxy to avoid burning. [Neumeyer]				Closed. C1 coil testing complete.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	8	Consider inserting screw into side of C-1 connects to ensure good joints. [Neumeyer]				Closed. C1 coil testing complete.

Chits Status(4)

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National Compact Stellarator Experiment

Design Review [Cog Engr/RLM/Chair]	Rvw Date	#	Chit Finding [Originator]	Project Disposition	Status	Due Date	New Status 7/26/07
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	9	Consider a pre-heating/cooling cycle on C-1 joints with N2 blast to clean any epoxy which may be in joints. [Heitzenroeder]				Closed. C1 coil testing complete.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	10	Compare "cool-heat" to Cu clamps in effectiveness to limit T of Cu before deciding on procedure details. [Heitzenroeder]				Closed. C1 coil testing complete.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	11	Pedigree of selected solder needs to be confirmed for impact toughness and conductivity. [Gettelfinger]				Closed. Fabricrication procedure w/ solder established.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	12	Formalize P. Heitzenroeder "sanding" approach by putting feed lines on mating elements [Gettelfinger]	See chit #3			Closed. Fabricrication procedure w/ solder established.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	13	How will project assure that the electrical interfaces on C-1 are clean enough to even consider soldering? [Gettelfinger]	Need to reconsider allowable joint resistance. Then, if C-1 passes resistance test, it is acceptable			Closed. C1 coil testing complete.
Modular Coil Electrical Joint Peer Review Williamson/Nelson/Neuymeyer	4/24/2006	15	Investigate drawing dimensional error and assess impact. [Neumeyer]				Closed. Fabricrication procedure w/ solder established.
C1 Coil Testing Peer Review Gettlelfinger/vonHalle/Reiersen	6/1/2006	1	Circulate copies of the plans and procedures for review to RLM's and EM. [W. Reiersen]				Closed. C1 coil testing complete.
C1 Coil Testing Peer Review Gettlelfinger/vonHalle/Reiersen	6/1/2006	2	Check out eddy current issues with displacement monitor. [W. Reiersen]				Closed. C1 coil testing complete.
C1 Coil Testing Peer Review Gettlelfinger/vonHalle/Reiersen	6/1/2006	3	ES& H inspection of final CTF lock/interlock configuaration should be made before testing penetration begins in the enclosure. [J. Levine]				Closed. C1 coil testing complete.
C1 Coil Testing Peer Review Gettlelfinger/vonHalle/Reiersen	6/1/2006	4	Add TC's to WP exterior for monitoring cooldown. [W. Reiersen]				Closed. C1 coil testing complete.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	1	Strain gages on steel will be fairly each to interpret but gages on the composite conductor and chill plates may yield readings that are not so easy to interpret due to the uncertainty of the material. [Brooks]	**Agree – put all the strain gages the steel?**			Open pending final specification of strain gages. Resolution by Jan08.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	2	Perform accuracy measurement on FBG sensors. [Dong]	**Don't use FBG sensors?**			Open pending final specification of strain gages. Resolution by Jan08.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	3	Assume that installation and electronics costs are in WBS1 as they are not in WBS 5. [Gettelfinger]				Closed. Equip costs included in latest estimate Jun07.

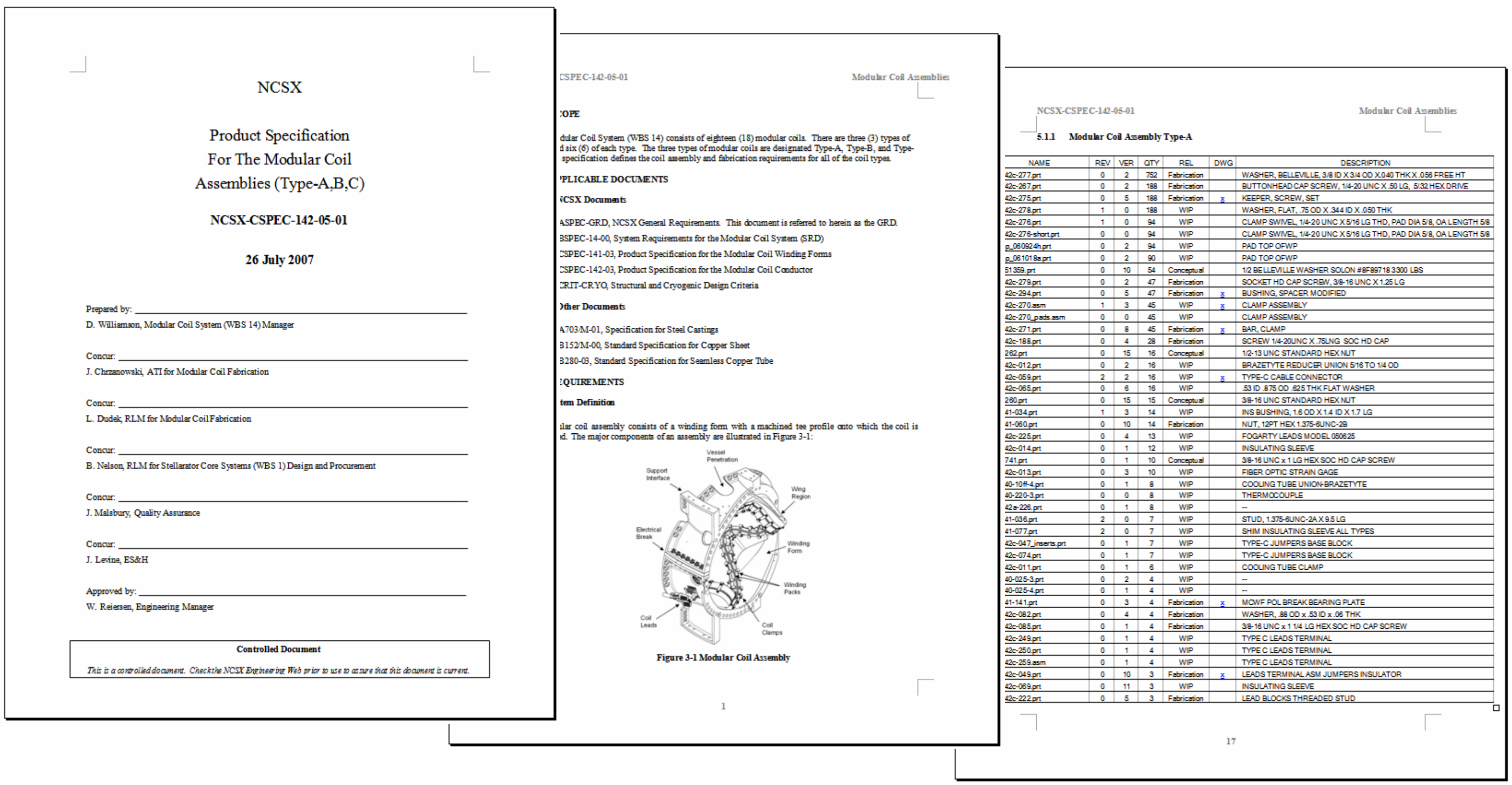
Chits Status(5)

Design Review [Cog Engr/RLM/Chair]	Rvw Date	#	Chit Finding [Originator]	Project Disposition	Status	Due Date	New Status 7/26/07
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	4	Consider monitoring the coolant tube inlet and outlet temperatures. Useful diagnostic for monitoring will cooldown. [Reiersen]				Closed. Included in final design.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	5	Monitor coil resistance to infer coil temperature. Reduce number of TC's. 600 looks to be an excessive number fold into coil protection.				Closed. Number of TCs has been reduced to 240.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	6	Verify that problems with displacement gage were due to condensation could be done at PPPL. Also consider installing on machine.	Are we using displacement gage?			Open pending final specification of strain gages. Resolution by Jan08.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	7	Investigate the calibration of FBG's so they have the same issues as Fabry Perot gages. [Reiersen]	Are we using FBG gages?			Open pending final specification of strain gages. Resolution by Jan08.
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	8	We need to use calibrated gages if they are used to validate the structures models. Require the use of weldable gages. [Reiersen]	Sounds like a good idea			Open pending final specification of strain gages. Resolution by Jan08.

Product Specification

NCSX National Compact Stellarator Experiment

- Revision-0 approved for Type-C coil assembly in Nov-2005
- Electrical resistance table, minor wording changes made in Revision-1
- Section-5 tables derived from Pro/INTRALINK bill of materials report
- Some complex models, such as chill plates, are not present in the coil assembly (model tree), but are listed on the drawing parts list



NCSX

Product Specification
For The Modular Coil
Assemblies (Type-A,B,C)

NCSX-CSPEC-142-05-01

26 July 2007

Prepared by: ____________________
D. Williamson, Modular Coil System (WBS 14) Manager

Concur: ____________________
J. Chrzanowski, ATI for Modular Coil Fabrication

Concur: ____________________
L. Dudek, RLM for Modular Coil Fabrication

Concur: ____________________
B. Nelson, RLM for Stellarator Core Systems (WBS 1) Design and Procurement

Concur: ____________________
J. Malsbury, Quality Assurance

Concur: ____________________
J. Levine, ES&H

Approved by: ____________________
W. Reiersen, Engineering Manager

Controlled Document

This is a controlled document. Check the NCSX Engineering Web prior to use to assure that this document is current.

CSPEC-142-05-01 Modular Coil Assemblies

:OPE

dular Coil System (WBS 14) consists of eighteen (18) modular coils. There are three (3) types of d six (6) of each type. The three types of modular coils are designated Type-A, Type-B, and Type- specification defines the coil assembly and fabrication requirements for all of the coil types.

'PLICABLE DOCUMENTS

'CSX Documents

ASPEC-GRD, NCSX General Requirements. This document is referred to herein as the GRD.

BSPEC-14-00, System Requirements for the Modular Coil System (SRD)

CSPEC-141-03, Product Specification for the Modular Coil Winding Forms

CSPEC-142-03, Product Specification for the Modular Coil Conductor

CRIT-CRYO, Structural and Cryogenic Design Criteria

)ther Documents

A703/M-01, Specification for Steel Castings

B152/M-00, Standard Specification for Copper Sheet

B280-03, Standard Specification for Seamless Copper Tube

:QUIREMENTS

tem Definition

ılar coil assembly consists of a winding form with a machined tee profile onto which the coil is d. The major components of an assembly are illustrated in Figure 3-1:

Figure 3-1 Modular Coil Assembly

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NCSX-CSPEC-142-05-01 Modular Coil Assemblies

5.1.1 Modular Coil Assembly Type-A

NAME	REV	VER	QTY	REL	DWG	DESCRIPTION
42c-277.prt	0	2	752	Fabrication		WASHER, BELLEVILLE, 3/8 ID X 3/4 OD X.040 THK X .056 FREE HT
42c-267.prt	0	2	188	Fabrication		BUTTONHEAD CAP SCREW, 1/4-20 UNC X .50 LG, 5/32 HEX DRIVE
42c-275.prt	0	5	188	Fabrication	x	KEEPER, SCREW, SET
42c-278.prt	1	0	188	WIP		WASHER, FLAT, .75 OD X .344 ID X .050 THK
42c-276.prt	1	0	94	WIP		CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH 5/8
42c-276-short.prt	0	0	94	WIP		CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH 5/8
p_060924h.prt	0	2	94	WIP		PAD TOP OFWP
p_061018a.prt	0	2	90	WIP		PAD TOP OFWP
51359.prt	0	10	54	Conceptual		1/2 BELLEVILLE WASHER SOLON #8F89718 3300 LBS
42c-279.prt	0	2	47	Fabrication		SOCKET HD CAP SCREW, 3/8-16 UNC X 1.25 LG
42c-294.prt	0	5	47	Fabrication	x	BUSHING, SPACER MODIFIED
42c-270.asm	1	3	45	WIP	x	CLAMP ASSEMBLY
42c-270_pads.asm	0	0	45	WIP		CLAMP ASSEMBLY
42c-271.prt	0	8	45	Fabrication	x	BAR, CLAMP
42c-188.prt	0	4	28	Fabrication		SCREW 1/4-20UNC X .75LNG SOC HD CAP
262.prt	0	15	16	Conceptual		1/2-13 UNC STANDARD HEX NUT
42c-012.prt	0	2	16	WIP		BRAZETYTE REDUCER UNION 5/16 TO 1/4 OD
42c-059.prt	2	2	16	WIP	x	TYPE-C CABLE CONNECTOR
42c-065.prt	0	6	16	WIP		.53 ID .875 OD .625 THK FLAT WASHER
260.prt	0	15	15	Conceptual		3/8-16 UNC STANDARD HEX NUT
41-034.prt	1	3	14	WIP		INS BUSHING, 1.6 OD X 1.4 ID X 1.7 LG
41-060.prt	0	10	14	Fabrication		NUT, 12PT HEX 1.375-6UNC-2B
42c-225.prt	0	4	13	WIP		FOGARTY LEADS MODEL 050625
42c-014.prt	0	1	12	WIP		INSULATING SLEEVE
741.prt	0	1	10	Conceptual		3/8-16 UNC x 1 LG HEX SOC HD CAP SCREW
42c-013.prt	0	3	10	WIP		FIBER OPTIC STRAIN GAGE
40-10ff-4.prt	0	1	8	WIP		COOLING TUBE UNION-BRAZETYTE
40-220-3.prt	0	0	8	WIP		THERMOCOUPLE
42a-226.prt	0	1	8	WIP		--
41-036.prt	2	0	7	WIP		STUD, 1.375-6UNC-2A X 9.5 LG
41-077.prt	2	0	7	WIP		SHIM INSULATING SLEEVE ALL TYPES
42c-047_inserts.prt	0	1	7	WIP		TYPE-C JUMPERS BASE BLOCK
42c-074.prt	0	1	7	WIP		TYPE-C JUMPERS BASE BLOCK
42c-011.prt	0	1	6	WIP		COOLING TUBE CLAMP
40-025-3.prt	0	2	4	WIP		--
40-025-4.prt	0	1	4	WIP		--
41-141.prt	0	3	4	Fabrication	x	MCWF POL BREAK BEARING PLATE
42c-082.prt	0	4	4	Fabrication		WASHER, .88 OD x .53 ID x .06 THK
42c-085.prt	0	1	4	Fabrication		3/8-16 UNC x 1 1/4 LG HEX SOC HD CAP SCREW
42c-249.prt	0	1	4	WIP		TYPE C LEADS TERMINAL
42c-250.prt	0	1	4	WIP		TYPE C LEADS TERMINAL
42c-259.asm	0	1	4	WIP		TYPE C LEADS TERMINAL
42c-049.prt	0	10	3	Fabrication	x	LEADS TERMINAL ASM JUMPERS INSULATOR
42c-069.prt	0	11	3	WIP		INSULATING SLEEVE
42c-222.prt	0	5	3	Fabrication		LEAD BLOCKS THREADED STUD

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Type-A Coil BOM Report

NO.	NAME	REV	VER	QTY	REL	DWG	DESCRIPTION
1	se142c-277.prt	0	2	752	Fabrication		WASHER, BELLEVILLE, 3/8 ID X 3/4 OD X.040 THK X .056 FREE HT
2	se142c-267.prt	0	2	188	Fabrication		BUTTONHEAD CAP SCREW, 1/4-20 UNC X .50 LG, 5/32 HEX DRIVE
3	se142c-275.prt	0	5	188	Fabrication	x	KEEPER, SCREW, SET
4	se142c-278.prt	1	0	188	WIP		WASHER, FLAT, .75 OD X .344 ID X .050 THK
5	se142c-276.prt	1	0	94	WIP		CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH 5/8
6	se142c-276-short.prt	0	0	94	WIP		CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH 5/8
7	temp_060924h.prt	0	2	94	WIP		PAD TOP OFWP
8	temp_061018a.prt	0	2	90	WIP		PAD TOP OFWP
9	ns151359.prt	0	10	54	Conceptual		1/2 BELLEVILLE WASHER SOLON #8F89718 3300 LBS
10	se142c-279.prt	0	2	47	Fabrication		SOCKET HD CAP SCREW, 3/8-16 UNC X 1.25 LG
11	se142c-294.prt	0	5	47	Fabrication	x	BUSHING, SPACER MODIFIED
12	se142c-270.asm	1	3	45	WIP	x	CLAMP ASSEMBLY
13	se142c-270_pads.asm	0	0	45	WIP		CLAMP ASSEMBLY
14	se142c-271.prt	0	8	45	Fabrication	x	BAR, CLAMP
15	se142c-188.prt	0	4	28	Fabrication		SCREW 1/4-20UNC X .75LNG SOC HD CAP
16	150262.prt	0	15	16	Conceptual		1/2-13 UNC STANDARD HEX NUT
17	se142c-012.prt	0	2	16	WIP		BRAZETYTE REDUCER UNION 5/16 TO 1/4 OD
18	se142c-059.prt	2	2	16	WIP	x	TYPE-C CABLE CONNECTOR
19	se142c-065.prt	0	6	16	WIP		.53 ID .875 OD .625 THK FLAT WASHER
20	150260.prt	0	15	15	Conceptual		3/8-16 UNC STANDARD HEX NUT
21	se141-034.prt	1	3	14	WIP		INS BUSHING, 1.6 OD X 1.4 ID X 1.7 LG
22	se141-060.prt	0	10	14	Fabrication		NUT, 12PT HEX 1.375-6UNC-2B
23	se142c-225.prt	0	4	13	WIP		FOGARTY LEADS MODEL 050625
24	se142c-014.prt	0	1	12	WIP		INSULATING SLEEVE
25	150741.prt	0	1	10	Conceptual		3/8-16 UNC x 1 LG HEX SOC HD CAP SCREW
26	se142c-013.prt	0	3	10	WIP		FIBER OPTIC STRAIN GAGE
27	se140-10ff-4.prt	0	1	8	WIP		COOLING TUBE UNION-BRAZETYTE
28	se140-220-3.prt	0	0	8	WIP		THERMOCOUPLE
29	se142a-226.prt	0	1	8	WIP		--
30	se141-036.prt	2	0	7	WIP		STUD, 1.375-6UNC-2A X 9.5 LG
31	se141-077.prt	2	0	7	WIP		SHIM INSULATING SLEEVE ALL TYPES
32	se142c-047_inserts.prt	0	1	7	WIP		TYPE-C JUMPERS BASE BLOCK
33	se142c-074.prt	0	1	7	WIP		TYPE-C JUMPERS BASE BLOCK
34	se142c-011.prt	0	1	6	WIP		COOLING TUBE CLAMP
35	se140-025-3.prt	0	2	4	WIP		--
36	se140-025-4.prt	0	1	4	WIP		--
37	se141-141.prt	0	3	4	Fabrication	x	MCWF POL BREAK BEARING PLATE
38	se142c-082.prt	0	4	4	Fabrication		WASHER, .88 OD x .53 ID x .06 THK
39	se142c-085.prt	0	1	4	Fabrication		3/8-16 UNC x 1 1/4 LG HEX SOC HD CAP SCREW
40	se142c-249.prt	0	1	4	WIP		TYPE C LEADS TERMINAL
41	se142c-250.prt	0	1	4	WIP		TYPE C LEADS TERMINAL
42	se142c-259.asm	0	1	4	WIP		TYPE C LEADS TERMINAL
43	se142c-049.prt	0	10	3	Fabrication	x	LEADS TERMINAL ASM JUMPERS INSULATOR
44	se142c-069.prt	0	11	3	WIP		INSULATING SLEEVE

Type-A Coil BOM Report(2)

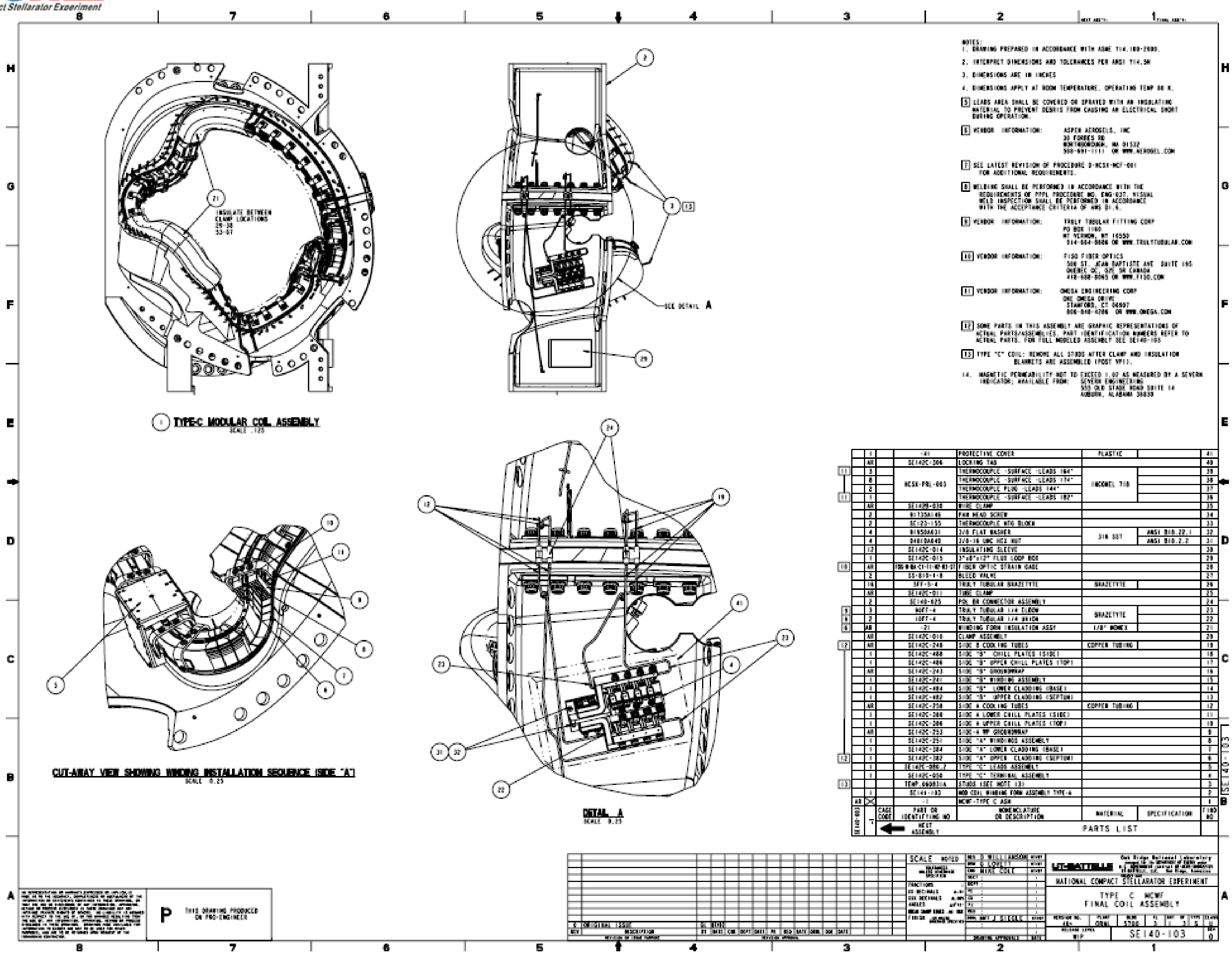
NCSX National Compact Stellarator Experiment

NO.	NAME	REV	VER	QTY	REL	DWG	DESCRIPTION
43	se142c-049.prt	0	10	3	Fabrication	x	LEADS TERMINAL ASM JUMPERS INSULATOR
44	se142c-069.prt	0	11	3	WIP		INSULATING SLEEVE
45	se142c-222.prt	0	5	3	Fabrication		LEAD BLOCKS THREADED STUD
46	02-06-chillplate-side-tube.prt	0	6	2	WIP		--
47	10ff-4.prt	0	8	2	WIP		--
48	90ff-4.prt	0	3	2	WIP		TRULY TUBULAR 1/4 ELBOW
49	se123-150-8.prt	0	3	2	Fabrication		#6-32 UNC X .38 LG TRUSS HEAD SCREW
50	se123-155.prt	0	8	2	Fabrication		THERMOCOUPLE MOUNT PLT,
51	se140-025-1.asm	0	4	2	WIP		PB CROSSOVER INSULATOR
52	se140-025-5.prt	0	2	2	WIP		--
53	se140-101_tc1.prt	0	2	2	WIP		SINGLE THERMOCOUPLE
54	se141-083.prt	3	0	2	WIP		INS SHEET, 3 X 26 X .063 THK
55	se141-125.prt	0	14	2	Fabrication		TYPE "A" LEADS BLOCK MOUNTS
56	se141-142.prt	0	4	2	Fabrication	x	MCWF POL BREAK BEARING PLATE
57	se142a-010_pat.prt	0	2	2	WIP		CLAMP_POSITION
58	se142a-083.prt	0	0	2	WIP		SCREW, 1/2-13UNC x 1LG LOW HEX HD SOC
59	se142a-084.prt	0	0	2	WIP		SCREW, 1/2-13UNC x 1LG LOW HEX HD SOC
60	se142a-183.prt	0	1	2	WIP		--
61	se142a-246-3.prt	0	4	2	WIP		
62	se142a-246-4.prt	0	2	2	WIP		
63	se142a-256-3.prt	0	3	2	WIP		
64	se142a-256-4.prt	0	4	2	WIP		
65	se142b-030.prt	0	0	2	WIP		WIRE CLAMP
66	se142c-254.prt	0	3	2	Fabrication	x	INSULATING PLATE
67	se142c-260.prt	0	1	2	Fabrication	x	SPACER, TEMPORARY
68	se142c-302.prt	0	9	2	WIP		BAR, CLAMP-MODIFIED
69	se142c-302-1.prt	0	3	2	WIP		BAR, CLAMP
70	se142c-303.asm	0	11	2	WIP		CLAMP ASSEMBLY
71	se142c-304.asm	0	2	2	WIP		SHORT CLAMP PADS
72	ss-810-1-8.prt	0	4	2	WIP		1/2 OD TUBE TO 1/2 NPT
73	_type_a_number_text.prt	0	1	1	WIP		
74	114_cut.prt	0	3	1	WIP		--
75	se140-101_wire1.prt	0	2	1	WIP		FIBER OPTIC STRAIN GAGE
76	se140-220-1.prt	0	0	1	WIP		THERMOCOUPLE
77	se140-220-2.prt	0	0	1	WIP		THERMOCOUPLE
78	se141-031.prt	2	0	1	Fabrication		INS SHEET, 15 X 32 X .063 THK
79	se141-033.prt	2	0	1	WIP		POLOIDAL BREAK SHIM TYPE-A
80	se141-035.prt	2	0	1	Fabrication		INS SHEET, 15 X 32 X .063 THK
81	se141-048.asm	2	0	1	Fabrication	x	POL BREAK SHIM ASSEMBLY TYPE-A
82	se141-101.asm	3	2	1	Fabrication	x	MOD COIL WINDING FORM ASSEMBLY TYPE-A
83	se141-114.prt	7	13	1	WIP	x	PRODUCTION WINDING FORM TYPE-A

