

WBS 1 Activities after Proj. mtg

- Vessel segmentation
 - Several options studied
 - No conclusions yet
- NEEWC sample of larger square conductor
 - Higher packing fraction
 - Bend radius criteria too tight
- Coil cooling
 - HM has done FEA analysis
 - Paul Goranson has reviewed N2 cooling

Limit based on small conductor

- Compacted cable produced so far is only 7 mm square, compared to baseline design size of 13 x 16 mm.
- This cable is very flexible, and can be readily wound on a radius of 1.5 times the conductor thickness
- **Bend radius of 3 times the thickness** is recommended to avoid excessive key-stoning and bunching

Before
compaction



After
compaction

NEW ENGLAND ELECTRIC WIRE CORPORATION

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NEW ENGLAND PART NUMBER: NELD7920/36SSOPODN

TYPE & LITZ: (FAN COPPER)

3/0 AWG 12X5/3/44/36 SINGLE SOLDERABLE POLYESTER
(MW77-C), DOUBLE NYLON SERVE TO .419" +/- .010" BY
.583" +/- .010" DIMENSIONS

FINAL LAY = 6" LHL

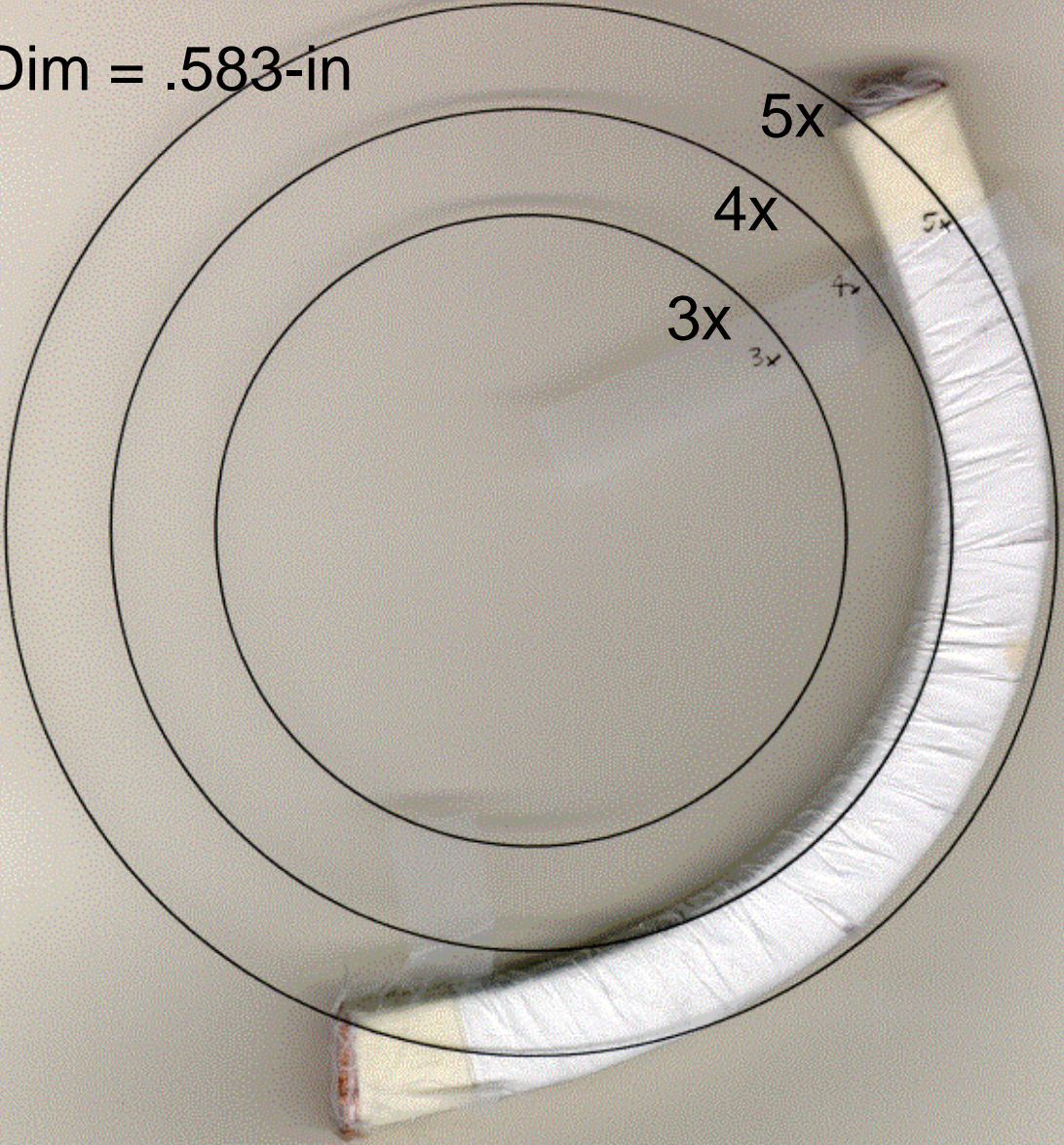
NOMEX 411 OVER ABOVE CONSTRUCTION

78% COPPER



ch

Dim = .583-in



5x

4x

3x

5x

4x