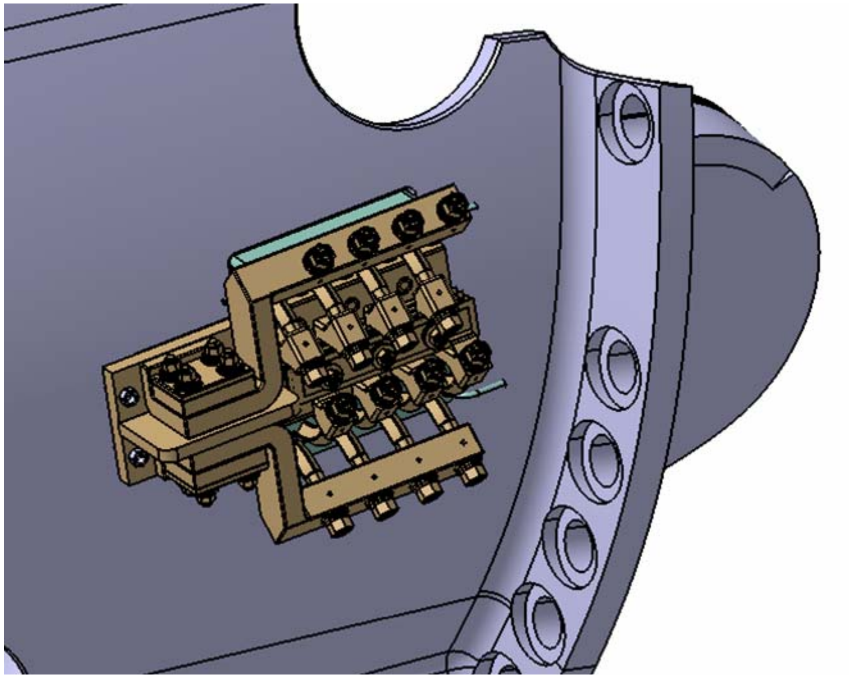
Type-A Coil BOM Report(3)

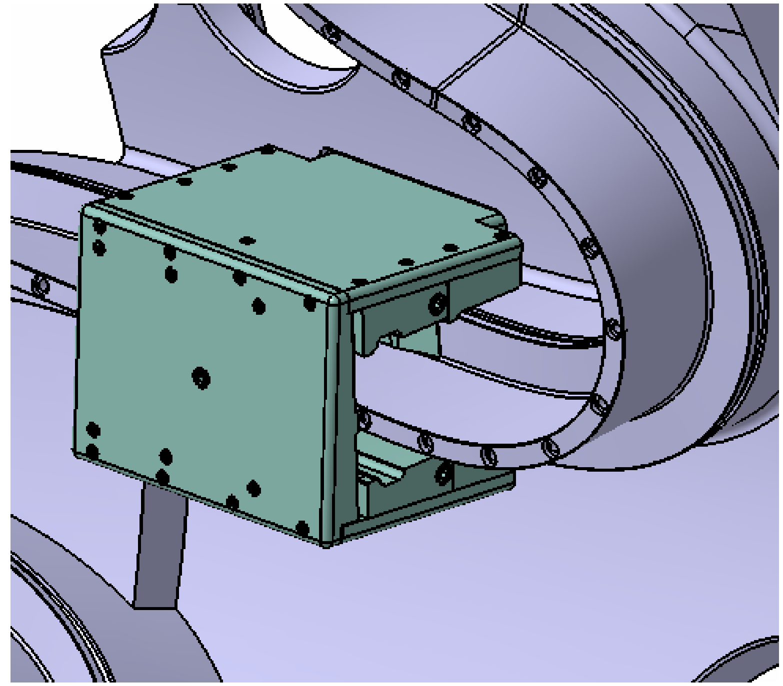
NO.	NAME	REV	VER	QTY	REL	DWG	DESCRIPTION
83	se141-114.prt	7	13	1	WIP	x	PRODUCTION WINDING FORM TYPE-A
84	se141-121-3.asm	0	4	1	WIP		
85	se142a-010.asm	0	3	1	WIP		CLAMP_POSITION
86	se142a-030.asm	0	2	1	WIP		
87	se142a-080.asm	0	31	1	WIP		--
88	se142a-121_weldments.prt	0	4	1	WIP		PRODUCTION WINDING FORM TYPE-A
89	se142a-134.prt	0	17	1	Fabrication	x	TYPE-A SIDE-A LOWER LEAD BLOCK
90	se142a-135.prt	0	17	1	Fabrication	x	TYPE-A SIDE-B LOWER LEAD BLOCK
91	se142a-136.prt	0	20	1	Fabrication	x	TYPE A SIDE A UPPER LEAD BLOCK
92	se142a-137.prt	0	19	1	Fabrication	x	TYPE A SIDE B UPPER LEAD BLOCK
93	se142a-140101_cut44.asm	0	12	1	WIP		
94	se142a-184.prt	0	6	1	Fabrication	x	TYPE "A" LEADS BLOCK TOP
95	se142a-220.prt	0	14	1	Fabrication	x	TYPE A SIDE A SIDE PLATE
96	se142a-221.prt	0	11	1	Fabrication	x	TYPE A SIDE B SIDE PLATE
97	se142a-235.prt	0	1	1	WIP		SCREW, 3/8-16UNC X 2.00 LNG SHCS
98	se142a-243.prt	0	1	1	Fabrication		TYPE-A SIDE-B WP GROUNDWRAP
99	se142a-243_cut44.prt	0	3	1	WIP		TYPE-A SIDE-B WP GROUNDWRAP
100	se142a-244-3.prt	0	0	1	WIP		
101	se142a-244-4.prt	0	0	1	WIP		
102	se142a-248.prt	1	10	1	WIP		TYPE-A SIDE-B TUBING
103	se142a-253.prt	0	0	1	Fabrication		TYPE-A SIDE-A WP GROUNDWRAP
104	se142a-253_cut44.prt	0	2	1	WIP		TYPE-A SIDE-A WP GROUNDWRAP
105	se142a-254-3.prt	0	0	1	WIP		
106	se142a-254-4.prt	0	0	1	WIP		
107	se142a-258.prt	1	11	1	WIP		TYPE-A SIDE-A CHILL PLATE TUBING
108	se142a-285.prt	0	0	1	WIP		FIXTURE ALIGNMENT BUSHING
109	se142a-bag_wrap.prt	0	4	1	WIP		TYPE "A" BAG AND WRAP
110	se142a-term_tube_a.prt	0	3	1	WIP		
111	se142a-term_tube_b.prt	0	3	1	WIP		
112	se142c-015.prt	0	0	1	WIP		--
113	se142c-045.prt	0	7	1	WIP		TYPE C TERMINAL LEADS CONNECTOR
114	se142c-046.prt	0	4	1	WIP		--
115	se142c-047.prt	1	2	1	WIP		TYPE-C JUMPERS BASE BLOCK
116	se142c-050.asm	1	12	1	WIP	x	TYPE-C LEADS TERMINAL ASSEMBLY
117	se142c-051.prt	1	3	1	Fabrication	x	TYPE-C TERMINAL JUMPER #1
118	se142c-052.prt	1	2	1	Fabrication	x	TYPE-C TERMINAL JUMPER #2
119	se142c-053.prt	1	2	1	Fabrication	x	TYPE-C TERMINAL JUMPER #3
120	se142c-054.prt	1	3	1	Fabrication	x	TYPE-C TERMINAL JUMPER #4
121	se142c-055.prt	1	4	1	WIP	x	TYPE-C SHORT TERMINAL LUG
122	se142c-056.prt	1	5	1	WIP	x	TYPE-C LONG TERMINAL LUG
123	se142c-072.prt	0	2	1	WIP		LEADS TERMINAL ASM KAPTON TAPE
124	se142c-073.prt	0	3	1	WIP		TYPE-C LEADS TERMINAL INSULATOR
125	se142c-211.prt	1	2	1	Fabrication	x	LEADS TERMINAL ASM INSUL SHEET
126	se142c-212.prt	1	4	1	Fabrication	x	LEADS TERMINAL ASM INSUL SPACER
127	se142c-306.prt	0	1	1	WIP		LOCKING TAB

Type-C Coil Assembly (SE140-103)



Type-C Coil Assembly (SE140-103)



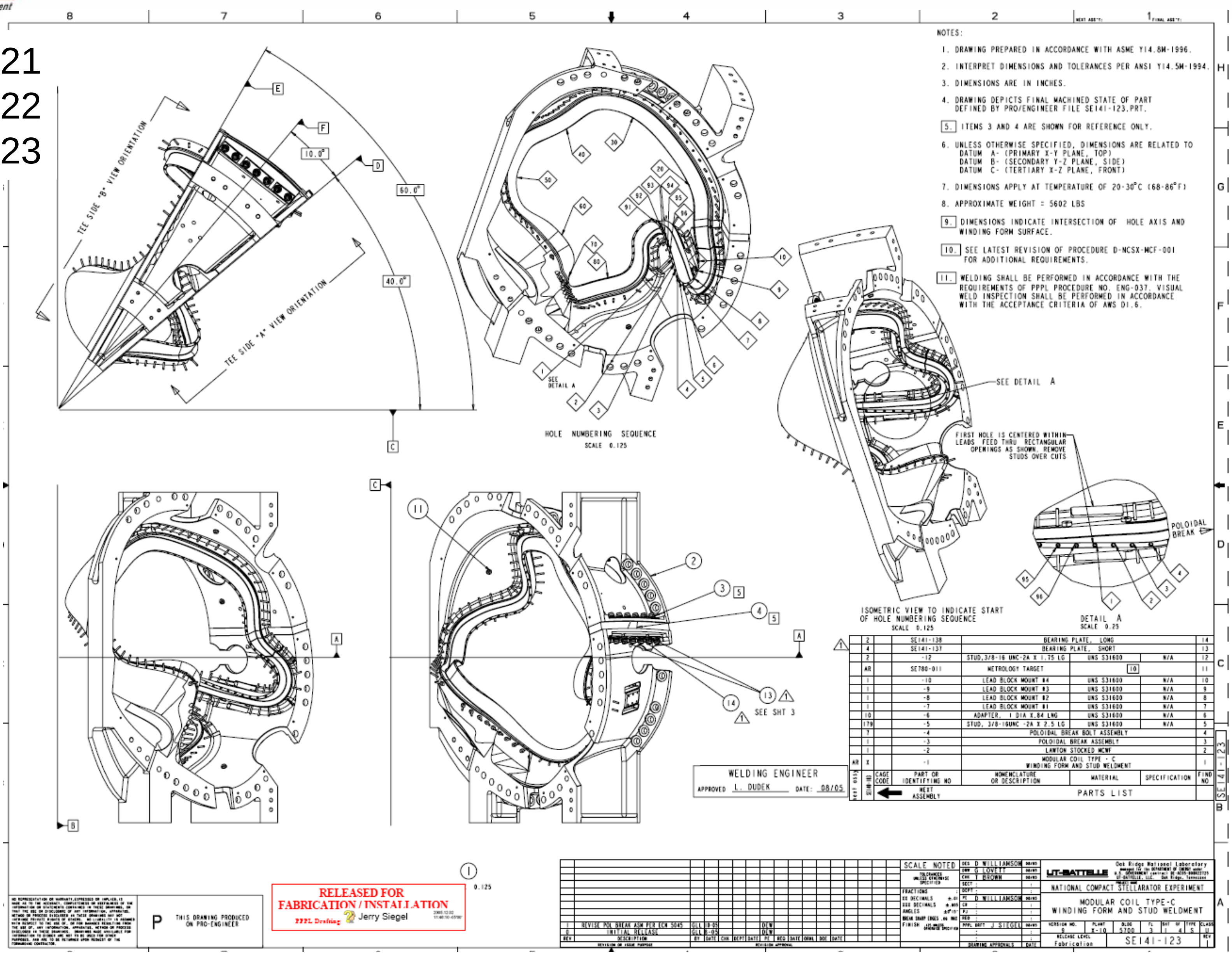


Flag		QTY	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		AR		SE142C-253	SIDE "A" WP GROUNDWRAP			9
		1		SE142C-251	SIDE "A" WINDINGS ASSEMBLY			8
		1		SE142C-384	SIDE "A" LOWER CLADDING (BASE)			7
12		1		SE142C-382	SIDE "A" UPPER CLADDING (SEPTUM)			6
		1		SE142C-080_2	TYPE "C" LEADS ASSEMBLY			5
		1		SE142C-050	TYPE "C" TERMINAL ASSEMBLY			4
13				TEMP_060831A	STUDS (SEE NOTE 13)			3
		1		SE141-103	MOD COIL WINDING FORM ASSEMBLY TYPE-A			2
	AR	X		-1	MCWF-TYPE C ASM			1
	SE140-003	-1	NEXT ASSEMBLY		PARTS LIST			

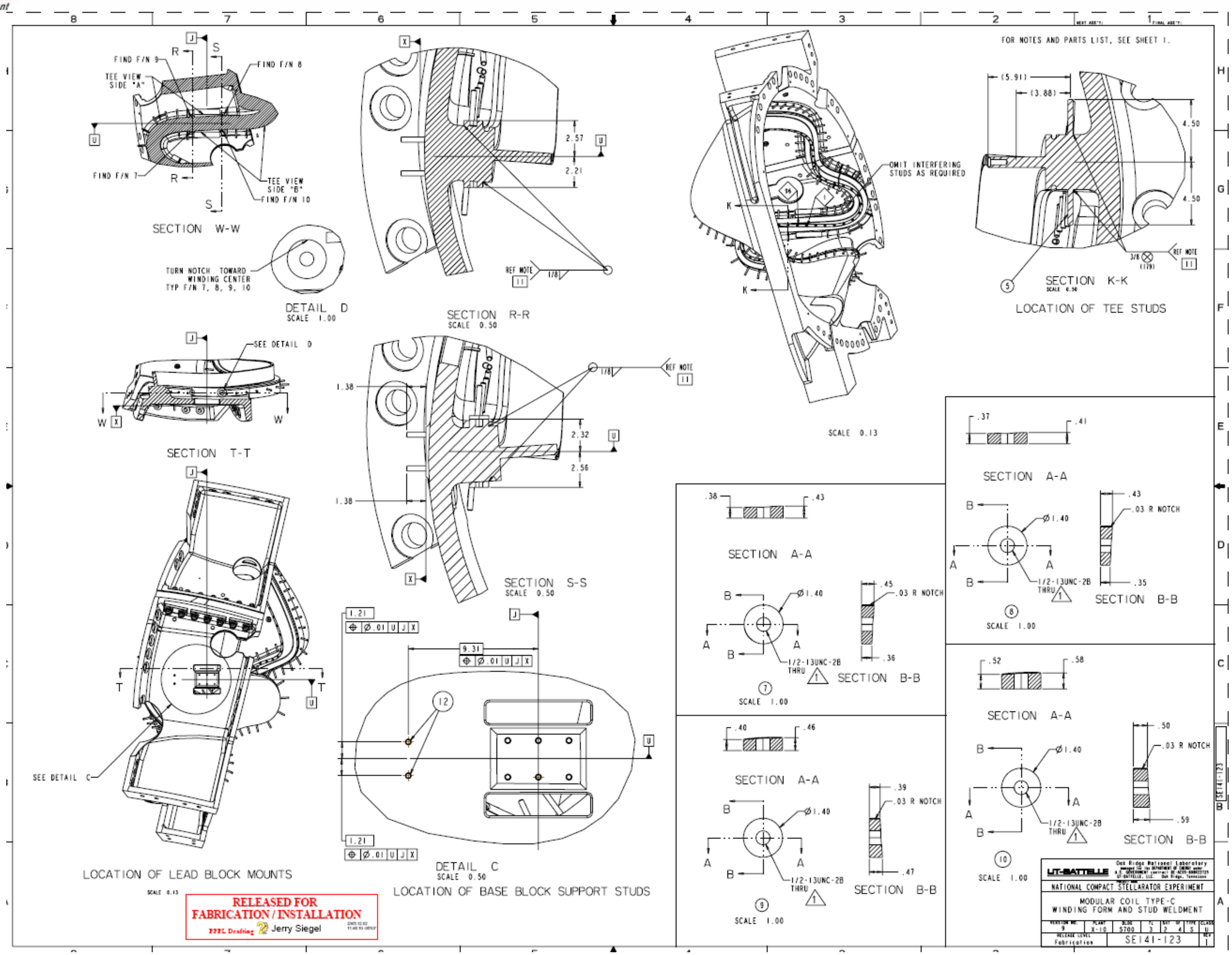
Type-C Winding Form Mods – Pre-Winding

NCSX National Compact Stellarator Experiment

SE141-121
SE141-122
SE141-123



Type-C Winding Form Mods – Pre-Winding



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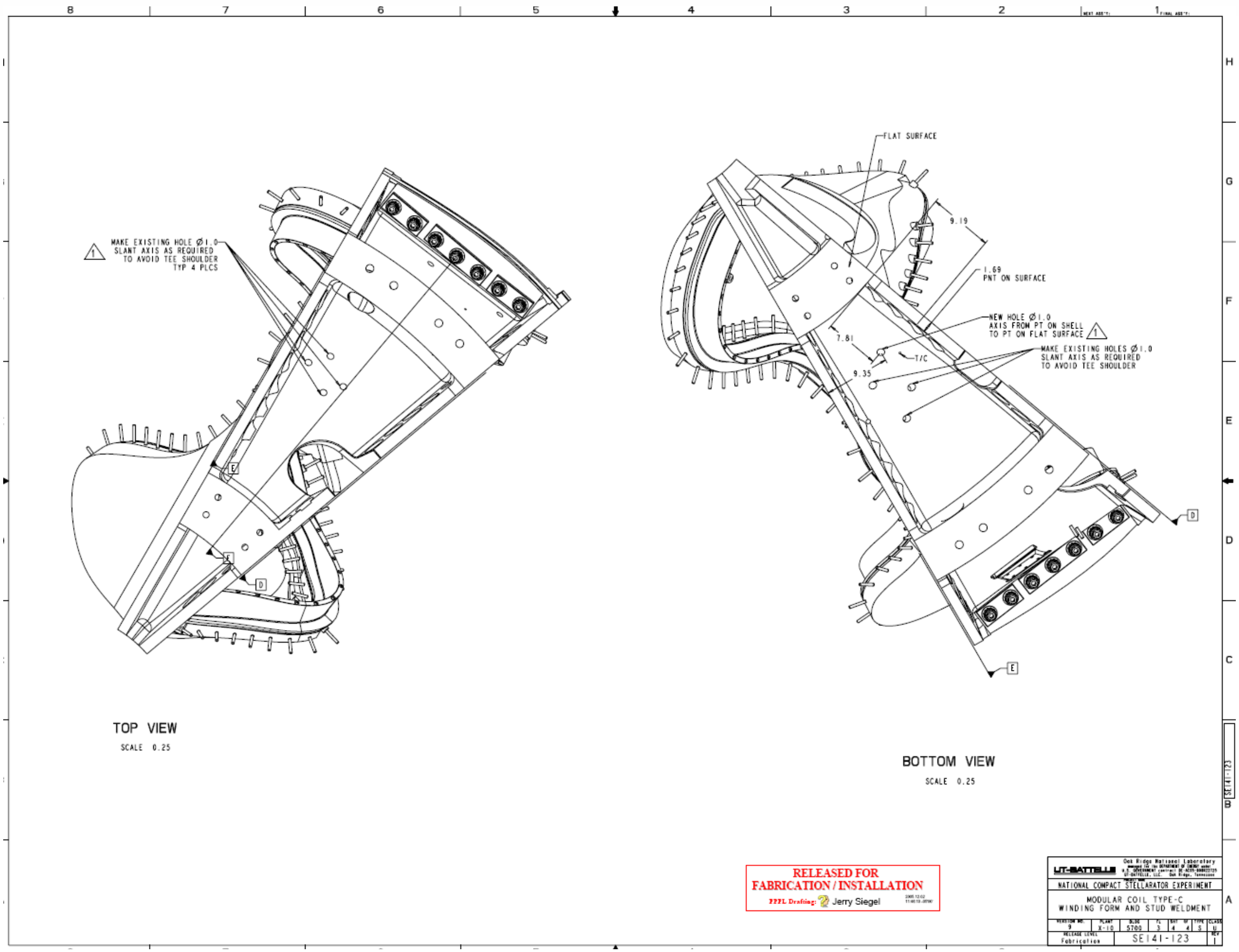
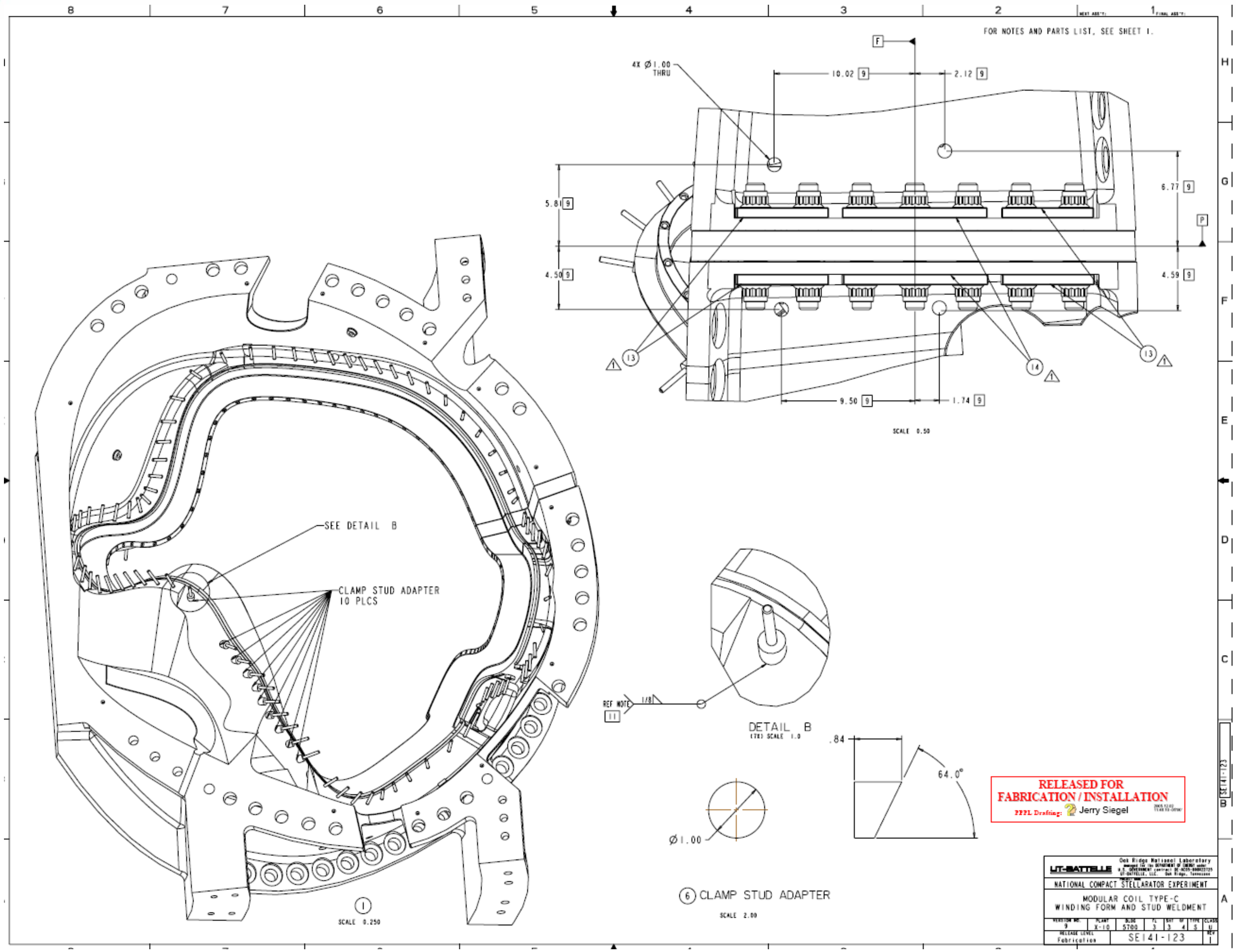
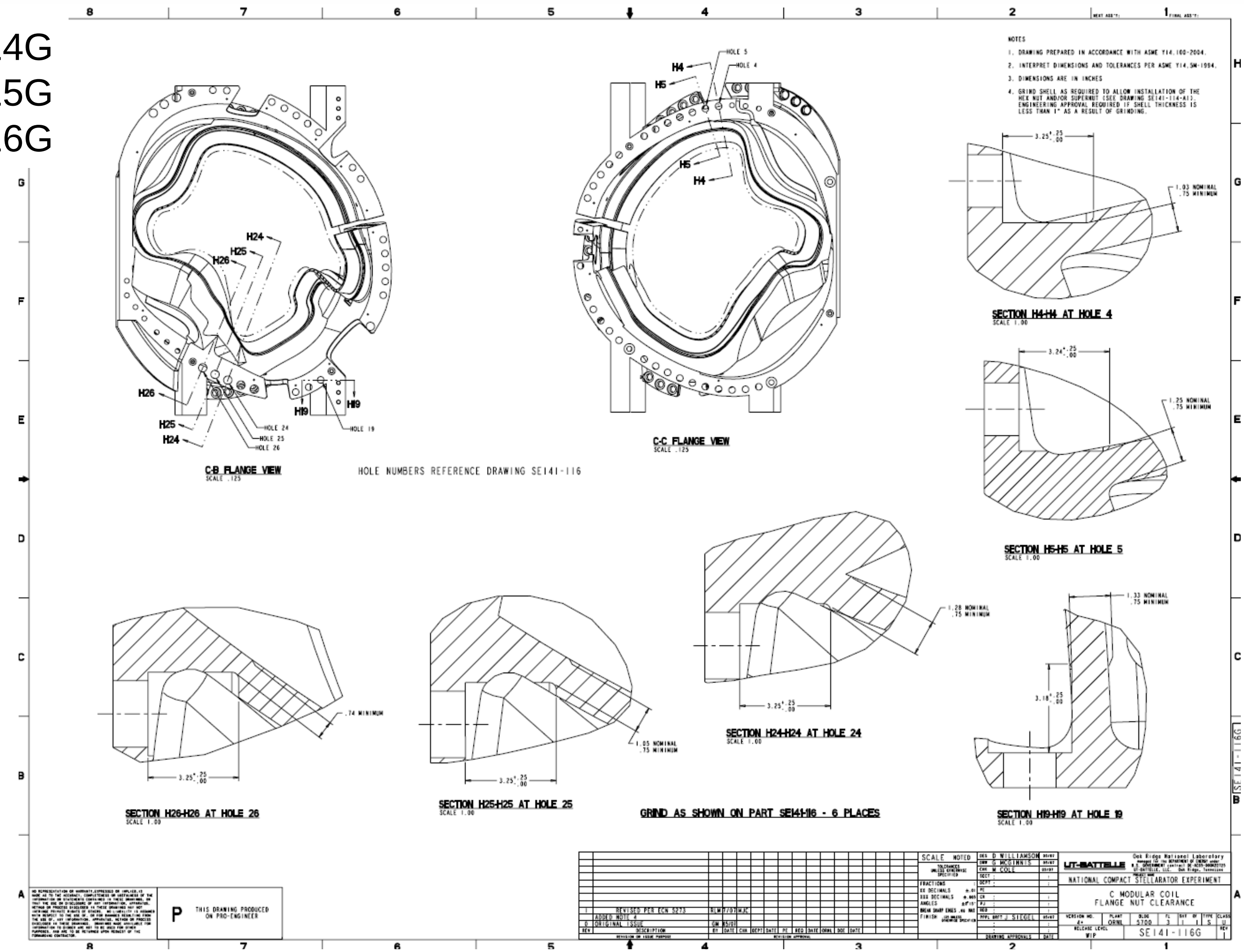


Type-C Winding Form Mods – Pre-Winding

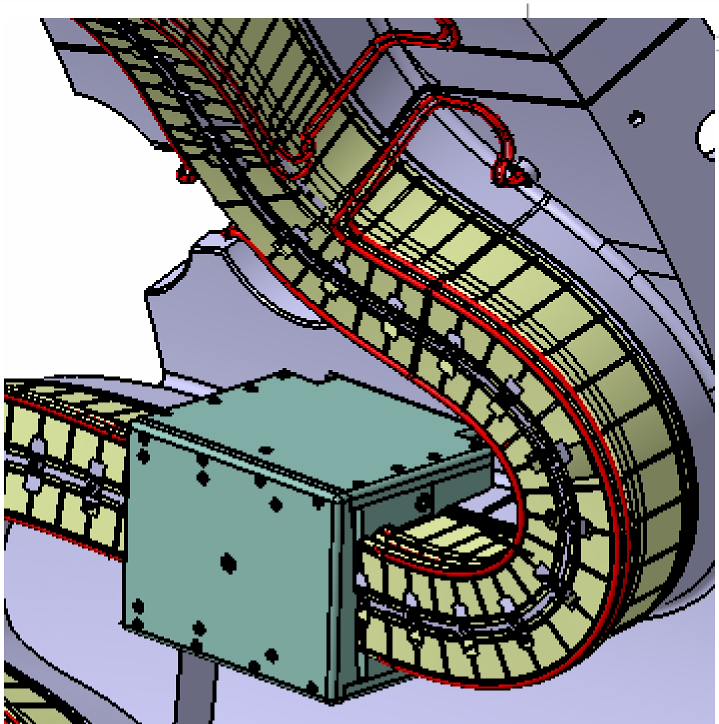


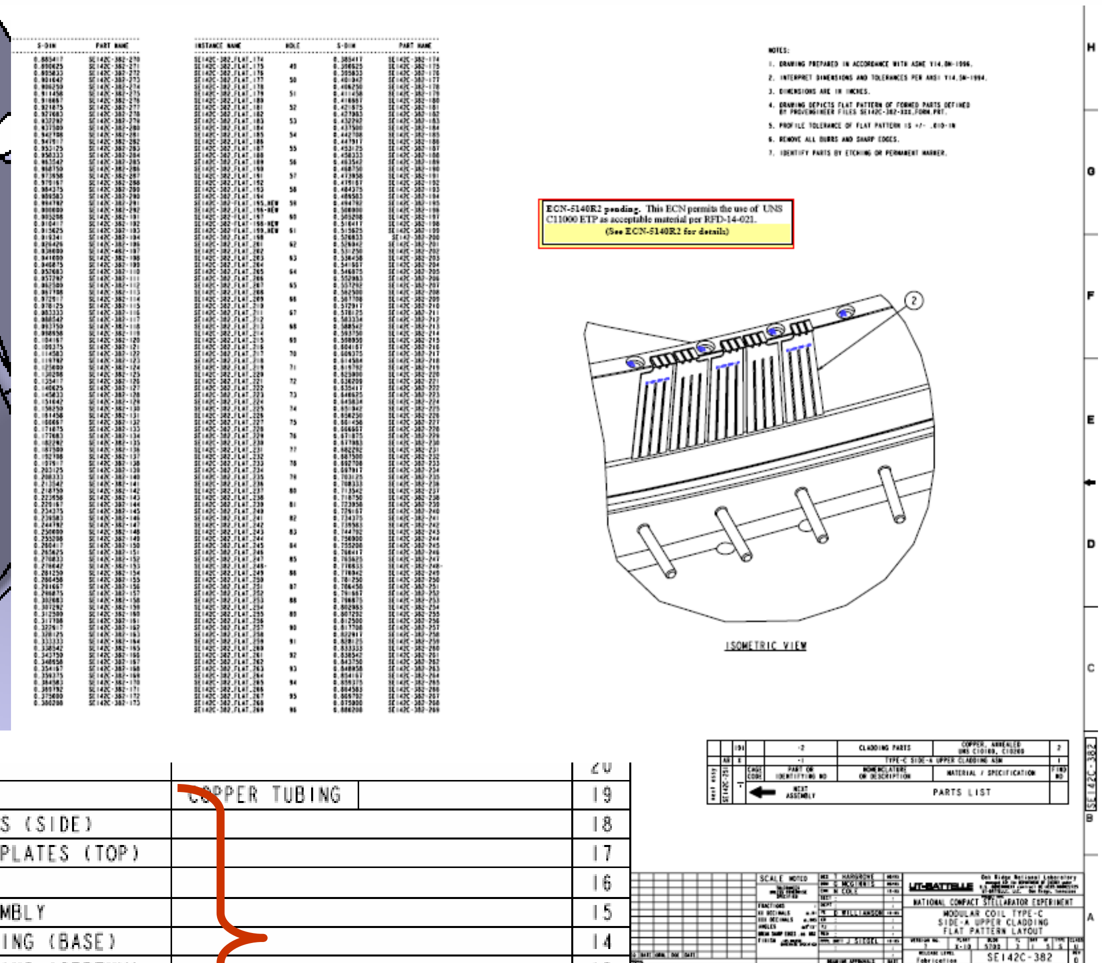
Type-C Winding Form Mods – Post-Winding

SE141-114G
SE141-115G
SE141-116G



Type-C Coil Assembly (SE140-103)

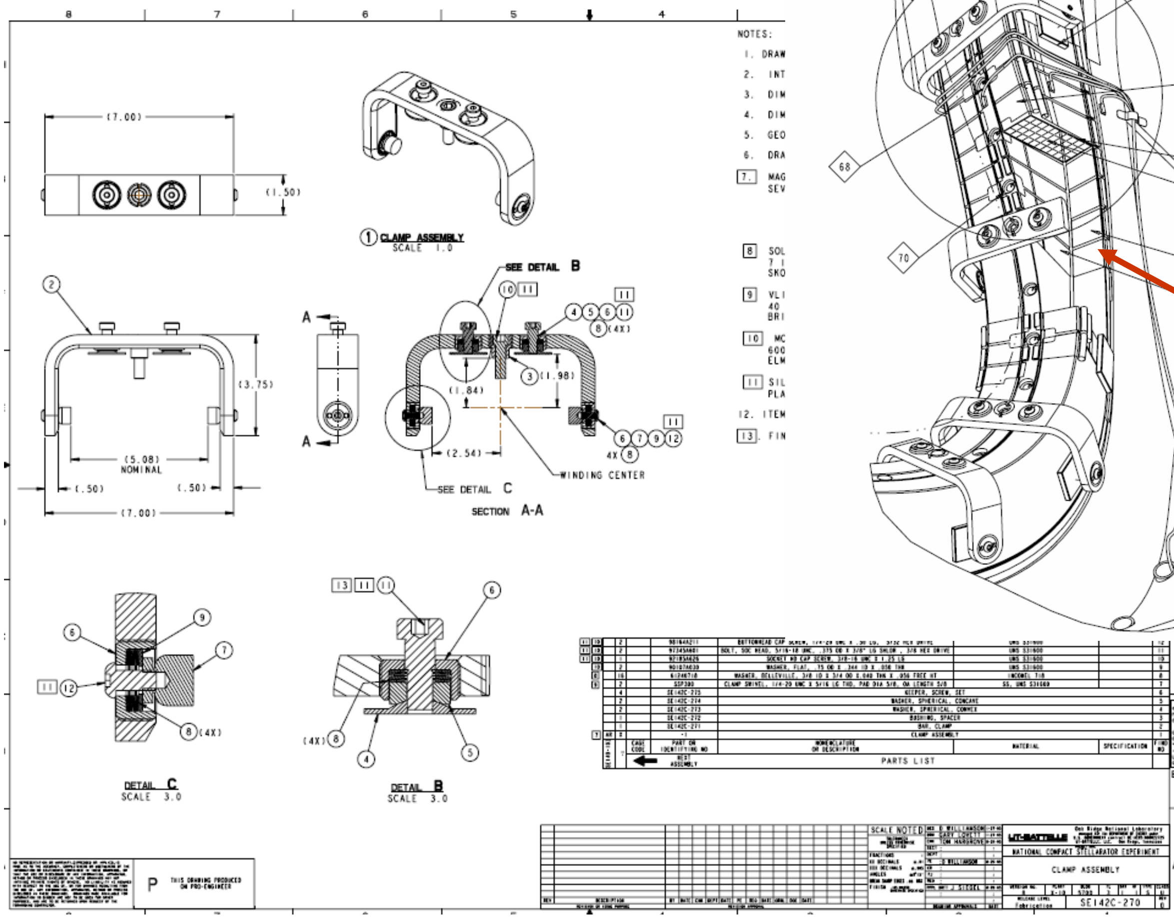


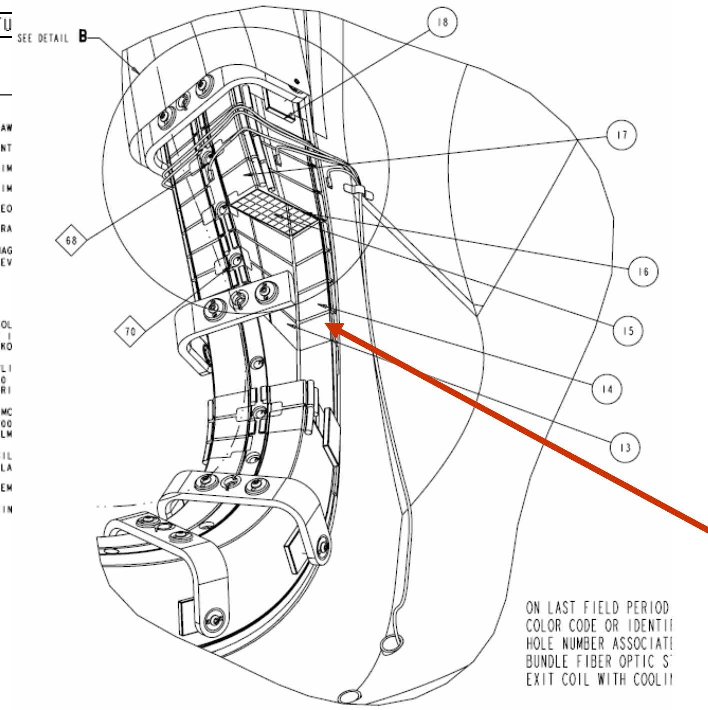


	AR	SE142C-010	CLAMP ASSEMBLY		20
12	AR	SE142C-248	SIDE B COOLING TUBES	COPPER TUBING	19
	1	SE142C-488	SIDE "B" CHILL PLATES (SIDE)		18
	1	SE142C-486	SIDE "B" UPPER CHILL PLATES (TOP)		17
	AR	SE142C-243	SIDE "B" GROUNDWRAP		16
	1	SE142C-241	SIDE "B" WINDING ASSEMBLY		15
	1	SE142C-484	SIDE "B" LOWER CLADDING (BASE)		14
	1	SE142C-482	SIDE "B" UPPER CLADDING (SEPTUM)		13
	AR	SE142C-258	SIDE A COOLING TUBES	COPPER TUBING	12
	1	SE142C-388	SIDE A LOWER CHILL PLATES (SIDE)		11
	1	SE142C-386	SIDE A UPPER CHILL PLATES (TOP)		10
	AR	SE142C-253	SIDE-A WP GROUNDWRAP		9
	1	SE142C-251	SIDE "A" WINDINGS ASSEMBLY		8
	1	SE142C-384	SIDE "A" LOWER CLADDING (BASE)		7
12	1	SE142C-382	SIDE "A" UPPER CLADDING (SEPTUM)		6
	1	SE142C-080_2	TYPE "C" LEADS ASSEMBLY		5

Type-C Coil Assembly (SE140-103)

10	AR	FOS-N-BA-CI-FI-MZ-R3-ST	FIBER OPTIC STRAIN GAGE		28
	2	SS-810-1-8	BLEED VALVE		27
	16	5FF-5-4	TRULY TUBULAR BRAZETYTE	BRAZETYTE	26
	AR	SE142C-011	TUBE CLAMP		25
	2	SE140-025	POL BR CONNECTOR ASSEMBLY		24
9	3	90FF-4	TRULY TUBULAR 1/4 ELBOW	BRAZETYTE	23
9	2	10FF-4	TRULY TUBULAR 1/4 UNION	BRAZETYTE	22
6	AR	-21	WINDING FORM INSULATION ASSY	1/8" NOMEX	21
	AR	SE142C-010	CLAMP ASSEMBLY		[illegible]
12	AR	SE142C-248	SIDE B COOLING TUBES	COPPER TU	
	1	SE142C-488	SIDE "B" CHILL PLATES (SIDE)		

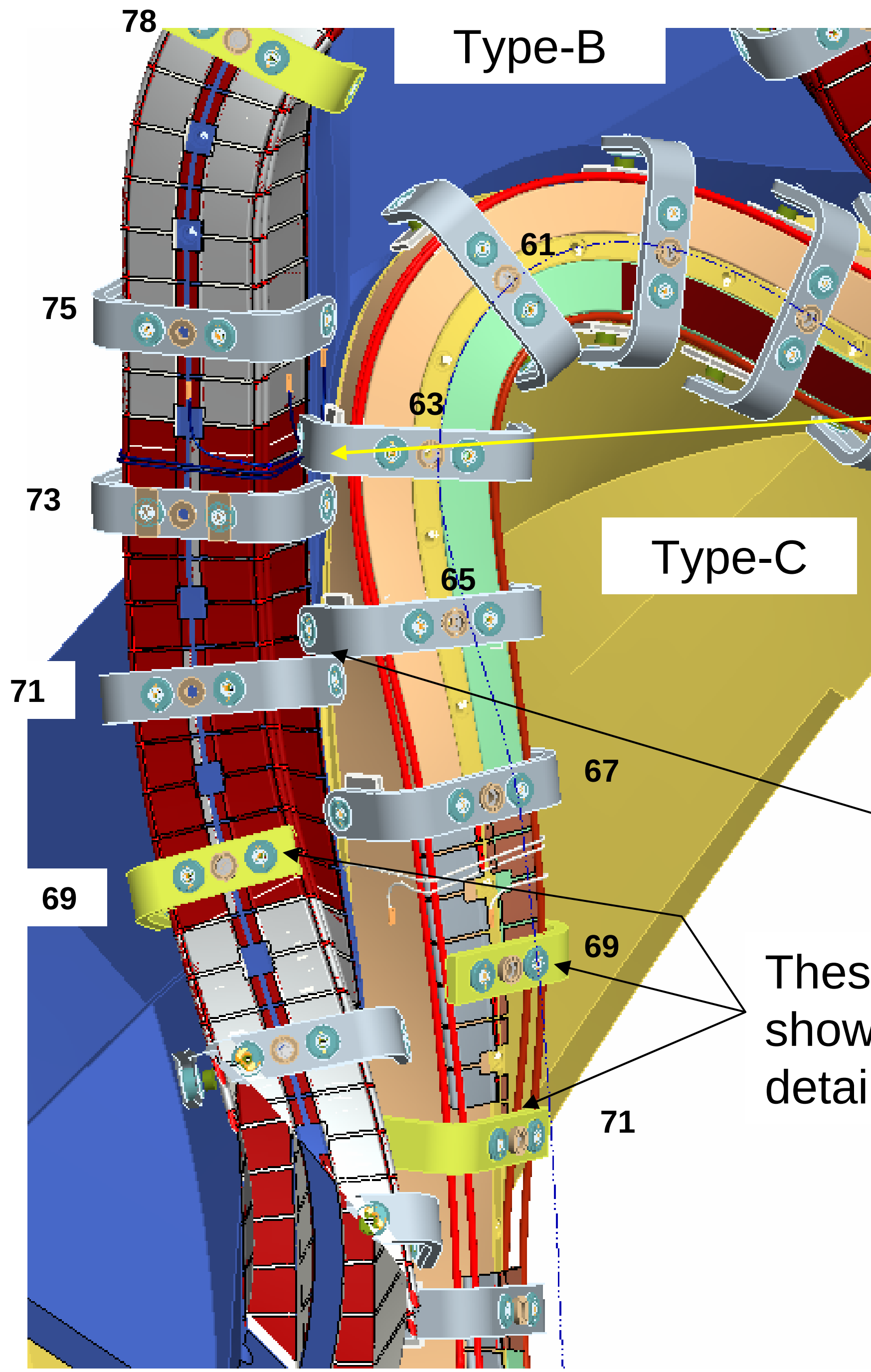


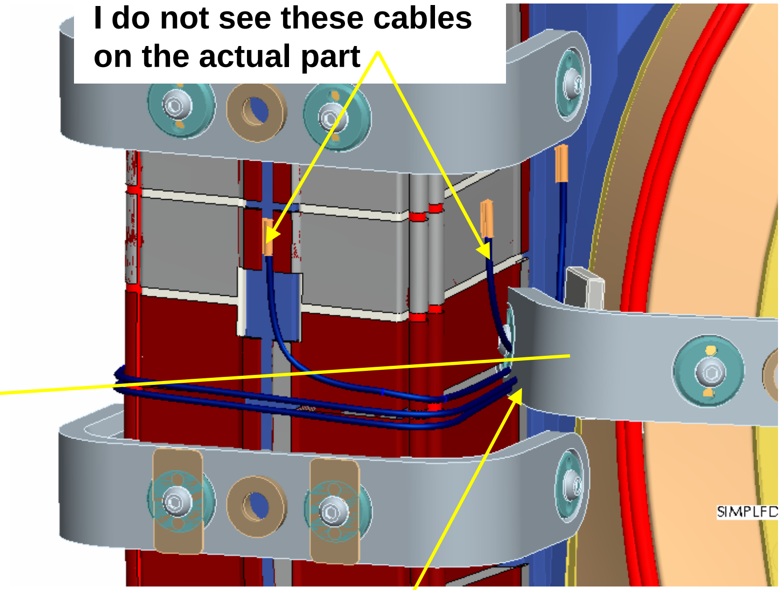


CLAMP CHART

NO.	HOLE NO.	CLAMP ASSEMBLY
1	04	SE142C-270
2	06	SE142C-270
3	09	SE142C-270
4	11	SE142C-270
5	13	SE142C-270
6	16	SE142C-270
7	18	SE142C-270
8	20	SE142C-270
9	22	SE142C-270
10	24	SE142C-270
11	26	SE142C-270
12	29	SE142C-270
13	31	SE142C-270
14	33	SE142C-270
15	35	SE142C-270
16	37	SE142C-270
17	39	SE142C-270
18	41	SE142C-270
19	43	SE142C-270
20	45	SE142C-270
21	47	SE142C-270
22	49	SE142C-270
23	51	SE142C-270
24	53	SE142C-270
25	55	SE142C-270
26	57	SE142C-270
27	59	SE142C-270
28	61	SE142C-270
29	63	SE142C-303
30	65	SE142C-303
31	67	SE142C-270
32	69	SE142C-303
33	71	SE142C-303
34	73	SE142C-270
35	75	SE142C-270
36	77	SE142C-270
37	79	SE142C-270
38	81	SE142C-270
39	83	SE142C-270
40	85	SE142C-270
41	87	SE142C-270
42	90	SE142C-270
43	92	SE142C-270
44	94	SE142C-270

B-to-C Fit-up





This clamp interferes with the Type-B winding

There is only .038” clearance between these clamps…too close.

These three clamps are shown cut and reflect model details as of 7/23/07

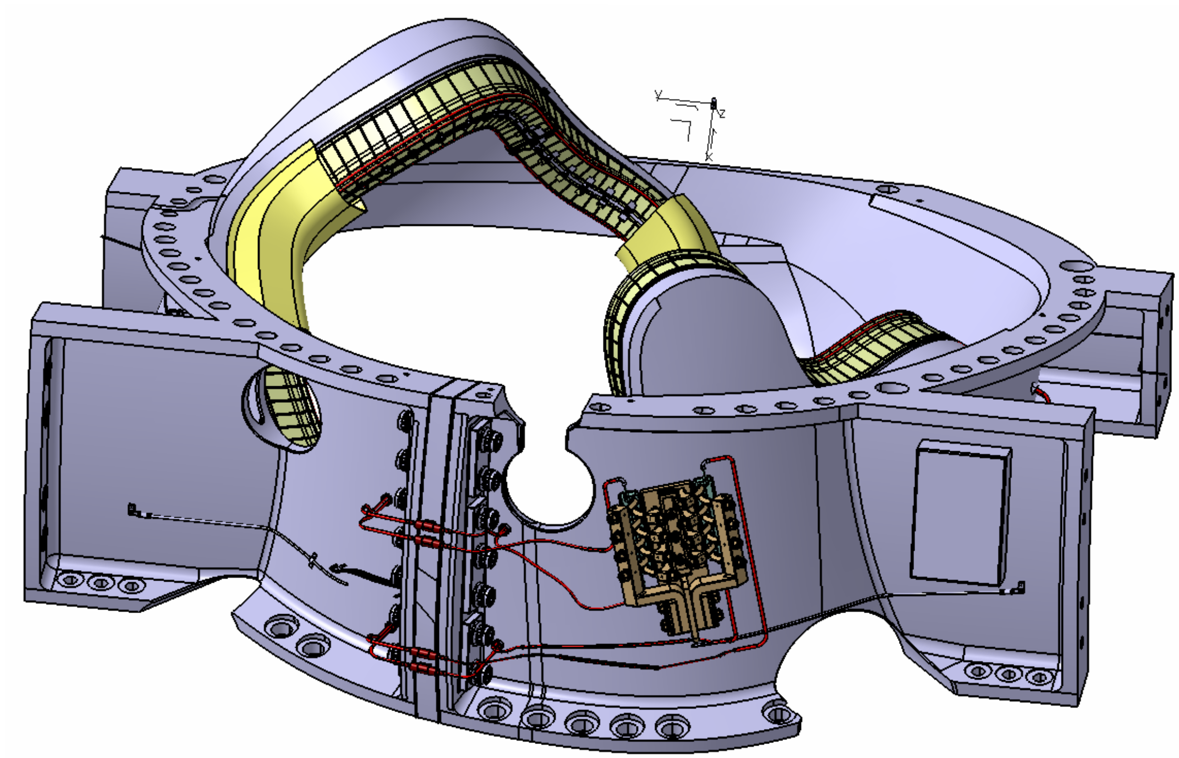
Tom Brown 7/23/07

Type-C Coil Assembly (SE140-103)

	Qty	Part No.	Description	Material	Spec	Item
	1	-41	PROTECTIVE COVER	PLASTIC		41
	AR	SE142C-306	LOCKING TAB			40
11	3	NCSX-PRL-003	THERMOCOUPLE -SURFACE -LEADS 164"	INCONEL 718		39
	8		THERMOCOUPLE -SURFACE -LEADS 174"			38
	2		THERMOCOUPLE PLUG -LEADS 144"			37
11	1		THERMOCOUPLE -SURFACE -LEADS 182"			36
	AR	SE142B-030	WIRE CLAMP			35
	2	91735A146	PAN HEAD SCREW			34
	2	SE123-155	THERMOCOUPLE MTG BLOCK			33
	4	91950A031	3/8 FLAT WASHER	316 SST	ANSI B18.22.1	32
	4	94819A049	3/8-16 UNC HEX NUT		ANSI B18.2.2	31
	12	SE142C-014	INSULATING SLEEVE			30
	1	SE142C-015	3"x8"x12" FLUX LOOP BOX			29
10	AR	FOS-N-BA-C1-F1-M2-R3-ST	FIBER OPTIC STRAIN GAGE			28
	2	SS-810-1-8	BLEED VALVE			27
	16	5FF-5-4	TRULY TUBULAR BRAZETYTE	BRAZETYTE		26
	AR	SE142C-011	TUBE CLAMP			25
	2	SE140-025	POL BR CONNECTOR ASSEMBLY			24
9	3	90FF-4	TRULY TUBULAR 1/4 ELBOW	BRAZETYTE		23
9	2	10FF-4	TRULY TUBULAR 1/4 UNION			22
6	AR	-21	WINDING FORM INSULATION ASSY	1/8" NOMEX		21
	AR	SE142C-010	CLAMP ASSEMBLY			20

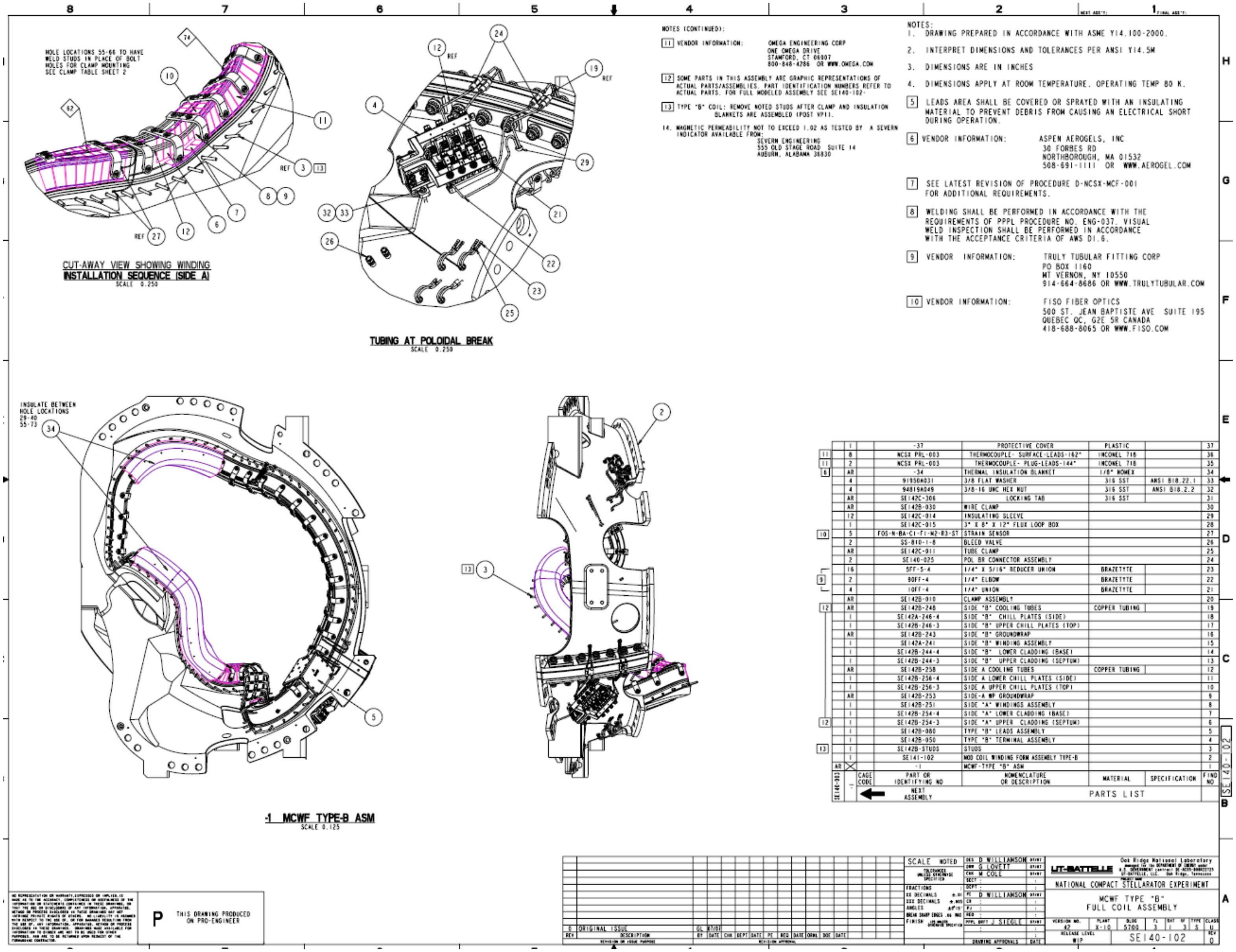
THERMOCOUPLE CHART

NO.	LABEL	LOCATION	LEAD LENGTH TO BUNDLE AT "A" COIL (IN)
1	TC-C01	OUTBOARD LOWER SUPPORT	182
2	TC-C02	OUTBOARD T/C HOLE	144
3	TC-C03	OUTBOARD T/C HOLE (DUPLICATE)	144
4	TC-C04	OUTBOARD UPPER SUPPORT	164
5	TC-C05	COOLING LINE OUTLET 1	174
6	TC-C06	COOLING LINE OUTLET 2	174
7	TC-C07	COOLING LINE OUTLET 3	174
8	TC-C08	COOLING LINE OUTLET 4	174
9	TC-C09	COOLING LINE OUTLET 5	174
10	TC-C10	COOLING LINE OUTLET 6	174
11	TC-C11	COOLING LINE OUTLET 7	174
12	TC-C12	COOLING LINE OUTLET 8	174
13	TC-C13	LEADS	164
14	TC-C14	LEADS	164



Type-B Coil Assembly (SE140-102)

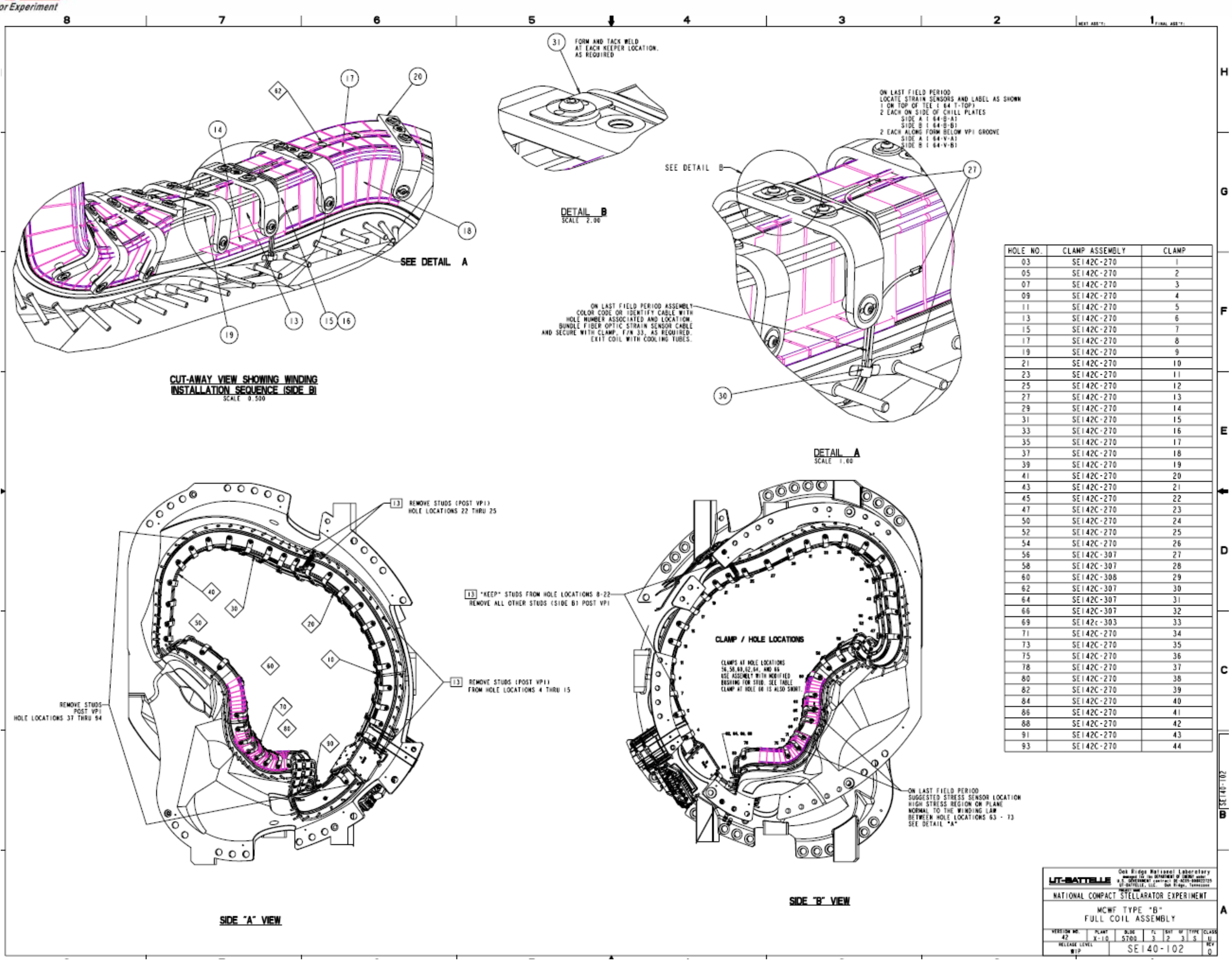
NCSX National Compact Stellarator Experiment



Note	SE140-003	-1	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		1		-37	PROTECTIVE COVER	PLASTIC		37
11		8		NCSX PRL-003	THERMOCOUPLE- SURFACE-LEADS-162"	INCONEL 718		36
11		2		NCSX PRL-003	THERMOCOUPLE- PLUG-LEADS-144"	INCONEL 718		35
6		AR		-34	THERMAL INSULATION BLANKET	1/8" NOMEX		34
		4		91950A031	3/8 FLAT WASHER	316 SST	ANSI B18.22.1	33
		4		94819A049	3/8-16 UNC HEX NUT	316 SST	ANSI B18.2.2	32
		AR		SE142C-306	LOCKING TAB	316 SST		31
		AR		SE142B-030	WIRE CLAMP			30
		12		SE142C-014	INSULATING SLEEVE			29
		1		SE142C-015	3" X 8" X 12" FLUX LOOP BOX			28
10		5		FOS-N-BA-C1-F1-M2-R3-ST	STRAIN SENSOR			27
		2		SS-810-1-8	BLEED VALVE			26
		AR		SE142C-011	TUBE CLAMP			25
		2		SE140-025	POL BR CONNECTOR ASSEMBLY			24
9		16		5FF-5-4	1/4" X 5/16" REDUCER UNION	BRAZETYTE		23
9		2		90FF-4	1/4" ELBOW	BRAZETYTE		22
9		4		10FF-4	1/4" UNION	BRAZETYTE		21
		AR		SE142B-010	CLAMP ASSEMBLY			20
12		AR		SE142B-248	SIDE "B" COOLING TUBES	COPPER TUBING		19
		1		SE142A-246-4	SIDE "B" CHILL PLATES (SIDE)			18
		1		SE142B-246-3	SIDE "B" UPPER CHILL PLATES (TOP)			17
		AR		SE142B-243	SIDE "B" GROUNDWRAP			16
		1		SE142A-241	SIDE "B" WINDING ASSEMBLY			15
		1		SE142B-244-4	SIDE "B" LOWER CLADDING (BASE)			14
		1		SE142B-244-3	SIDE "B" UPPER CLADDING (SEPTUM)			13
		AR		SE142B-258	SIDE A COOLING TUBES	COPPER TUBING		12
		1		SE142B-256-4	SIDE A LOWER CHILL PLATES (SIDE)			11
		1		SE142B-256-3	SIDE A UPPER CHILL PLATES (TOP)			10
		AR		SE142B-253	SIDE-A WP GROUNDWRAP			9
		1		SE142B-251	SIDE "A" WINDINGS ASSEMBLY			8
		1		SE142B-254-4	SIDE "A" LOWER CLADDING (BASE)			7
12		1		SE142B-254-3	SIDE "A" UPPER CLADDING (SEPTUM)			6
		1		SE142B-080	TYPE "B" LEADS ASSEMBLY			5
		1		SE142B-050	TYPE "B" TERMINAL ASSEMBLY			4
13		1		SE142B-STUDS	STUDS			3
		1		SE141-102	MOD COIL WINDING FORM ASSEMBLY TYPE-B			2
	AR	X		-1	MCWF-TYPE "B" ASM			1
	NEXT ASSEMBLY				PARTS LIST			

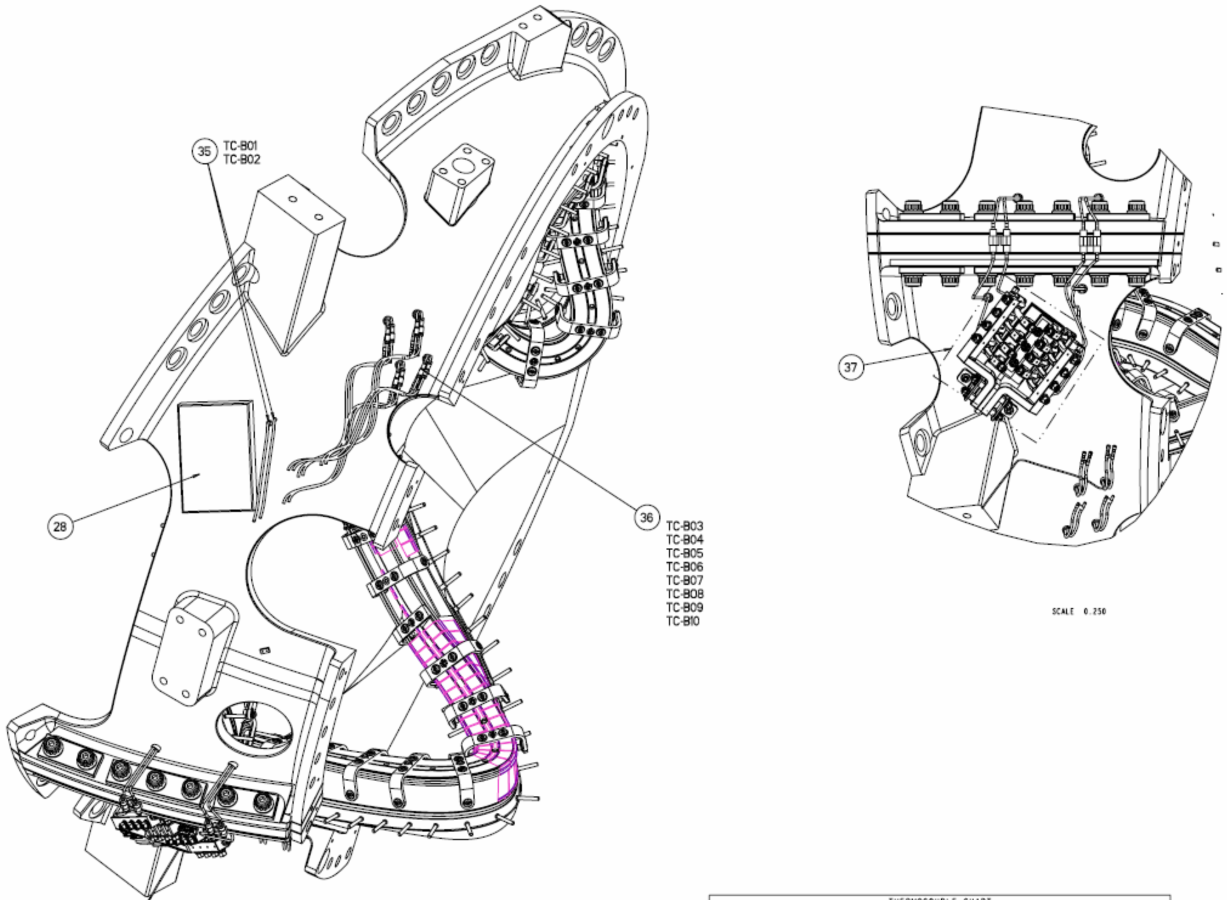
Type-B Coil Assembly (SE140-102)

NCSX National Compact Stellarator Experiment



HOLE NO.	CLAMP ASSEMBLY	CLAMP
03	SE142C-270	1
05	SE142C-270	2
07	SE142C-270	3
09	SE142C-270	4
11	SE142C-270	5
13	SE142C-270	6
15	SE142C-270	7
17	SE142C-270	8
19	SE142C-270	9
21	SE142C-270	10
23	SE142C-270	11
25	SE142C-270	12
27	SE142C-270	13
29	SE142C-270	14
31	SE142C-270	15
33	SE142C-270	16
35	SE142C-270	17
37	SE142C-270	18
39	SE142C-270	19
41	SE142C-270	20
43	SE142C-270	21
45	SE142C-270	22
47	SE142C-270	23
50	SE142C-270	24
52	SE142C-270	25
54	SE142C-270	26
56	SE142C-307	27
58	SE142C-307	28
60	SE142C-308	29
62	SE142C-307	30
64	SE142C-307	31
66	SE142C-307	32
69	SE142c-303	33
71	SE142C-270	34
73	SE142C-270	35
75	SE142C-270	36
78	SE142C-270	37
80	SE142C-270	38
82	SE142C-270	39
84	SE142C-270	40
86	SE142C-270	41
88	SE142C-270	42
91	SE142C-270	43
93	SE142C-270	44

Type-B Coil Assembly (SE140-102)



THERMOCOUPLE CHART			
NO.	LABEL	LOCATION	LEAD LENGTH TO BUNDLE @ COIL "A" (IN)
1	TC-B01	INBOARD T/C HOLE	144
2	TC-B02	INBOARD T/C HOLE (DUPLICATE)	144
3	TC-B03	COOLING LINE OUTLET 1	162
4	TC-B04	COOLING LINE OUTLET 2	162
5	TC-B05	COOLING LINE OUTLET 3	162
6	TC-B06	COOLING LINE OUTLET 4	162
7	TC-B07	COOLING LINE OUTLET 5	162
8	TC-B08	COOLING LINE OUTLET 6	162
9	TC-B09	COOLING LINE OUTLET 7	162
10	TC-B10	COOLING LINE OUTLET 8	162

UT-BATTELLE — Oak Ridge National Laboratory

NATIONAL COMPACT STELLARATOR EXPERIMENT

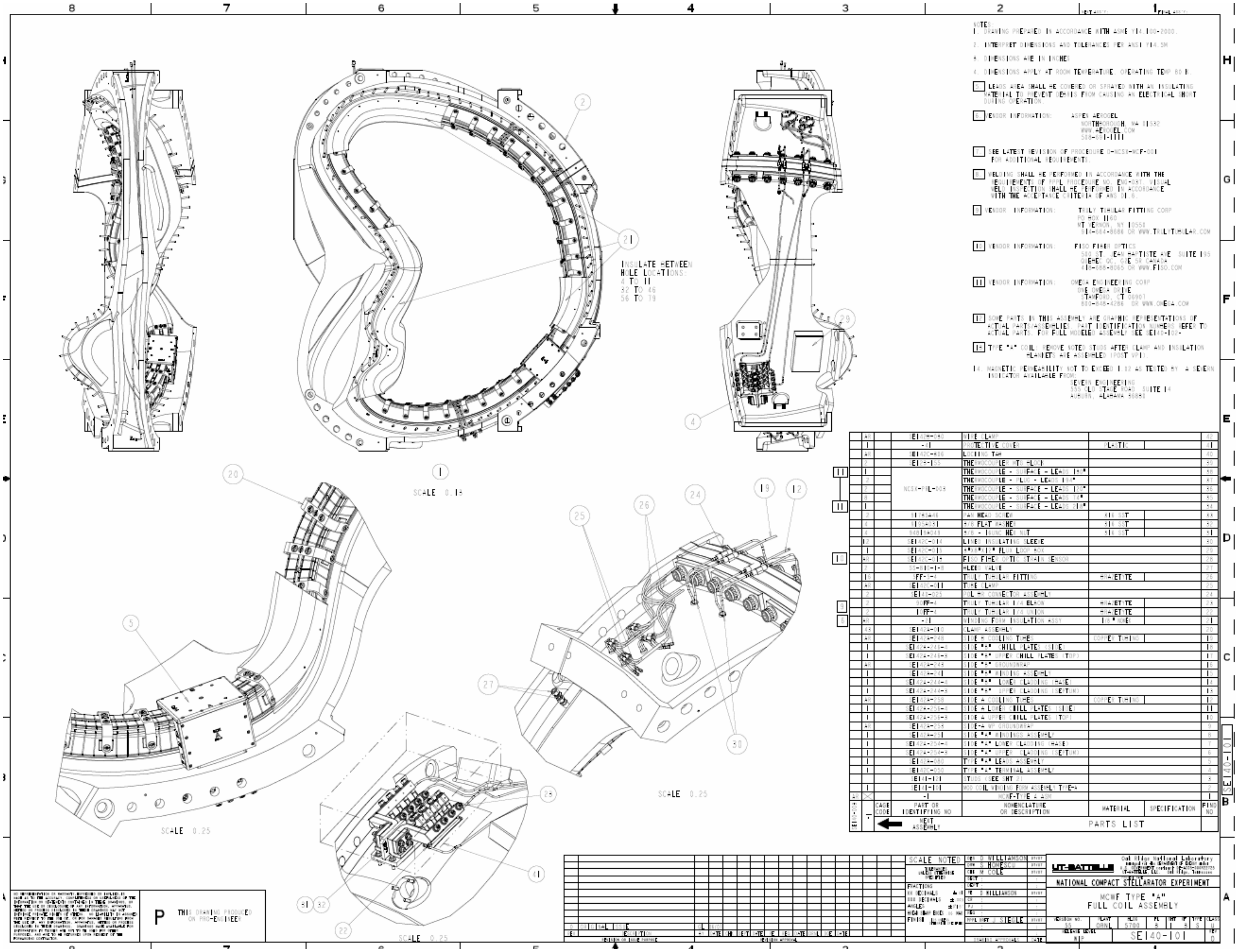
MCWF TYPE "B"
FULL COIL ASSEMBLY

VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
57+	X-10	5700	3	3	3	S	U

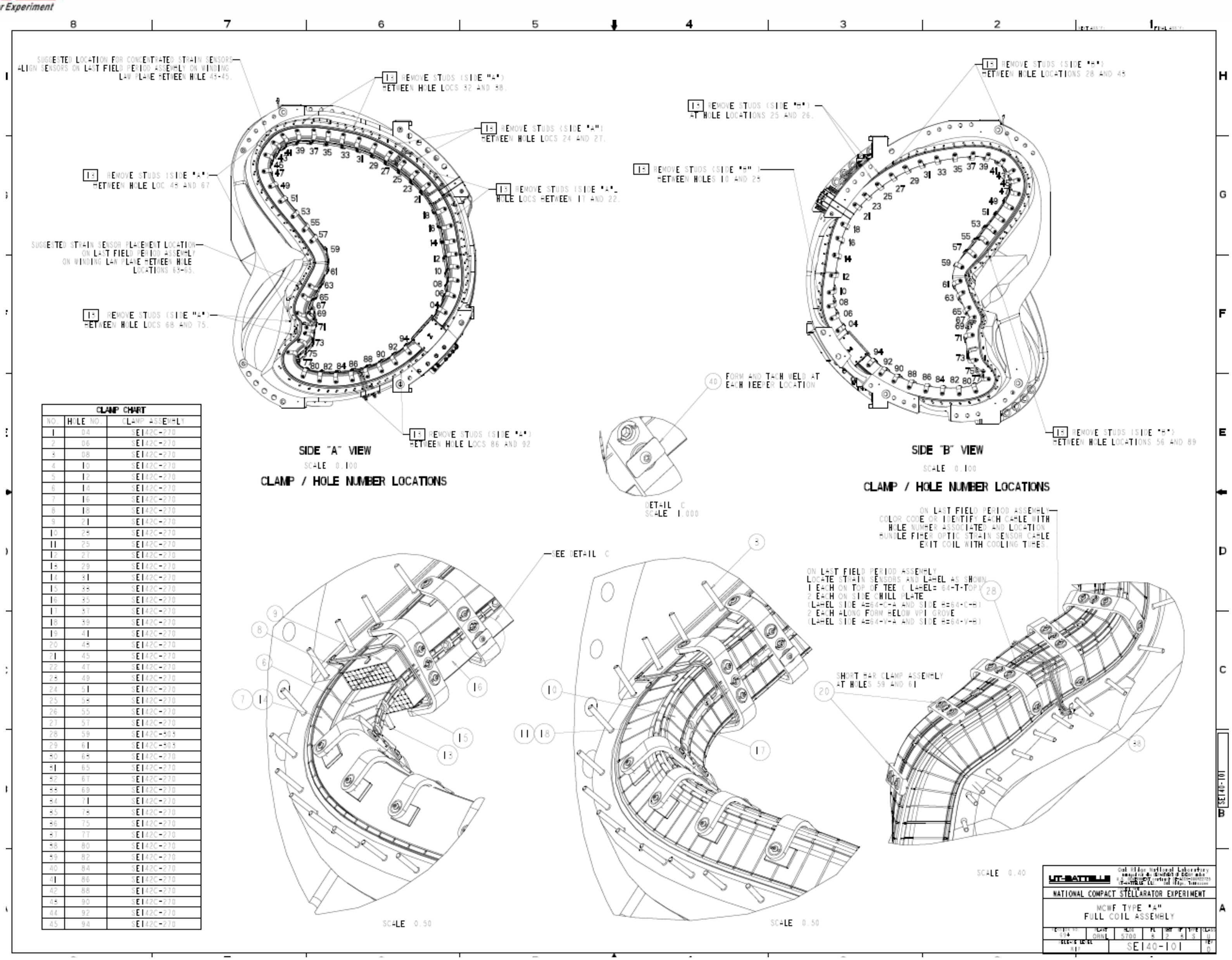
RELEASE LEVEL: WIP — SE140-102 — REV 0

Type-A Coil Assembly (SE140-101)

National Compact Stellarator Experiment

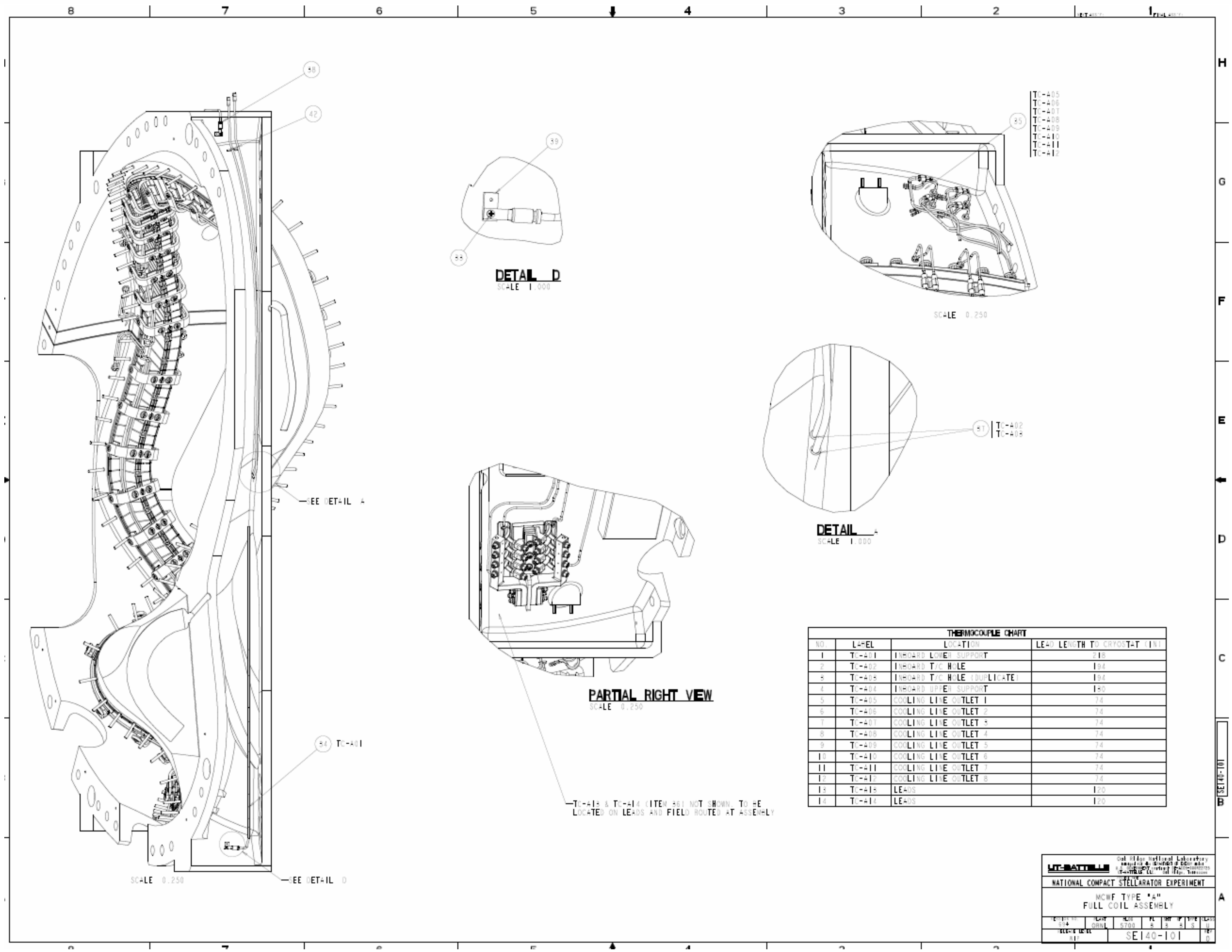


Type-A Coil Assembly (SE140-101)



CLAMP CHART		
NO.	HOLE NO.	CLAMP ASSEMBLY
1	04	SE142C-270
2	06	SE142C-270
3	08	SE142C-270
4	10	SE142C-270
5	12	SE142C-270
6	14	SE142C-270
7	16	SE142C-270
8	18	SE142C-270
9	21	SE142C-270
10	23	SE142C-270
11	25	SE142C-270
12	27	SE142C-270
13	29	SE142C-270
14	31	SE142C-270
15	33	SE142C-270
16	35	SE142C-270
17	37	SE142C-270
18	39	SE142C-270
19	41	SE142C-270
20	43	SE142C-270
21	45	SE142C-270
22	47	SE142C-270
23	49	SE142C-270
24	51	SE142C-270
25	53	SE142C-270
26	55	SE142C-270
27	57	SE142C-270
28	59	SE142C-303
29	61	SE142C-303
30	63	SE142C-270
31	65	SE142C-270
32	67	SE142C-270
33	69	SE142C-270
34	71	SE142C-270
35	73	SE142C-270
36	75	SE142C-270
37	77	SE142C-270
38	80	SE142C-270
39	82	SE142C-270
40	84	SE142C-270
41	86	SE142C-270
42	88	SE142C-270
43	90	SE142C-270
44	92	SE142C-270
45	94	SE142C-270

Type-A Coil Assembly (SE140-101)



THERMOCOUPLE CHART			
NO.	LABEL	LOCATION	LEAD LENGTH TO CRYOSTAT (IN)
1	TC-A01	INBOARD LOWER SUPPORT	218
2	TC-A02	INBOARD T/C HOLE	194
3	TC-A03	INBOARD T/C HOLE (DUPLICATE)	194
4	TC-A04	INBOARD UPPER SUPPORT	130
5	TC-A05	COOLING LINE OUTLET 1	74
6	TC-A06	COOLING LINE OUTLET 2	74
7	TC-A07	COOLING LINE OUTLET 3	74
8	TC-A08	COOLING LINE OUTLET 4	74
9	TC-A09	COOLING LINE OUTLET 5	74
10	TC-A10	COOLING LINE OUTLET 6	74
11	TC-A11	COOLING LINE OUTLET 7	74
12	TC-A12	COOLING LINE OUTLET 8	74
13	TC-A13	LEADS	120
14	TC-A14	LEADS	120

ECN Status

Modular Coil ECN Status 5/8/07

ECN No.	Affects Drawing No.	Drawing Title	Change Description	Status
5244	SE140-190-R1	MCWF FLANGE STUD KIT	Add supernut, optional thru-bolt config.	R2 to be checked.
5244	SE140-191-R0	MCWF FLANGE STUDS	Change length, thread class. Add rolled thread req.	R1 issued.
5220	SE142C-270-R0	CLAMP ASSEMBLY	Replace upper pusher asm with same components as lower asm.	R1 to be checked.
5185	SE141-114-R8	WINDING FORM TYPE-A	Chang flange hole clearance.	Add dwg stamp, change models only?
5185	SE141-115-R9B	WINDING FORM TYPE-B	Chang flange hole clearance, add cut to support post.	Add dwg stamp, change models only?
5185	SE141-116-R8	WINDING FORM TYPE-C	Chang flange hole clearance.	Add dwg stamp, change models only?
5140R2	SE140-101 (not issued)	COIL ASSEMBLY TYPE-A	Add notes re electrical insulation at leads.	R0 to be checked.
5140R2	SE140-102 (not issued)	COIL ASSEMBLY TYPE-B	Add notes re electrical insulation at leads.	R0 to be checked.
5140R2	SE140-103 (not issued)	COIL ASSEMBLY TYPE-C	Add notes re electrical insulation at leads.	R0 to be checked.
5140R2	SE141-101-R3A	MCWF ASM TYPE-A	Add note re poloidal break electrical connection.	Stamp to be added (R3B)
5140R2	SE141-102-R3B	MCWF ASM TYPE-B	Add note re poloidal break electrical connection.	Stamp to be added (R3C)
5140R2	SE141-103-R3A	MCWF ASM TYPE-C	Add note re poloidal break electrical connection.	Stamp to be added (R3B)
5140R2	SE142A-080 (not issued)	LEAD BLOCKS ASM TYPE-A	Modify fingers at leads.	R0 to be checked.
5140R2	SE142A-242-R0	TYPE-A SIDE-B CLADDING AND CHILL PLATES	Remove fingers at leads, add material options.	R1 issued.
5140R2	SE142A-252-R0A	TYPE-A SIDE-A CLADDING AND CHILL PLATES	Remove fingers at leads, add material options.	R1 to be checked.
5140R2	SE142B-080 (not issued)	LEAD BLOCKS ASM TYPE-B	Modify fingers at leads.	R0 to be checked.
5140R2	SE142B-184 (not issued)	LEAD BLOCKS TOP PLATE TYPE-B	Remove center rib.	R0 issued.
5140R2	SE142B-242-R0	TYPE-B SIDE-B CLADDING AND CHILL PLATES	Remove fingers at leads, add material options.	R1 to be checked.
5140R2	SE142B-252-R1	TYPE-B SIDE-A CLADDING AND CHILL PLATES	Remove fingers at leads, add material options.	R2 to be checked.
5140R2	SE142C-047-R0	JUMPERS BASE BLOCK	Change model to match drawing hole callout.	R1 to be checked.
5140R2	SE142C-050-R0	LEADS TERMINAL ASSEMBLY	Add kapton strip and other elec insulators.	R1 to be checked.
5140R2	SE142C-051-R0	JUMPER DETAIL	Add solder bleed hole, material options.	R1 issued.
5140R2	SE142C-052-R0	JUMPER DETAIL	Add solder bleed hole, material options.	R1 issued.
5140R2	SE142C-053-R0	JUMPER DETAIL	Add solder bleed hole, material options.	R1 issued.
5140R2	SE142C-054-R0	JUMPER DETAIL	Add solder bleed hole, material options.	R1 issued.
5140R2	SE142C-055-R0	TERMINAL LUG DETAIL	Add solder bleed hole, GDT to tapered holes.	R1 to be checked.
5140R2	SE142C-056-R0	TERMINAL LUG DETAIL	Add solder bleed hole, GDT to tapered holes.	R1 to be checked.
5140R2	SE142C-059-R1	CABLE CONNECTOR DETAIL	Modify taper.	R2 to be checked.
5140R2	SE142C-080-R0	LEAD BLOCKS ASM TYPE-C	Modify fingers at leads.	R1 to be checked.
5140R2	SE142C-184-R0	LEAD BLOCKS TOP PLATE TYPE-C	Modify fingers at leads.	R1 issued.
5140R2	SE142C-203-R0	TYPE-C SPECIAL CHILL PLATES	Remove fingers at leads, add material options.	R1 to be checked.
5140R2	SE142C-382-R0	TYPE-C SIDE-A UPPER CLADDING	Add material options.	R0A issued with stamp.
5140R2	SE142C-384-R0	TYPE-C SIDE-A LOWER CLADDING	Add material options.	R0A issued with stamp.
5140R2	SE142C-386-R0	TYPE-C SIDE-A UPPER CHILL PLATES	Add material options.	R0A issued with stamp.
5140R2	SE142C-388-R1	TYPE-C SIDE-A LOWER CHILL PLATES	Add material options.	R1A issued with stamp.
5140R2	SE142C-482-R0	TYPE-C SIDE-B UPPER CLADDING	Add material options.	R0A issued with stamp.
5140R2	SE142C-484-R0	TYPE-C SIDE-B LOWER CLADDING	Add material options.	R0A issued with stamp.
5140R2	SE142C-486-R0	TYPE-C SIDE-B UPPER CHILL PLATES	Add material options.	R0A issued with stamp.
5140R2	SE142C-488-R0	TYPE-C SIDE-B LOWER CHILL PLATES	Add material options.	R0A issued with stamp.

Interfaces Status

NCSX National Compact Stellarator Experiment

- ICDs originally drafted as single document, but figures incomplete
- Model-based interface control adopted within WBS1
- As-built geometry important to PF/TF and other interfaces

Navigation Trail Engineering > Interface Control > ICDs > WBS 14 ICDs

Potential Interfaces (WBS / WBS)	Lead Engineer	ICD #	Purpose	Status of Documenting Interfaces
WBS 14 Interfaces				
14 to all WBS Elements	Williamson	ICD-14-All-0001-00-dA	Defines the functional and physical interfaces between WBS 14 and all other WBS elements within the stellarator core	*This is a draft document - needs to be updated*
14 to 15	Williamson			*Fold into ICD document?*
14 to 16	Williamson			*Not Required - same WBS Manager*
14 to 17	Williamson			*Fold into ICD document?*
14 to 18	Williamson			*Fold into ICD document?*
14 to 24	Williamson			*NOT IN MIE PROJECT*
14 to 3	Williamson	ICD-14-3-0001-03-dA	Defines the magnetic field sensor loop location requirements	*Fold into ICD document?*
14 to 4	Williamson			*Fold into ICD document?*
14 to 5	Williamson			*Fold into ICD document?*
14 to 62	Williamson			*Fold into ICD document?*

INTERFACE CONTROL DOCUMENT TITLE AND APPROVAL PAGE

(Page 1)

ICD Number: ICD-14-310-0003	**Primary Author:** B. Stratton
Impacted WBS Elements: WBS-3 to WBS-14	**Type of Interface:** Mechanical/Envelope Interface

Description of Interface:

Diagnostic magnetic field sensor loops shall be co-wound with the modular field coils. Two sensor loops are required for each modular coil. They shall be located on top of the modular coil winding pack (facing plasma), with one sensor loop on each side of the center leg of the winding form tee.

Record of Revisions

Revision Number
0
1
2
3

Approvals

WBS Manager: David Jol

Project Engineer: Brad Nels

Systems Engineering

ICD DETAIL SHEET
ICD-14-310-0003
(Page 2)
(Use Continuation Sheets as Necessary to Include the Following Applicable Information)

Scope of Interface:
This interface impacts the design and fabrication of the modular coils (WBS14) and magnetics diagnostics (WBS3).

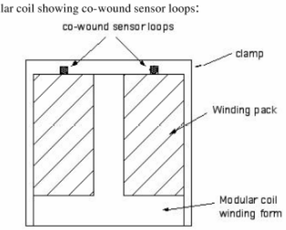
Equipment and Responsibility List:

Modular Coils (WBS 14): Williamson
Magnetics Diagnostics (WBS 3): Johnson

Related ICDs:

Notes and Abbreviations:

Interface Block Diagrams:
Cross section of modular coil showing co-wound sensor loops:



Installation Information:
The co-wound sensor loops shall be installed during winding of the modular coils. Installation of the sensor loops will be the responsibility of WBS14. This installation, as part of coil manufacture, shall include lead termination at the coil casing (or boundary). The leads are to be terminated in a heavy duty structure, rigidly attached to the coil and capable of protecting the leads from breakage for the coil lifetime. The dual sensors are for redundancy and the terminating structures should be appropriate to this function.
All other work related to these sensor loops (e. g., connections to instrumentation) will be the responsibility of WBS3.

Other Pertinent Information:
The sensor loops shall be laid on top of the winding pack before epoxy impregnation and held in place by the winding clamps (grooves on the inside of each clamp are required). The epoxy will hold the sensor loops in place after impregnation. The sensor loops shall be made of suitable thin cable such as mineral insulated cable (diameter: 0.061" or less). The two leads for each loop shall be brought out through holes in the center leg of the winding form tee. The reliability of the sensor loops shall be at the same level as the reliability of the modular coils. The loops shall be positioned within 1/16" of the design position and their positions shall be known to the same accuracy as that of the modular coils themselves.

- Modular coil asm design basis is defined by 5 analysis reports:

  HM Fan, Nonlinear Analysis of Coil and Shell Structure, NCSX-CALC-14-001, APPROVED
  HM Fan, Analysis of Integrated Structure, NCSX-CALC-14-003, APPROVED
  K Freudenberg, Modular Coil Thermal Analysis, NCSX-CALC-14-002, DRAFT
  K Freudenberg, Nonlinear Modular Coil Analysis, NCSX-CALC-14-004, DRAFT
  D Williamson, Modular Coil Failure Modes Analysis, NCSX-FMEA-14-002, DRAFT

- Additional analysis reports are planned before Design Closeout:

  K Freudenberg, Outboard Bolted Joint Analysis, IN PROGRESS
  K Freudenberg, Inboard Welded Shim Analysis, IN PROGRESS
  D Williamson, Modular Coil Leads Structural Analysis, PLANNED

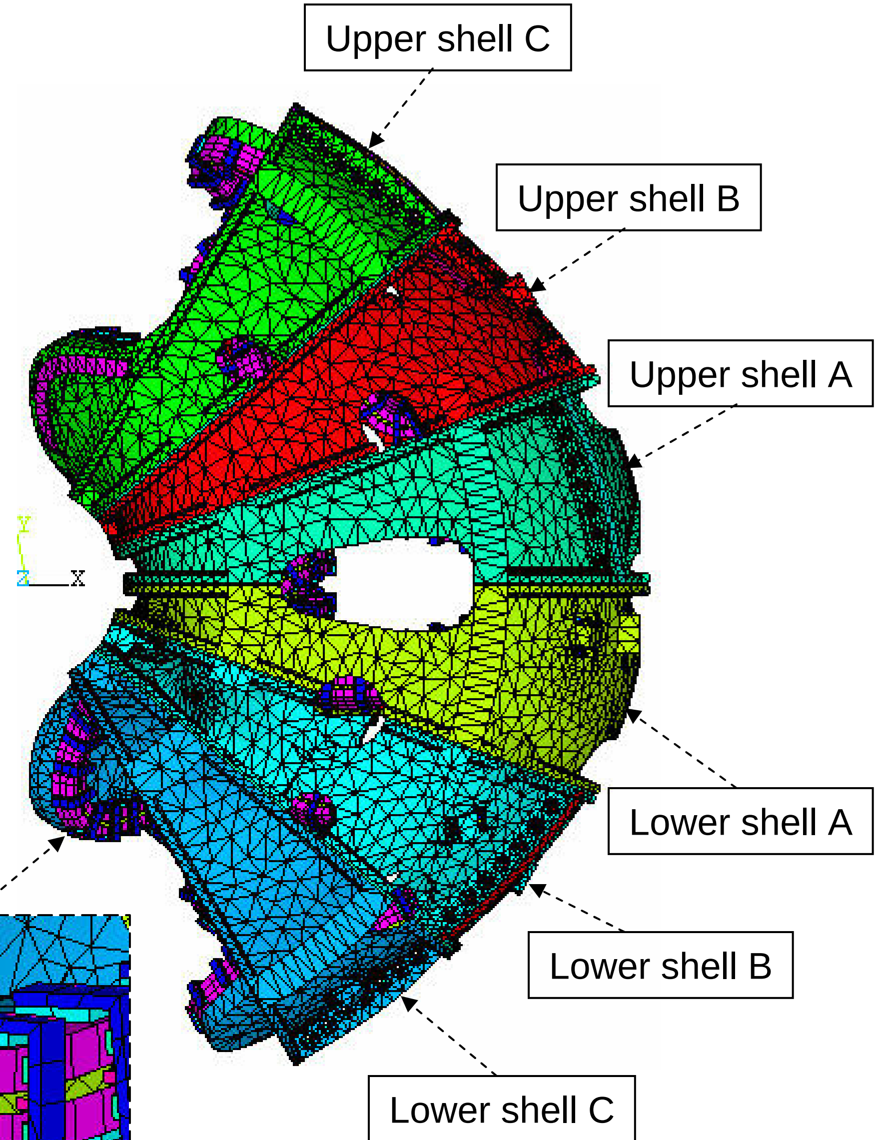
Nonlinear Analyses of Modular Coils and Shell structure for Coil Cool-down and EM Loads

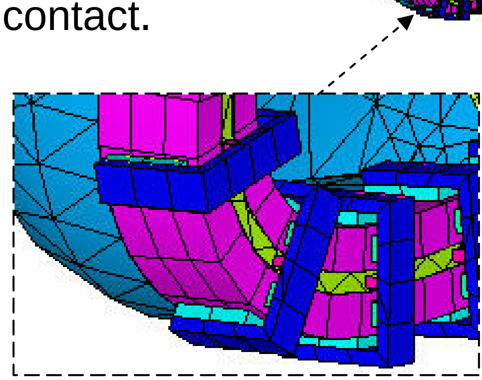
Part 1 – Results of Shell Structure and Modular Coils

H.M. Fan
PPPL
Sept. 28, 2005

FEA Model

- FEA model simulates one field period.
- Proper cyclically boundary conditions were applied as shown in the next slide.
- Geometry imported from Pro/E model, which was provided by ORNL
- Small features, such as chamfers and fillers, in the geometry were removed to improve meshing
- Model includes shells with tees and wings, wing bags, poloidal break spacers, toroidal flange spacers, modular coils and simplified clamp assembly.
- Modular coils are preloaded at side pads and top pads of the clamp assembly.
- Contact behavior of modular coil is the standard frictionless unilateral contact.
- The wings that extend beyond the shell edges are supported by wing bags on the adjacent shells.





Boundary Conditions and Constraints

- Cyclic symmetry between toroidal spacers at -60° and +60° (see Fig.A)
- Cyclic symmetry for wing bags outside the 120° range and their rotational images (see Fig.B)
- Vertical and toroidal displacement constraints at the bottom shell stiffeners in a four-degree regions of the shell type C.

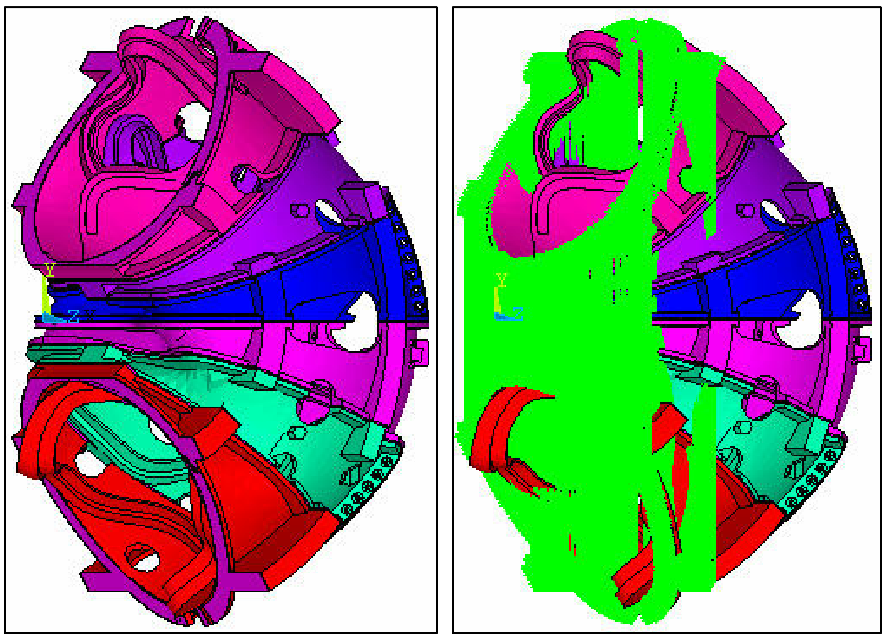


Figure A

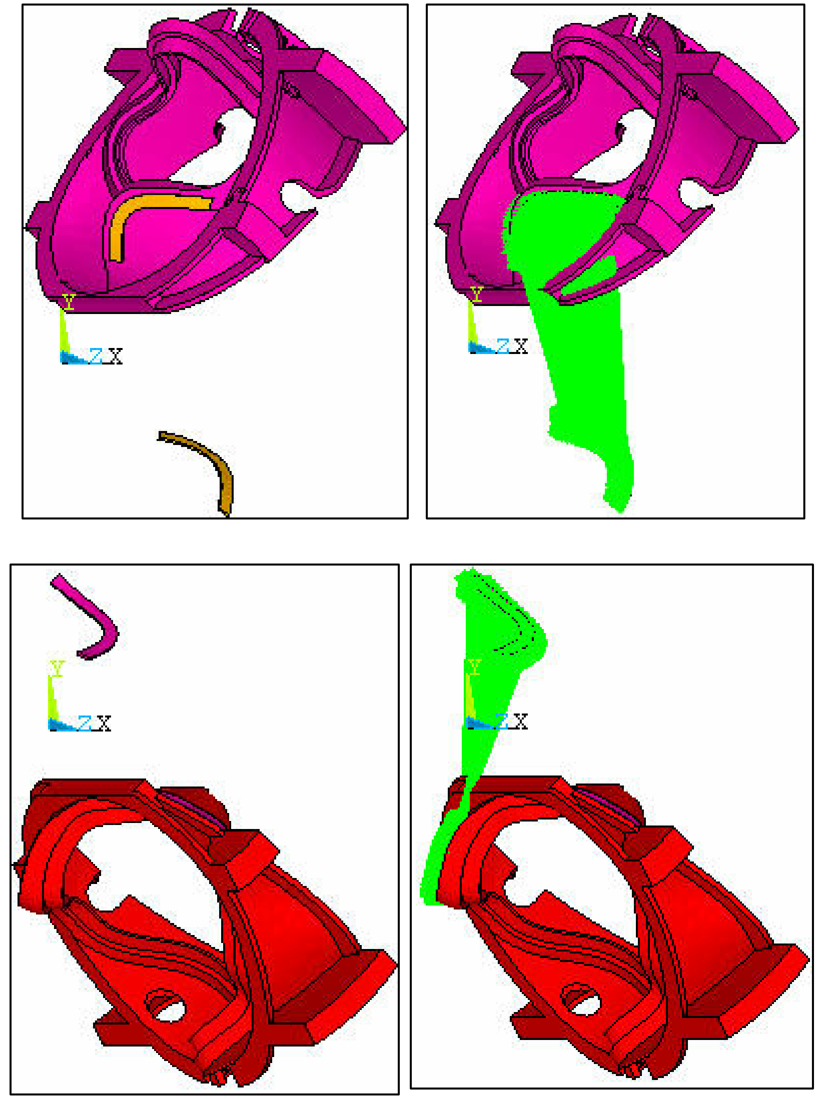


Figure B

Material Properties and Loadings

- The following material properties are used:

	E (MPa)	CTE (m/m/°C)	Poisson's Ratio
Tee/shell	145,000.00	1.70E-05	0.31
Modular coil	63,000.00	1.72E-05	0.20
Toroidal spacer	150,000.00	1.70E-05	0.27
poloidal spacer	193,000.00	1.70E-05	0.31
Wing bag	13,750.00	3.00E-05	0.32
Wing bag image	689.00	3.00E-05	0.32
Clamp	193,000.00	1.70E-05	0.31
Top pad	21.28	1.25E-03	0.00
Side pad	6.96	1.25E-03	0.00

- Magnetic loads are based on 2T high beta current scenario at 0.0 seconds.
- Initial cooling shrinkage of coil strain is 0.0004 m/m that is equivalent to a temperature reduction of 23.2558 °C.
- Clamp preloads are generated by the thermal expansions of the side pads and top pads.
- A temperature increase of 20 °C in the side pad provides a thermal strain of 2.5% that produces an initial preload of 556 N or 125 lbs.
- A temperature increase of 4 °C in the top pad provides thermal strain of 0.5% that produces an initial preload of 92.6 N or 20.8 lbs.

Coil Currents and Model Assumptions

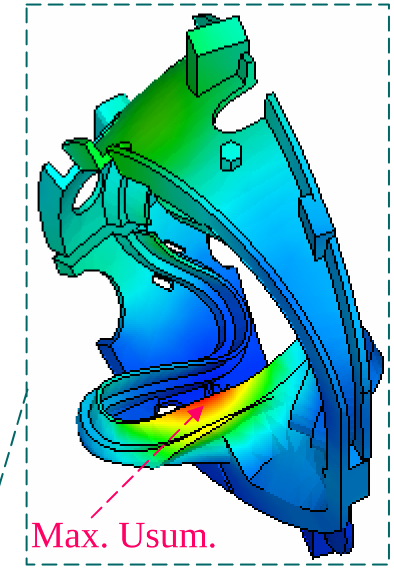
- Col currents used in the electro-magnetic analysis are:

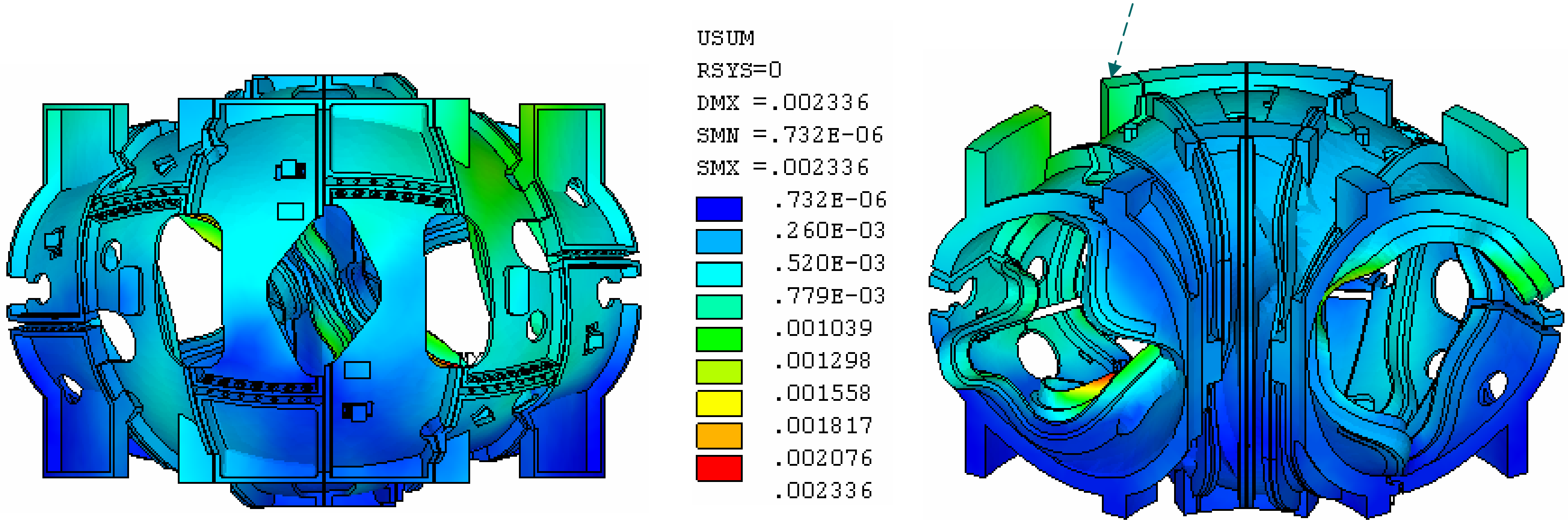
Component	Current (A/turn)	Turn
M1	40908	20
M2	41561	20
M3	40598	18
PF1	-15274	72
PF2	-15274	72
PF3	-5857	72
PF4	-9362	80
PF5	1080	24
PF6	-24	14
TF	-1301	12
Plasma	0	1

- Isotropic smeared property is assumed for the modular coil winding.
- Modular coil is allowed to slide along tee and clamp assembly without friction force – geometry nonlinear.
- No bolt preload are provided and the bolt joints are assumed to be bonded.
- Large-deflection effects are ignored in the nonlinear analysis

Total Displacements of Shell - Usum

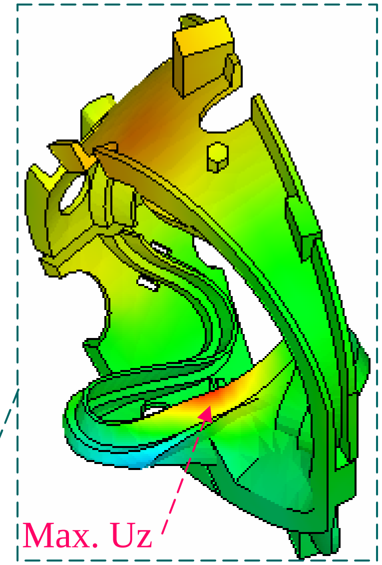
- The maximum displacement, 2.336 mm, occurs on tee in shell type B due to lateral deformation of web caused by the lateral force of the modular coil.
- Because of net vertical forces are equal and opposite with respect to the mid-span, the deformation at bottom of the mid-span is small.
- The smaller deformation at the inboard than the outboard is the result of higher shell stiffness in the inboard.
- The unit of the displacement is in meter

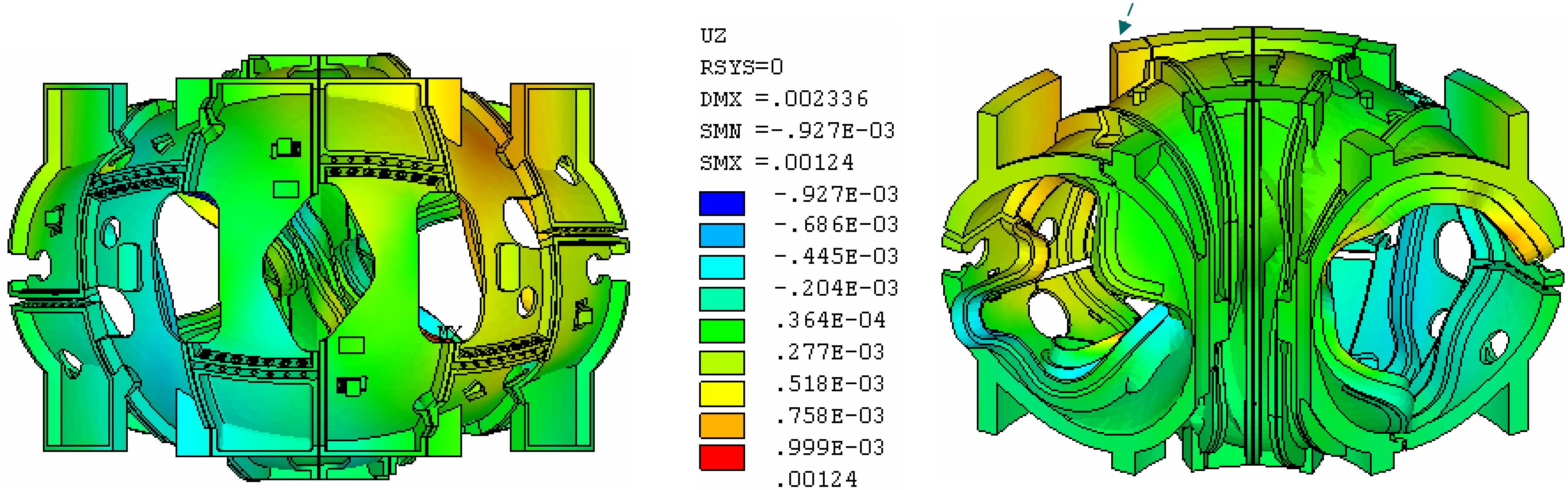




Vertical Displacements of Shell - Uz

- Maximum Uz occurs on tee in shell type B about the same location as the maximum displacement
- The magnitude of maximum Uz is 1.24 mm, which is about half of the maximum displacement 2.336 mm
- The positive and negative displacements are shown at the opposite side of the mid-span due to the net vertical forces are equal and opposite with respect to the mid-span
- The unit of the displacement is in meter

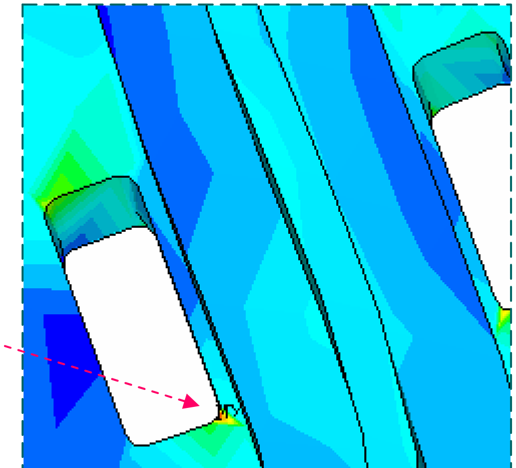


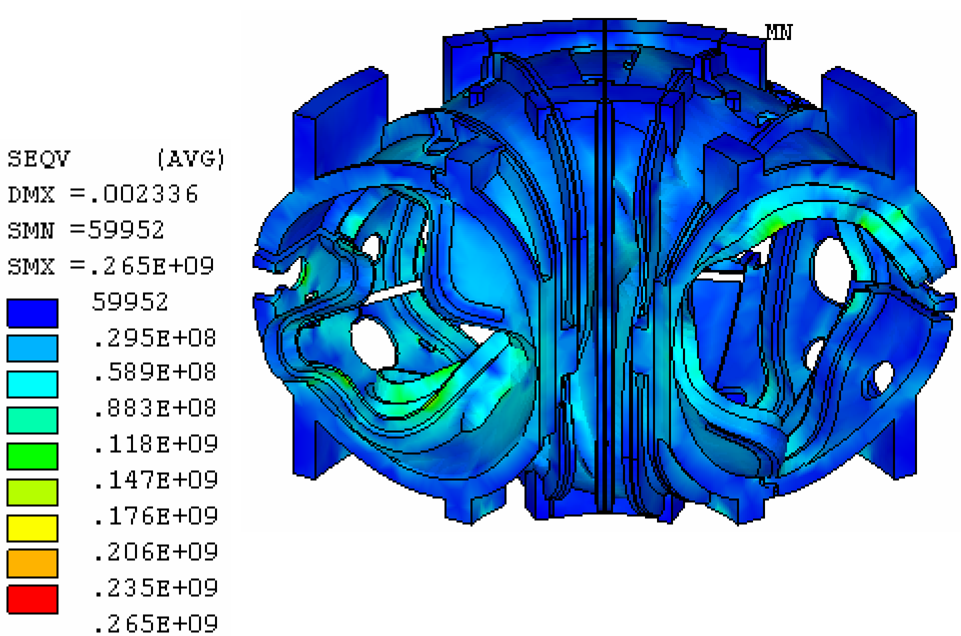


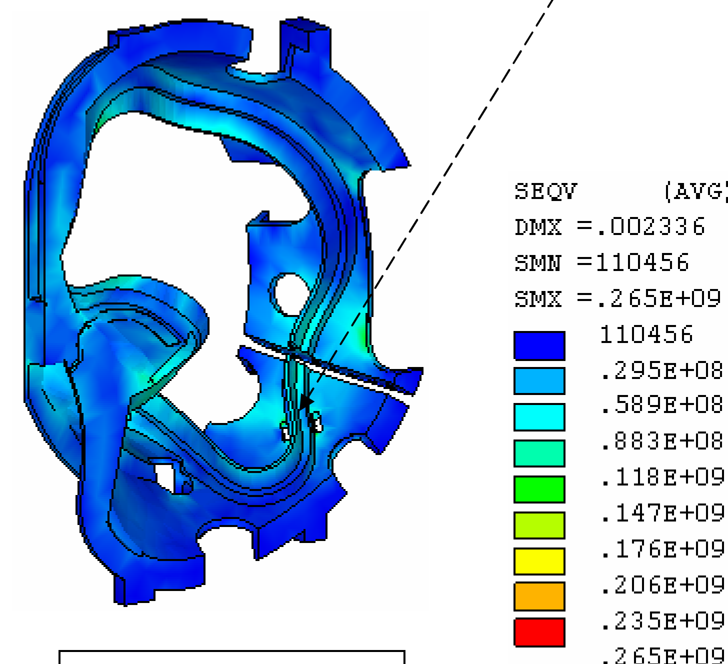
Von Mises Stress of Shell Structure

- The maximum local von Mises stress, Seqv, occurs at the corner of lead opening in shell type B.
- The model was built without chamfers at the lead openings. With chamfer, the local stress will be greatly reduced.
- The next slides will display some high stress areas

Max. Seqv





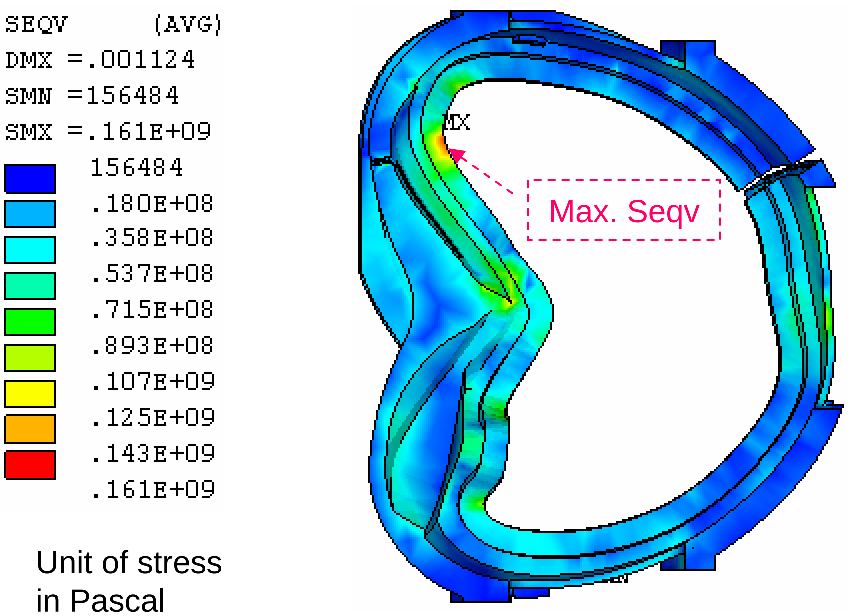


Unit of stress in pascal

Upper shell type B

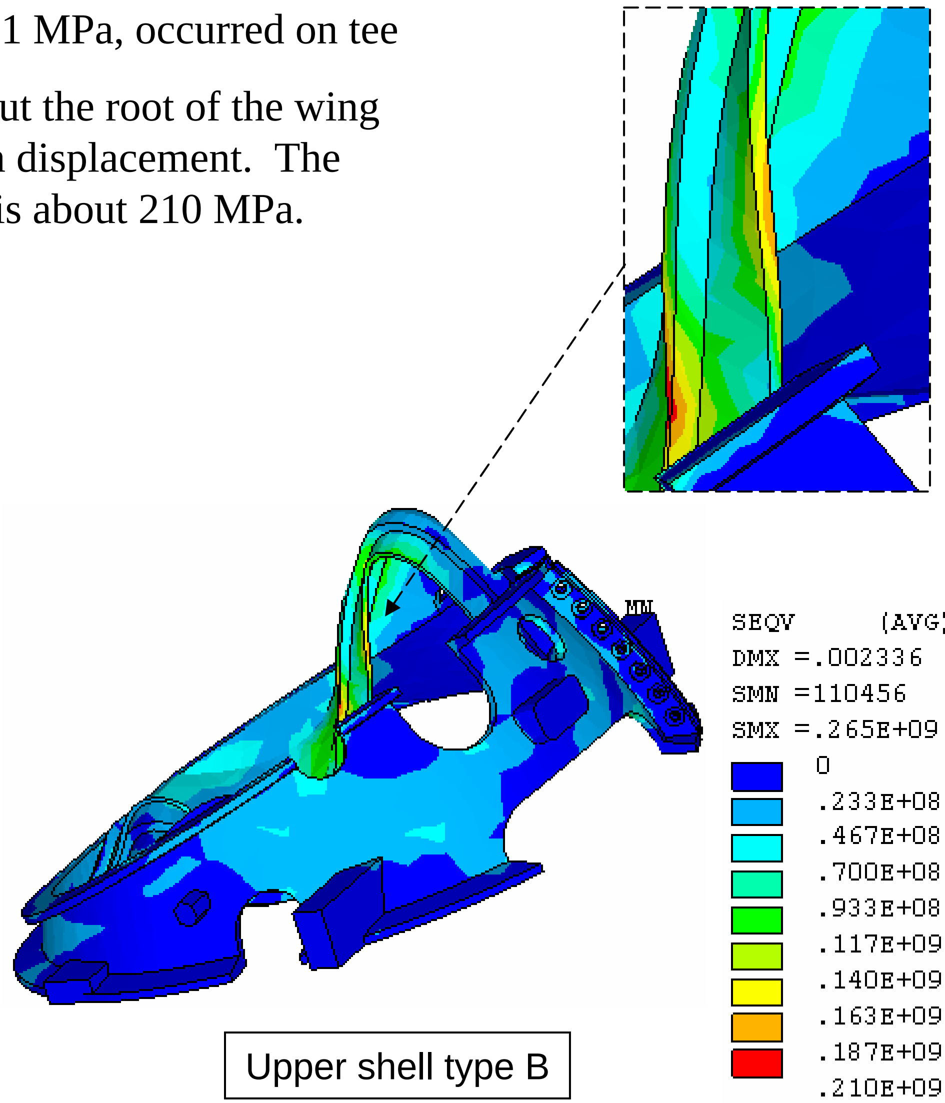
Von Mises Stresses of Shell Type A and B

- For shell type A, the maximum Seqv is 161 MPa, occurred on tee
- For shell type B, the peak stress come about the root of the wing cantilever, near the location of the maximum displacement. The flange of tee is thin and the maximum Seqv is about 210 MPa.



Unit of stress in Pascal

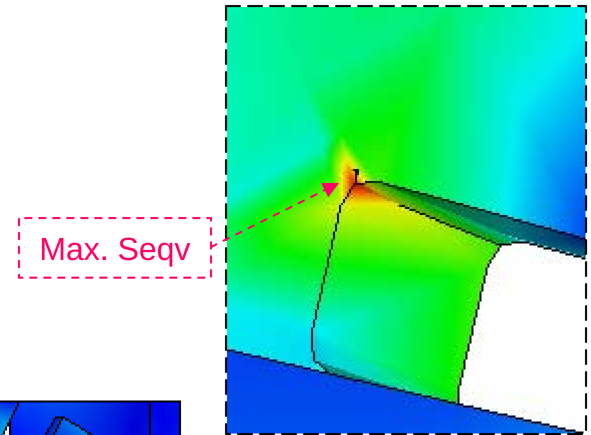
Upper shell type A

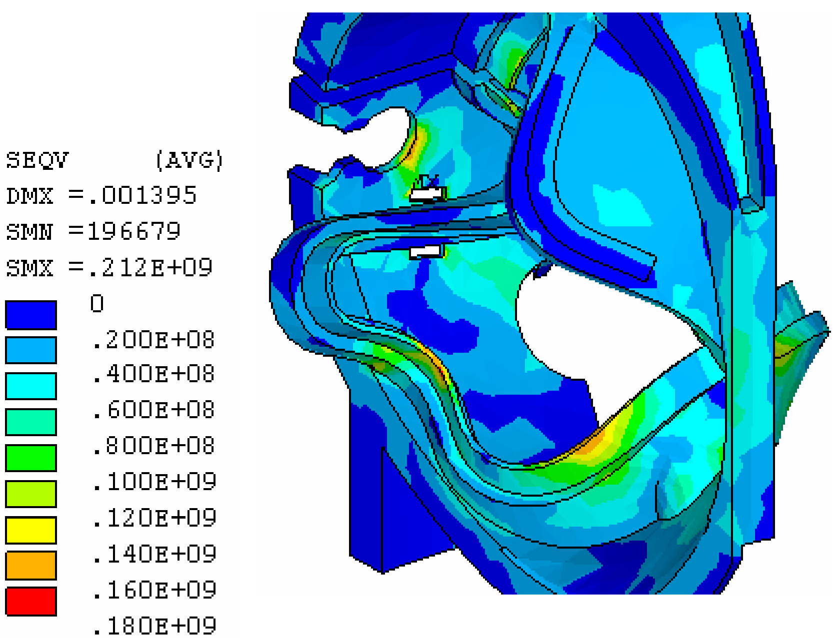


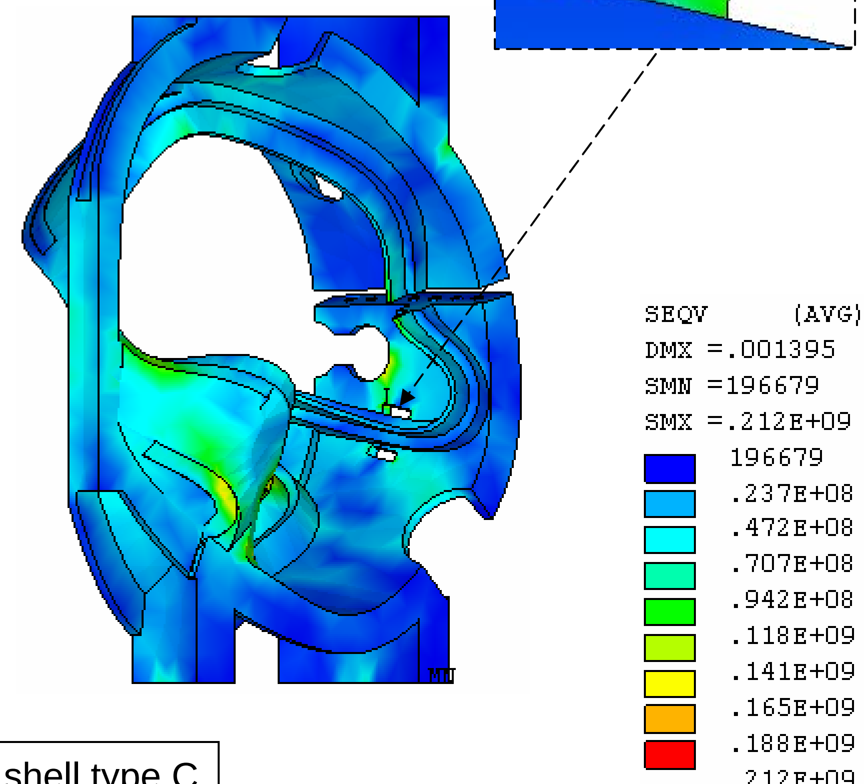
Upper shell type B

Von Mises Stresses of Shell Type C

- The maximum local von Mises stress, Seqv, occurs at the corner of lead opening in shell type C.
- The model was built without chamfers at the lead openings. With chamfer, the local stress will be greatly reduced.
- The Figure on the left displays three high stress regions. The magnitude of stress is below 180 MPa.





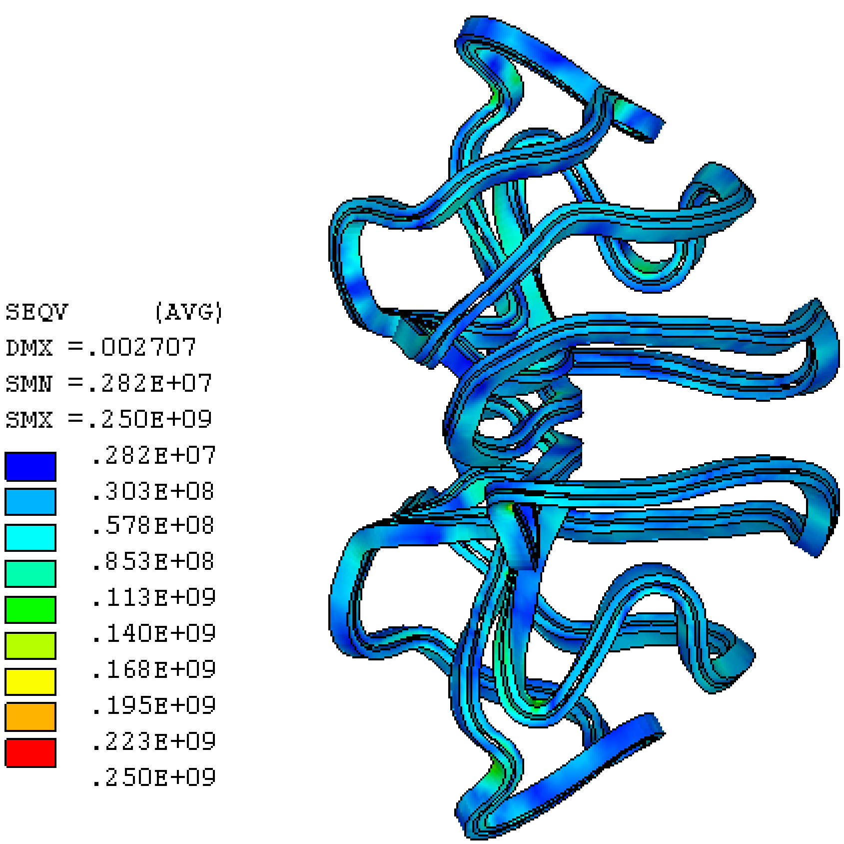


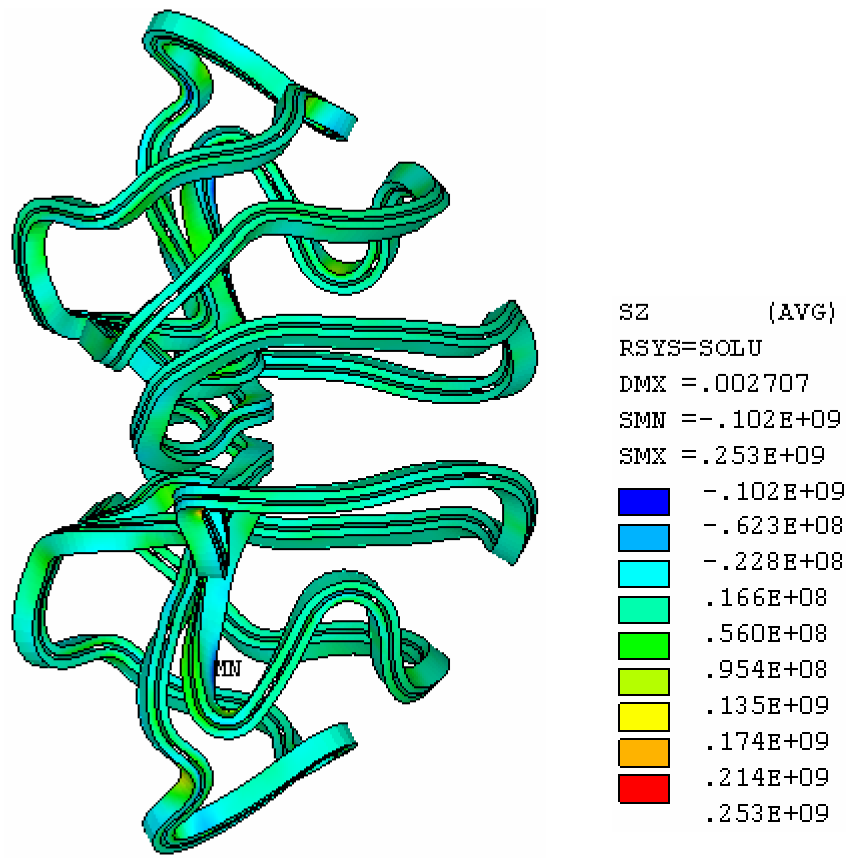
Upper shell type C

Stress Plots of Modular Coils

- The maximum Displacement, Dmx, of 2.707 mm is larger than the maximum displacement of shell structure, which is 2.336 mm, duo to separation of tee and coil

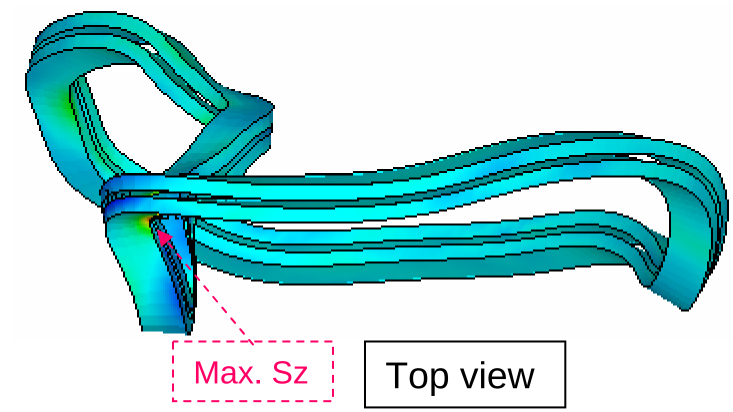
- The maximum von Mises stress, Seqv, and maximum axial stress, Sz, come about the same values and happen at the same place in the coil type A. This indicates the axial stress is the primary stress in the coil.

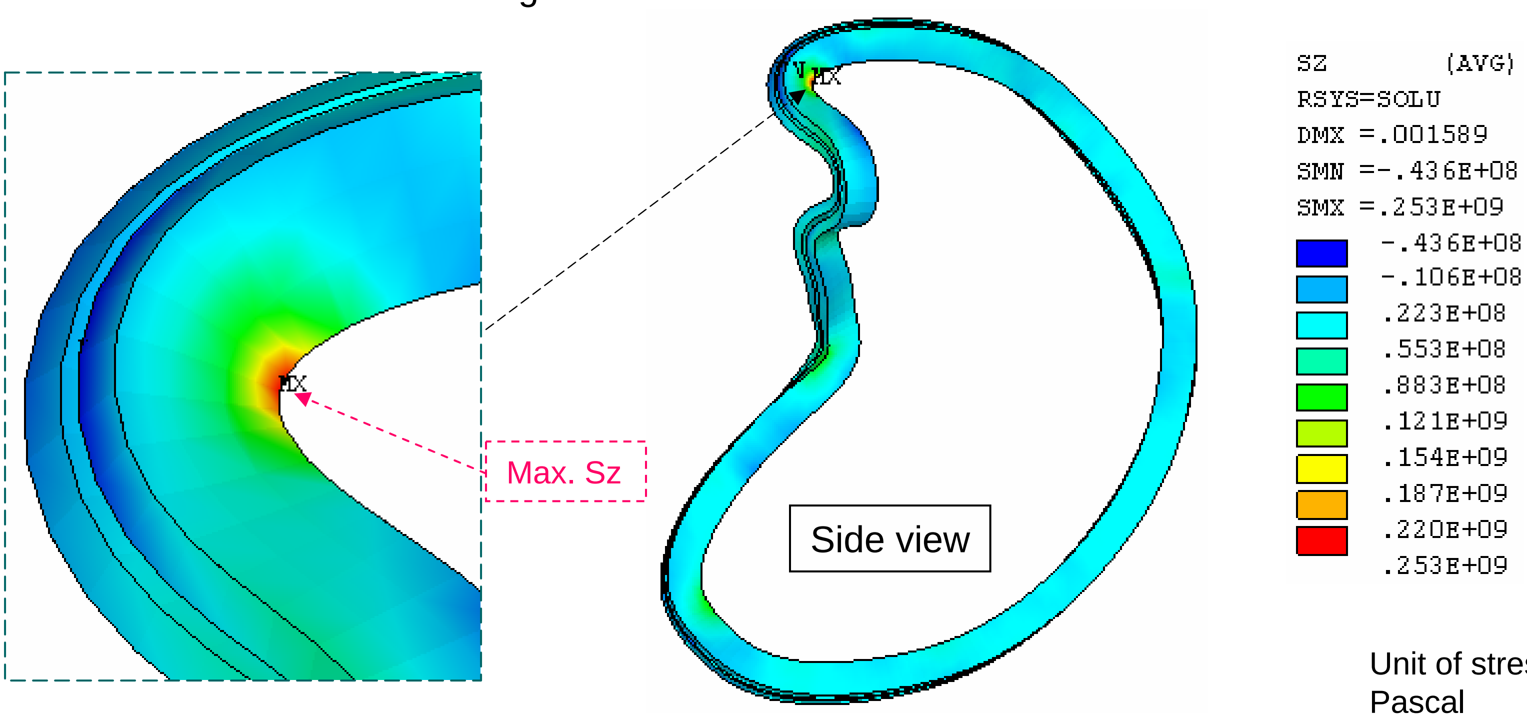




Axial Stress of Modular Coil Type A

- Peak axial stress, Sz, locates at where radius of curvature is small and bending due to winding extend beyond shell
- Because of bending, the compression occurs at the other side of the cross section where maximum tension exists
- Coil type A has the highest axial stress among all coils.
- More uniform tensile stresses take place at the coil where radius of curvature is large

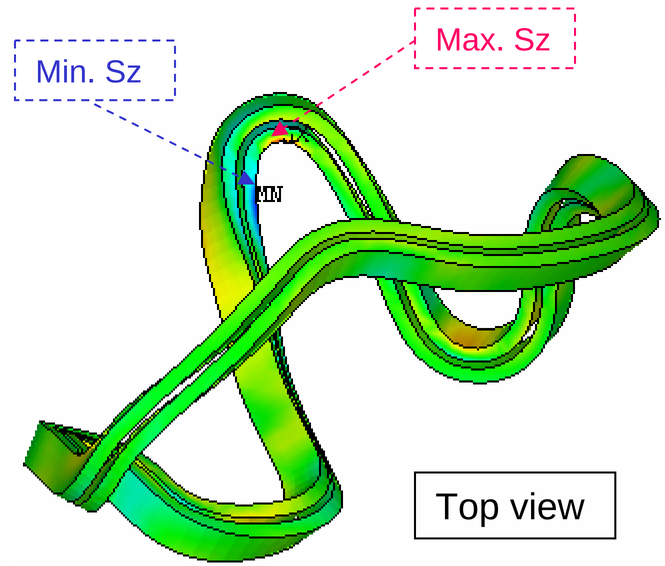


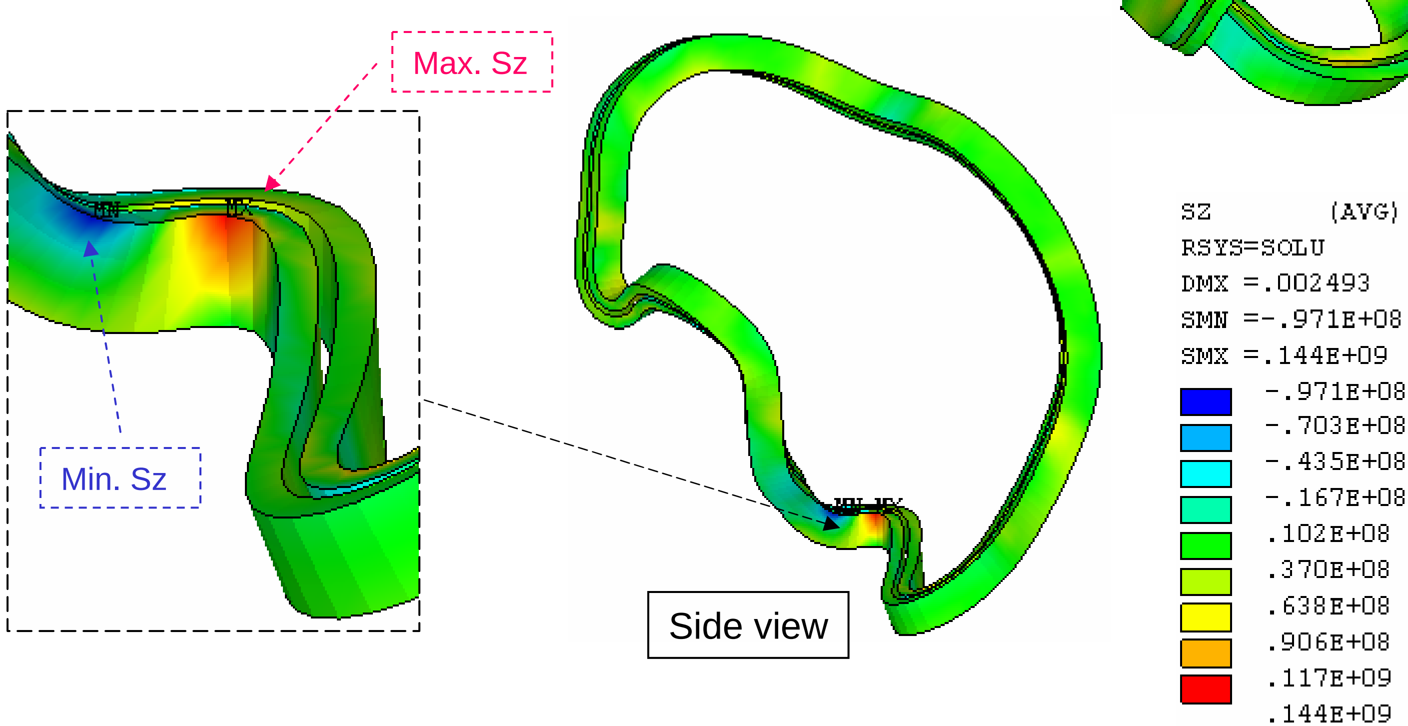


Unit of stress in Pascal

Axial Stress of Modular Coil Type B

- The maximum axial stress and the minimum axial stress locates at the wing as shown in the top view.
- More uniform tensile stresses take place at the coil where radius of curvature is large

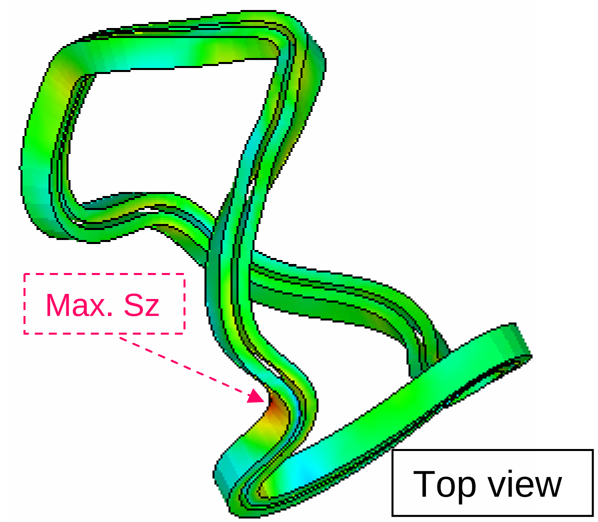


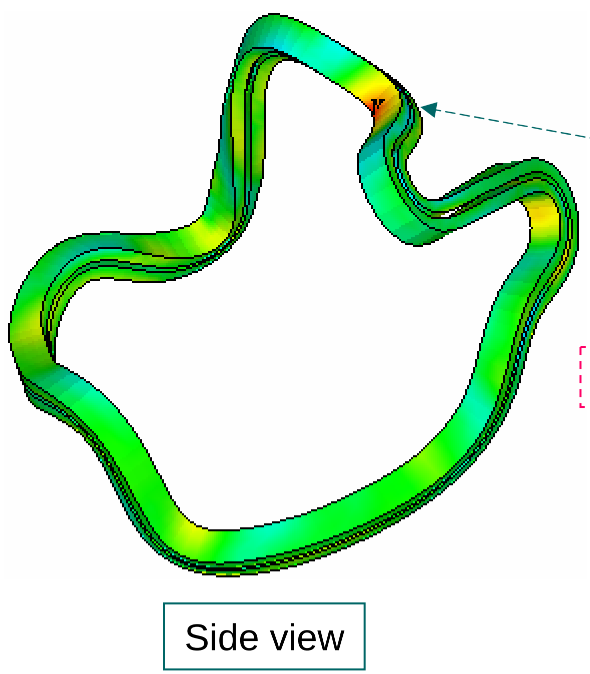


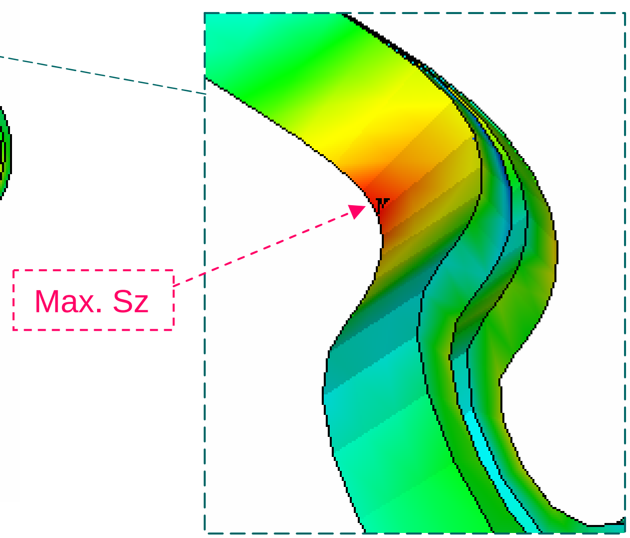
Unit of stress in Pascal

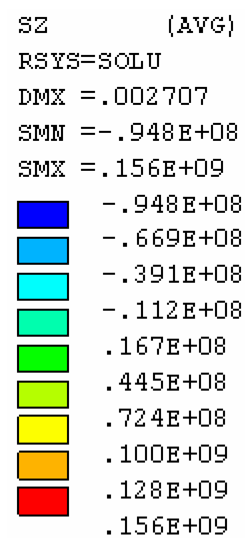
Axial Stress of Modular Coil Type C

- Maximum axial stress locates at where radius of curvature is small and bending due to extend beyond shell.
- Because of bending, the compression occurs at the other side of the cross section where maximum tension exists.
- Coil type C has the largest displacement among all coils.





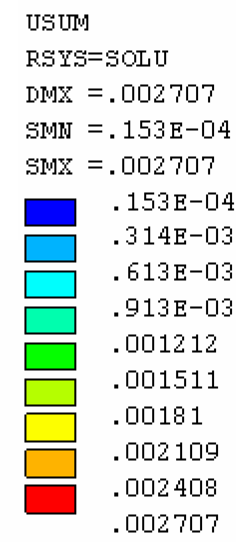


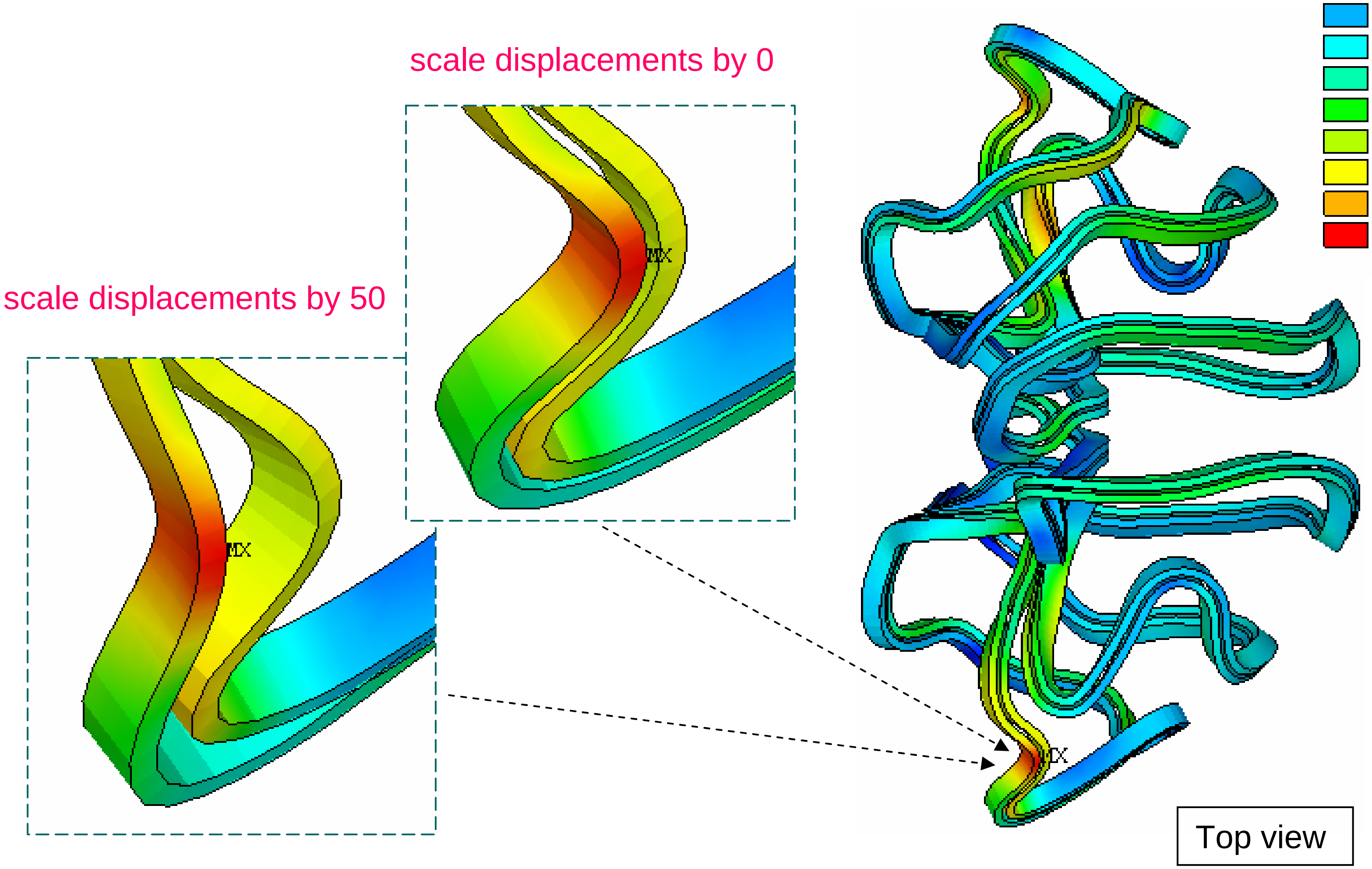


Unit of stress in Pascal

Displacement of Modular Coils

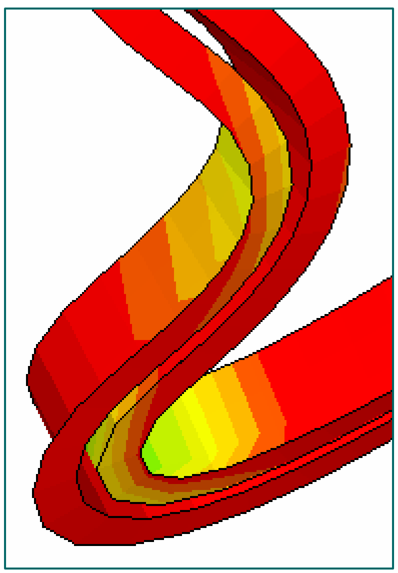
- Maximum displacement is 2.707 mm in the coil type C.



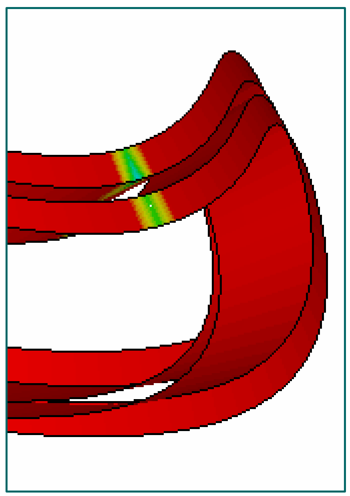


Gap Distance Between Modular Coils and Tees

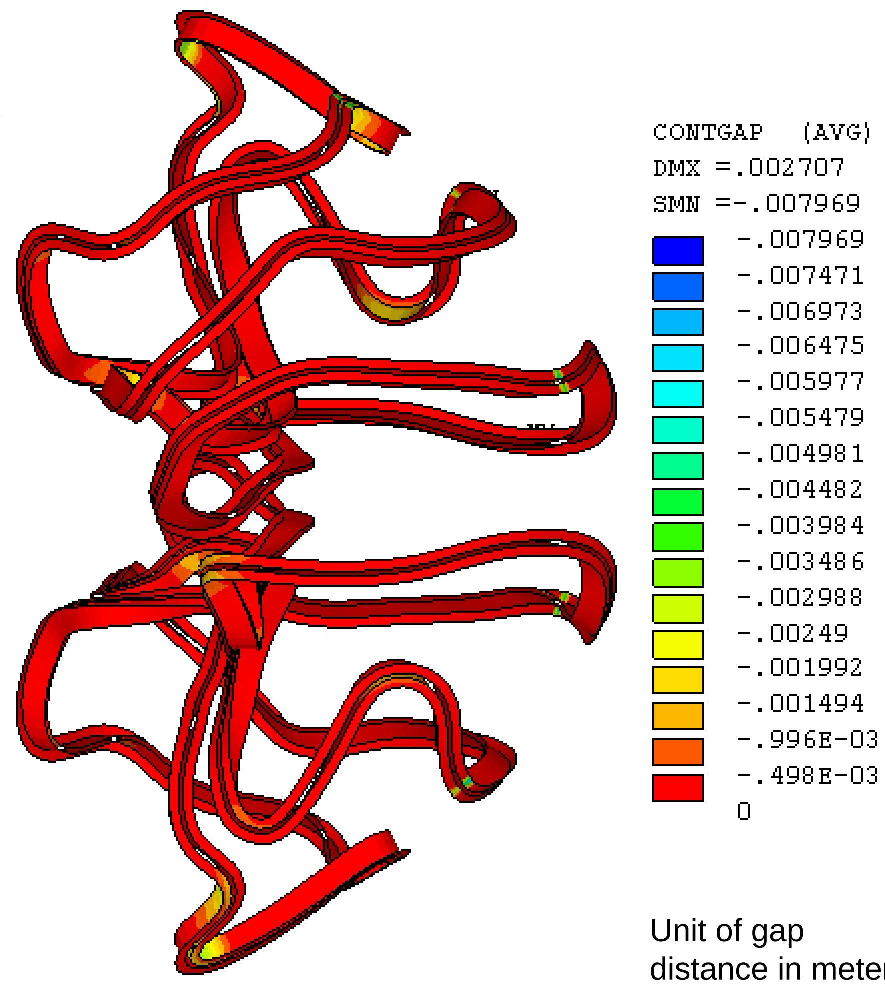
- The gap distances are in general very small (red in CONTGAP plot) except at where the radius of curvatures are small
- Because of cooldown shrinkage, when one side of winding at tee develops gap, the other side of winding is in contact (see example below for coil type C.
- The gap shown below in coil type A is caused by geometry errors. However, the small areas should have negligible effects on the results.



Coil Type C



Coil Type A

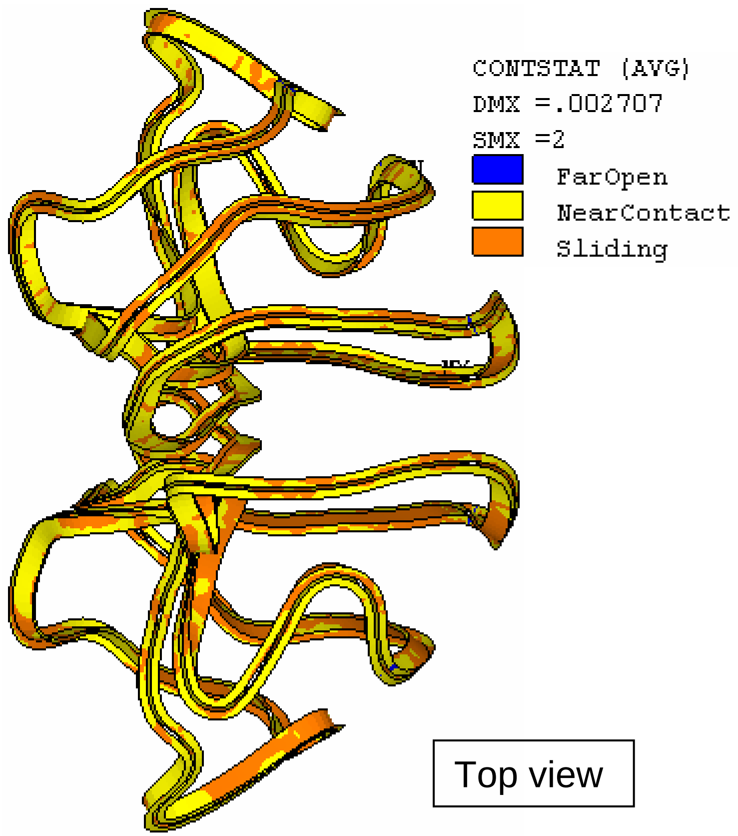


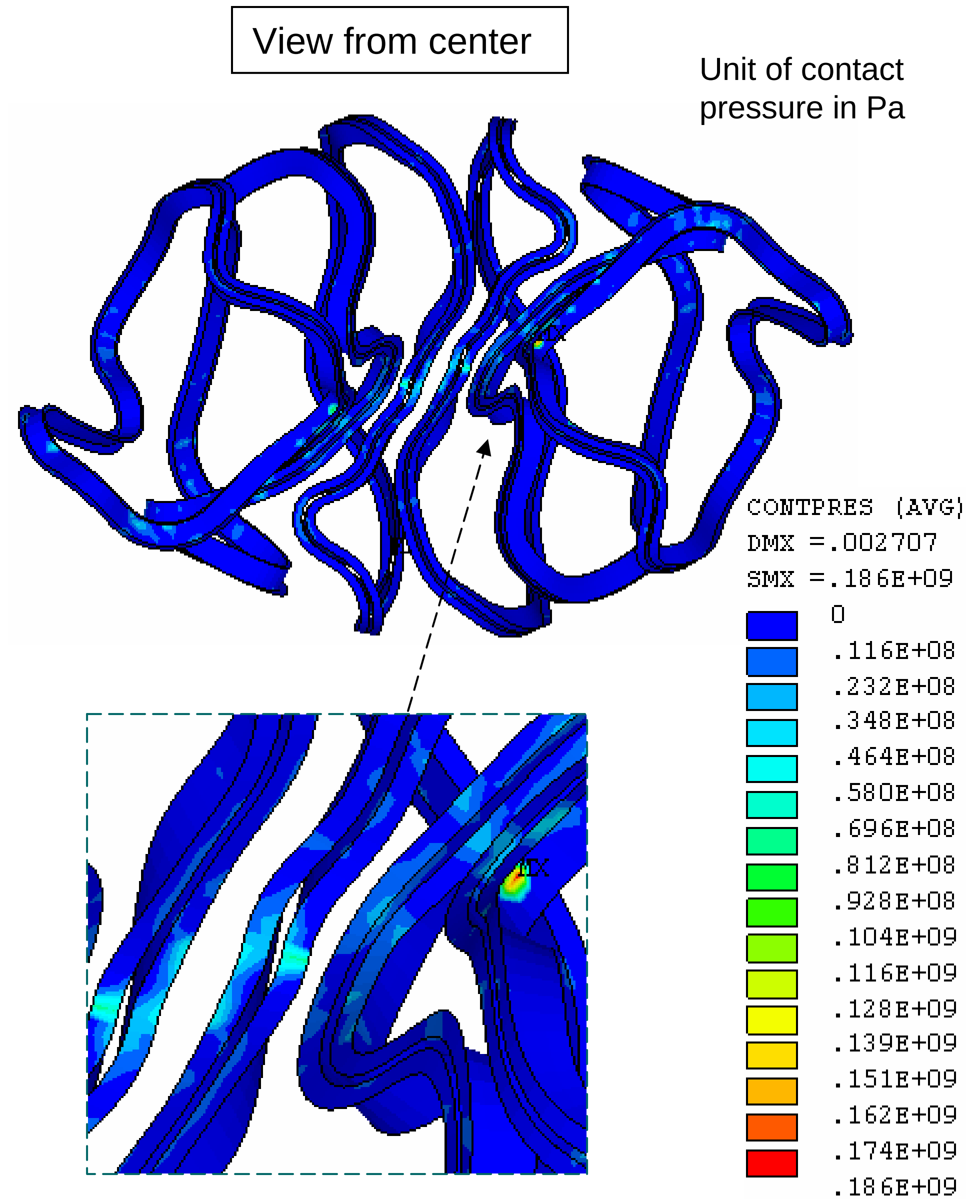
Top view

Unit of gap distance in meter

Modular Coil Contact Pressure and Contact Status

- The tees and modular coils are general in sliding contact or near contact status
- Higher contact pressure locations are found in the inboard regions.





Summary and Further Work

- The gap and sliding between the modular coil and tee are the results of cooldown of winding to 80°K
- On the base of the selected material properties, the assumed contact properties, and the designated base support locations, the stresses and displacements of the modular coils and the shell structure are as follow:

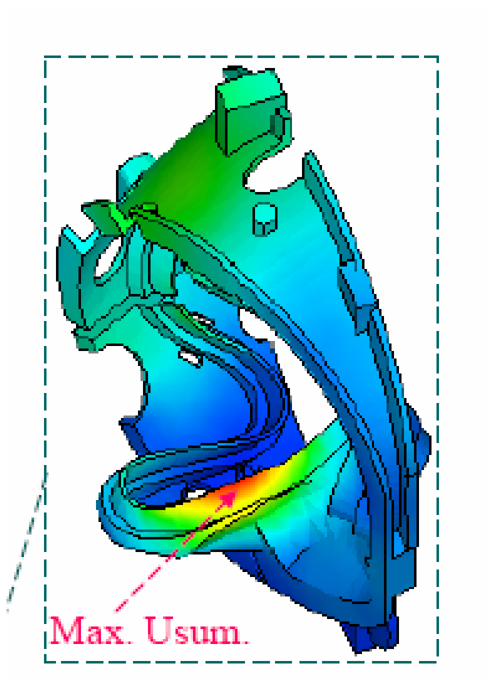
	E (GPa)	Max Displacement (mm)	Max von Mises stress (MPa)	Max axial stress (MPa)
Shell Type A	145	1.124	161	
Shell Type B	145	2.336	210*	
Shell Type C	145	1.395	180*	
Coil Type A	63	1.589		253
Coil Type B	63	2.493		144
Coil Type C	63	2.707		156

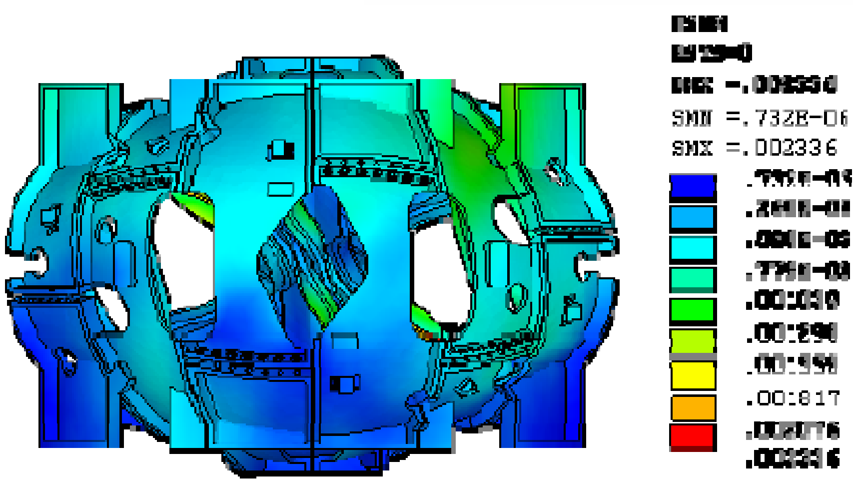
* Note – By neglecting the local peak stress at the corner of the lead opening

- As the magnitude of the material properties has a direct effects on the results, it is recommended that the further analyses shall be performed using the more accurate material properties, such as the test data for the modular coil and the shell casting material.
- The thermal effects of the modular coil during operation shall also be considered.

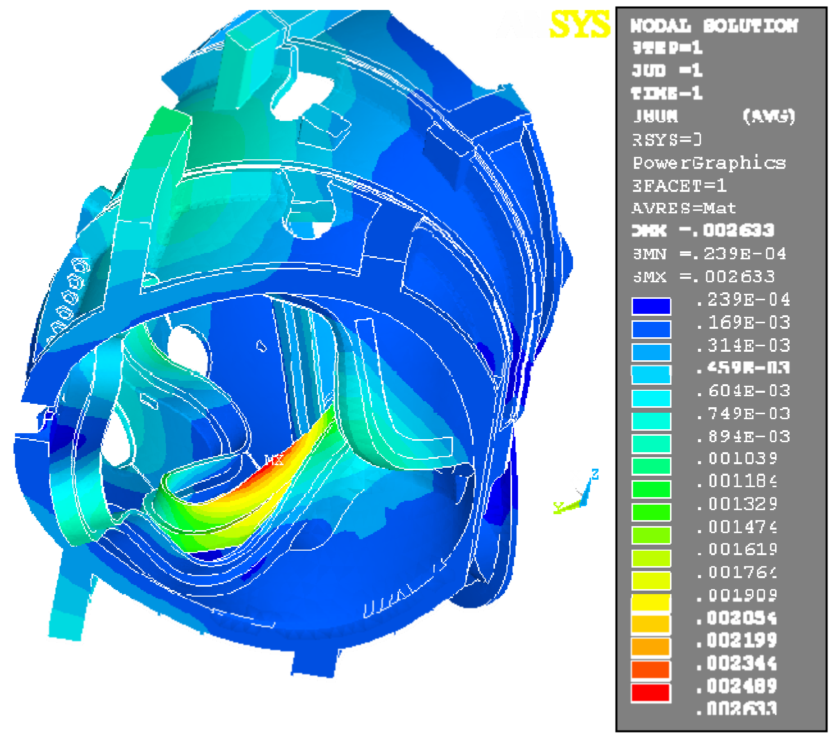
Total Displacements of shell

PPPL Analyses





ORNL Analysis



Max Displacement of both non-linear models occurs on the tee of shell B.

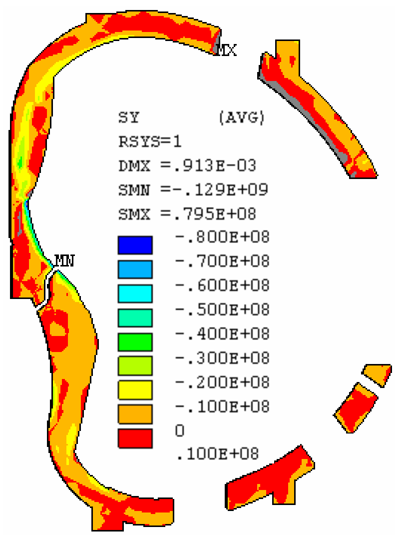
ORNL model: 2.63 mm max defl.

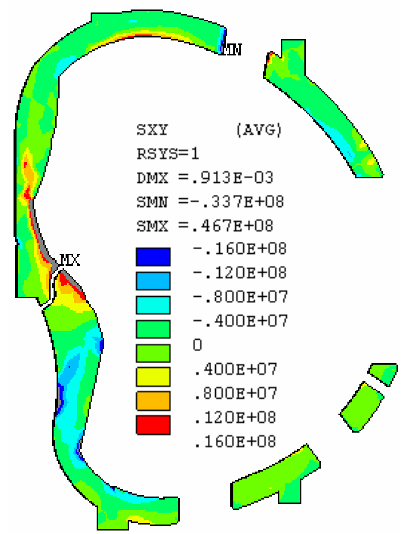
PPPL model: 2.34 mm max defl.

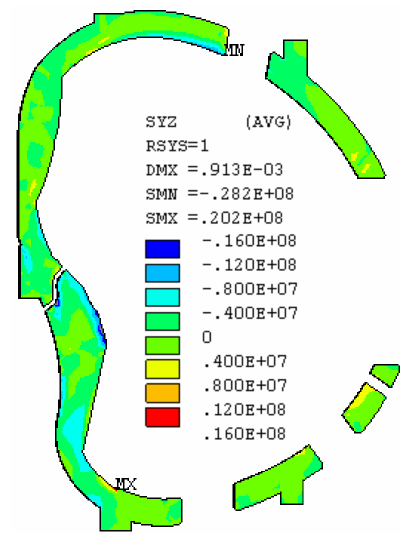
Normal Stresses and Shear Stresses for the Flange Spacer Elements at 20° [Comparison]

Normal stress | Radial shear Stress | Vertical shear stress

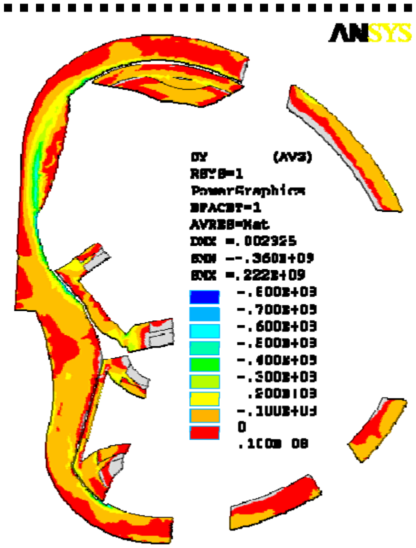
PPPL

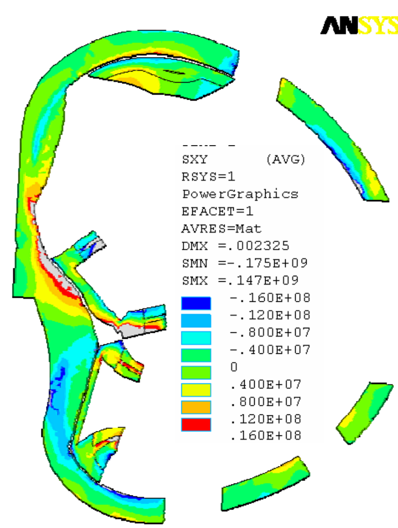


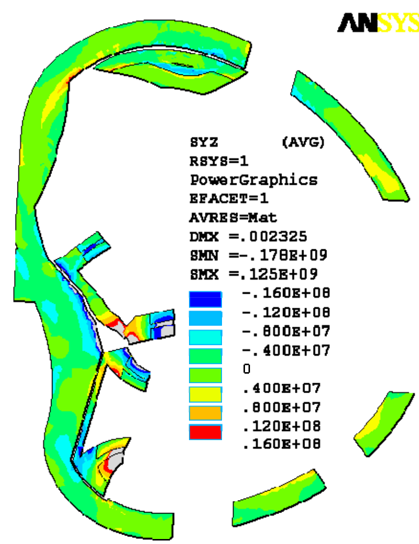




ORNL



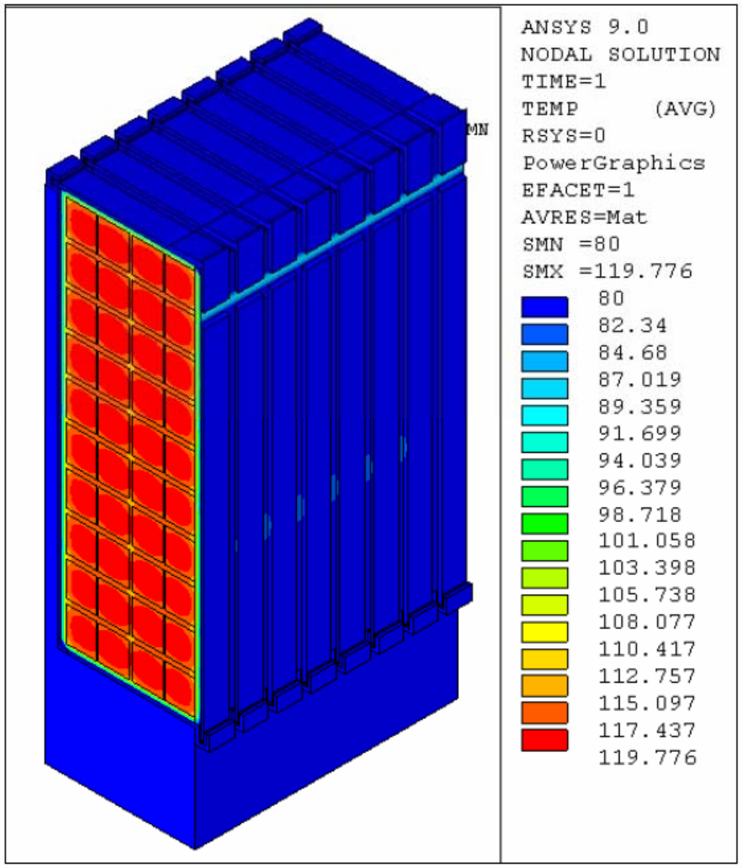




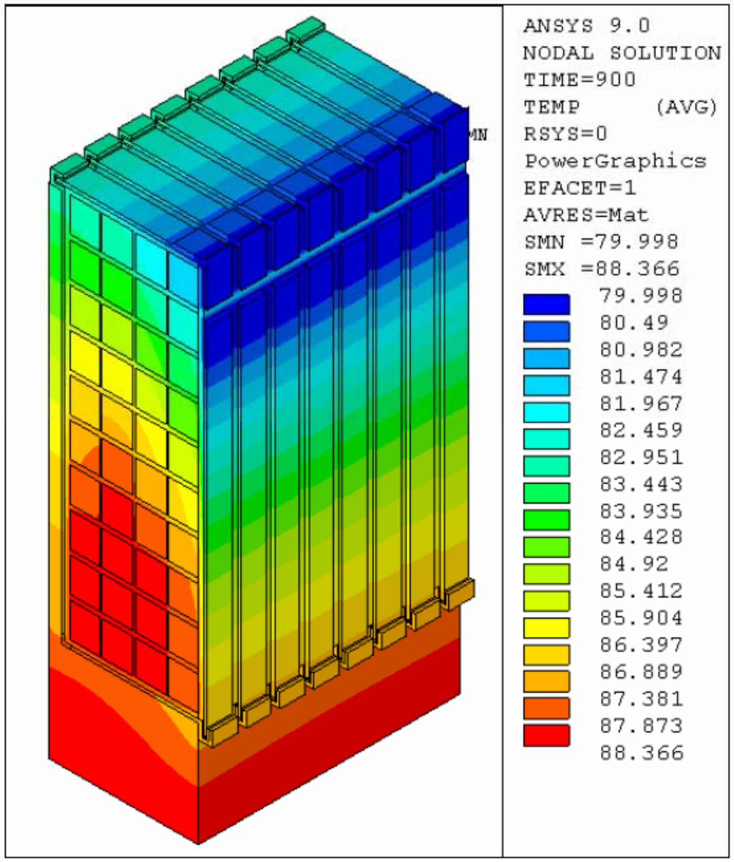
Winding Pack Thermal Analysis

- Temperature dependent heat generation (see next slide)
- Crimp conductivity set to 100 W/m-K
- Groundwrap overlap is reduced from 2X to 1.3X.
- Copper thickness is 0.04 in.
- Pulse shot is still 2T, high beta, 10,390 Amps/cable.
- Cool down time is still 15 minutes.

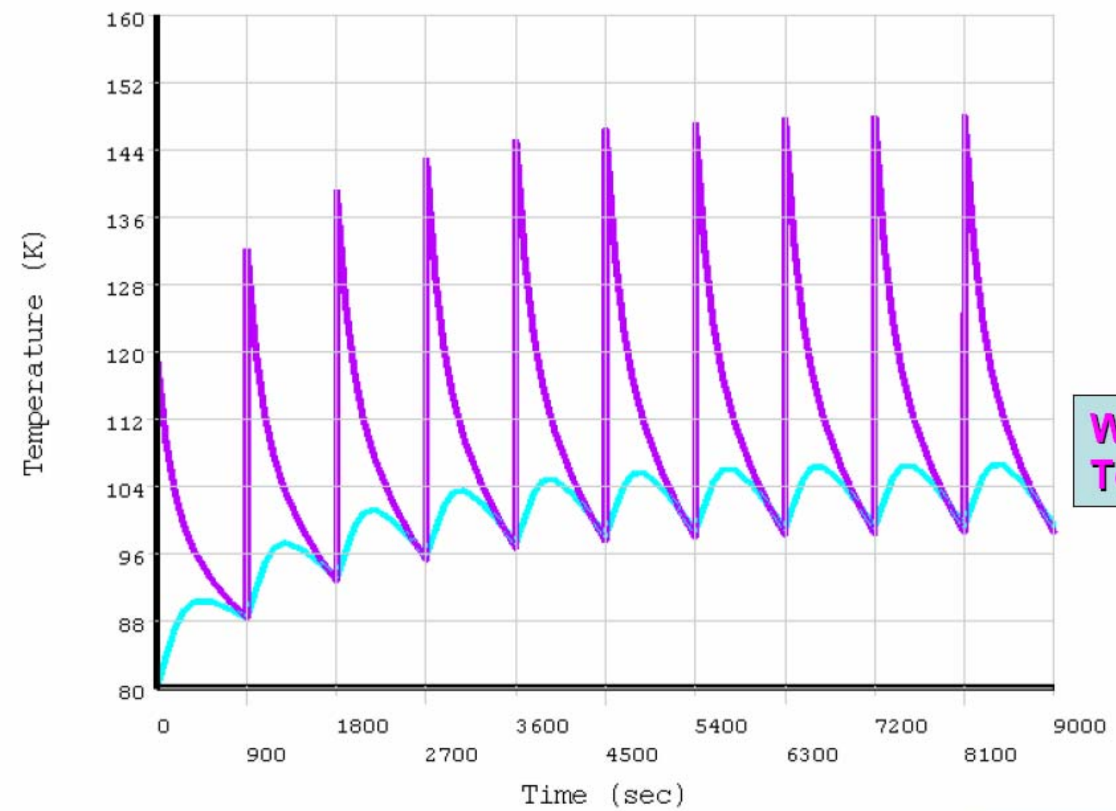
NCSX



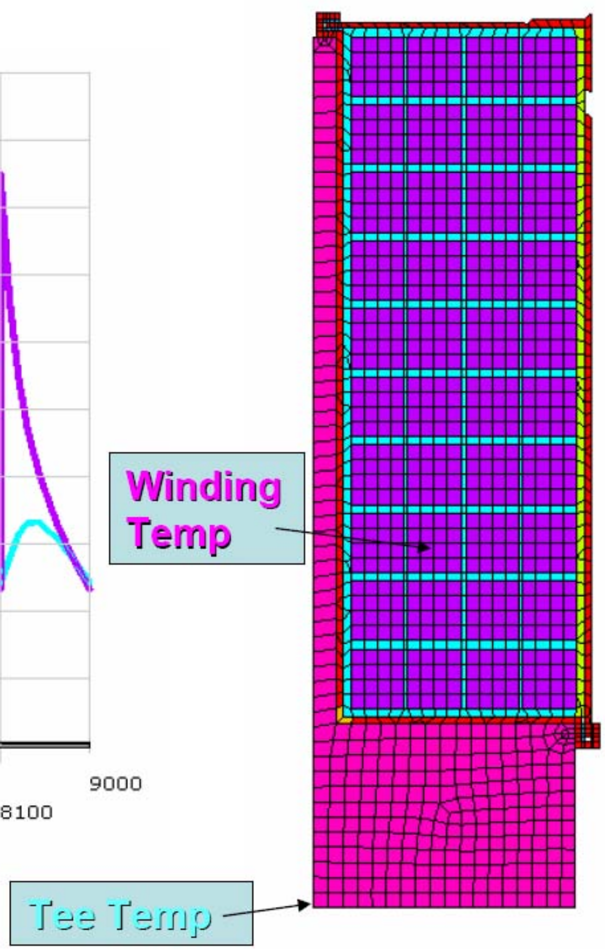
Immediately after pulse



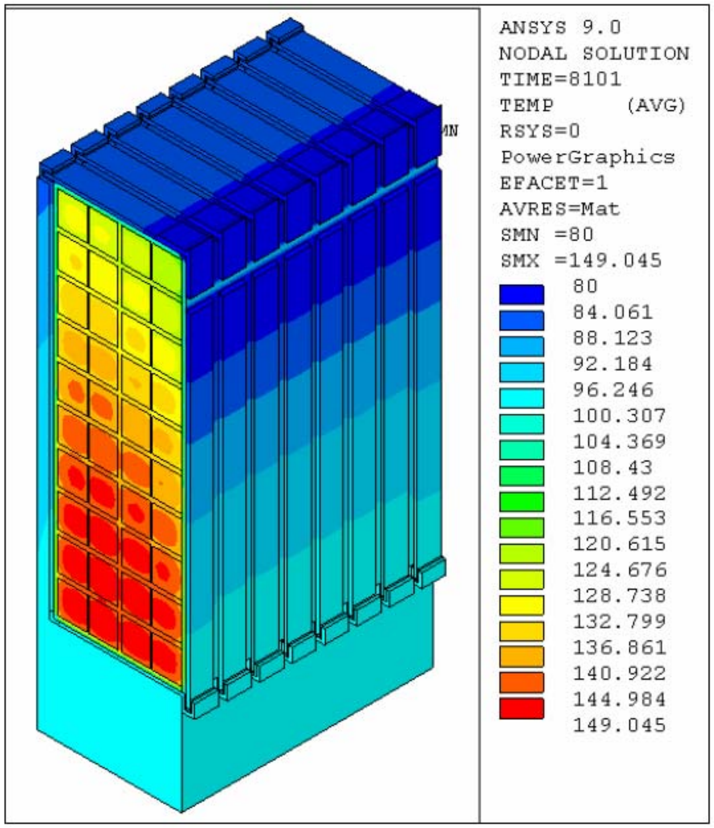
T = 15 minutes (after cool down)



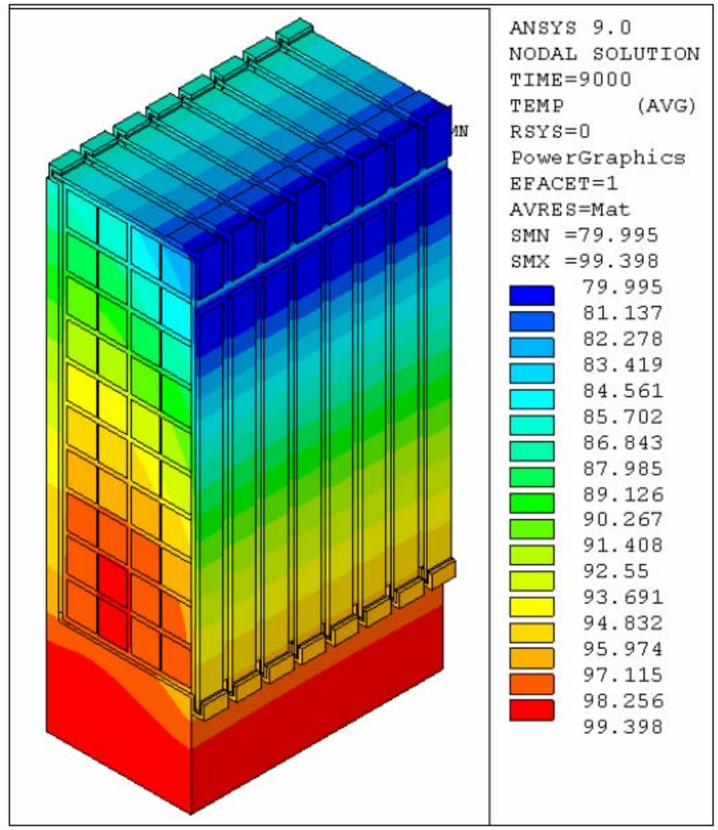
Temperature (K)
160
152
144
136
128
120
112
104
96
88
80
0
900
1800
2700
3600
4500
5400
6300
7200
8100
9000
Time (sec)



Winding Temp
Tee Temp

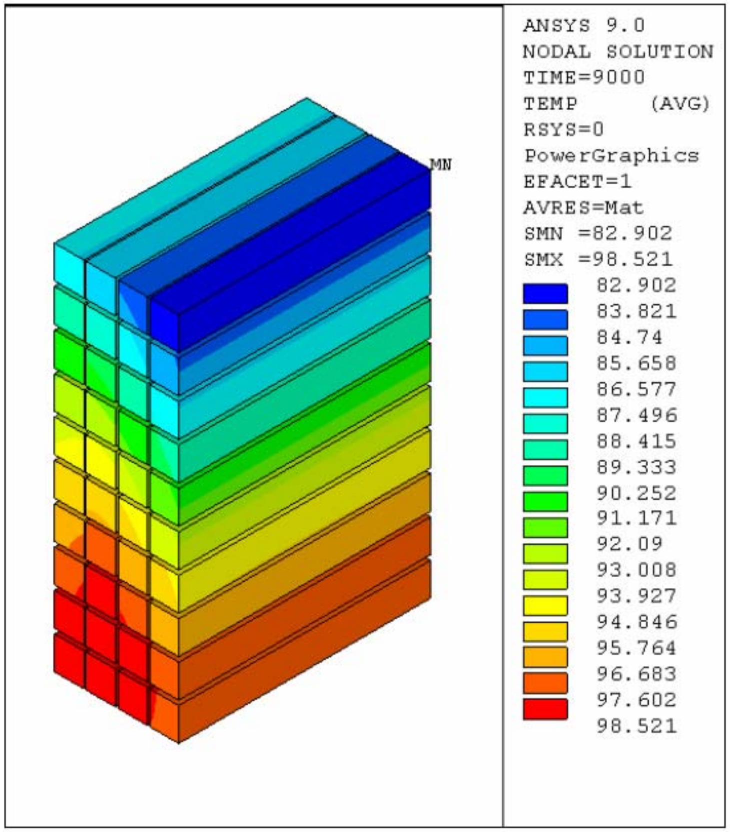


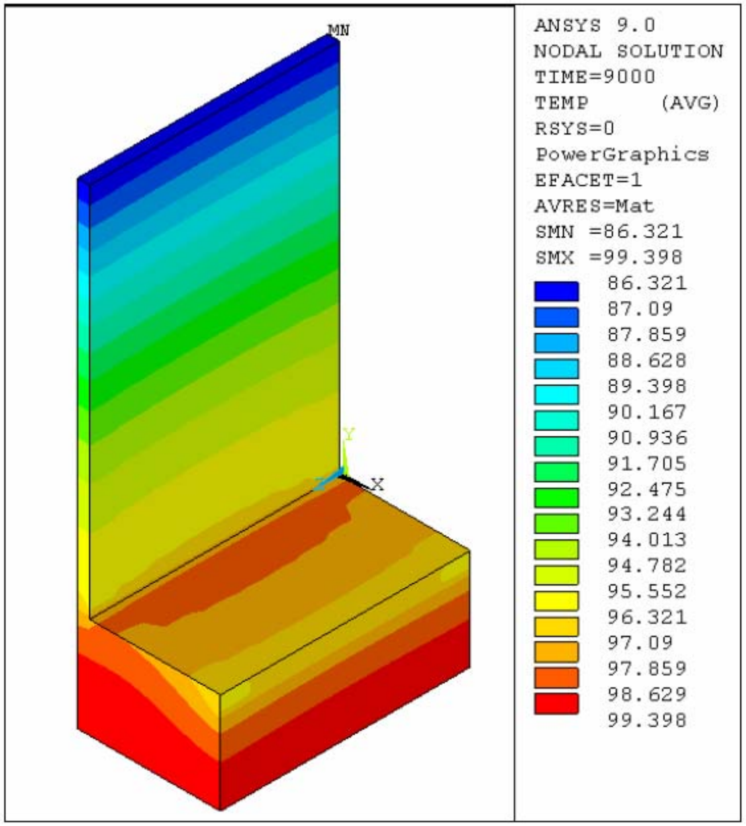
Temperature after the 10th shot



Temperature after the 10th cool down

After 10th cycle (winding and tee isolated)





Conclusion

NCSX National Compact Stellarator Experiment

- Are the coil assembly models and drawings complete?
  Yes. Drawings include clamp mods, fittings, TCs, strain gages

- Have post-VPI coil mods and punch-list items been addressed?
  Yes. Notes added to subassemblies or top-level drawings

- Is the model tree / BOM complete?
  Yes. Need to promote catalog items, clean up “description” attribute, finish check and promote of open ECNs (by 11/07)

- Is the modular coil analysis documentation checked/complete?
  Yes. Kevin and HM’s analysis in agreement, documented

- Have prior design review chits been addressed?
  Most can be closed, except leads analysis, final specification of strain gages for last field period, possible addition of brackets to support power cable routing (by 11/07)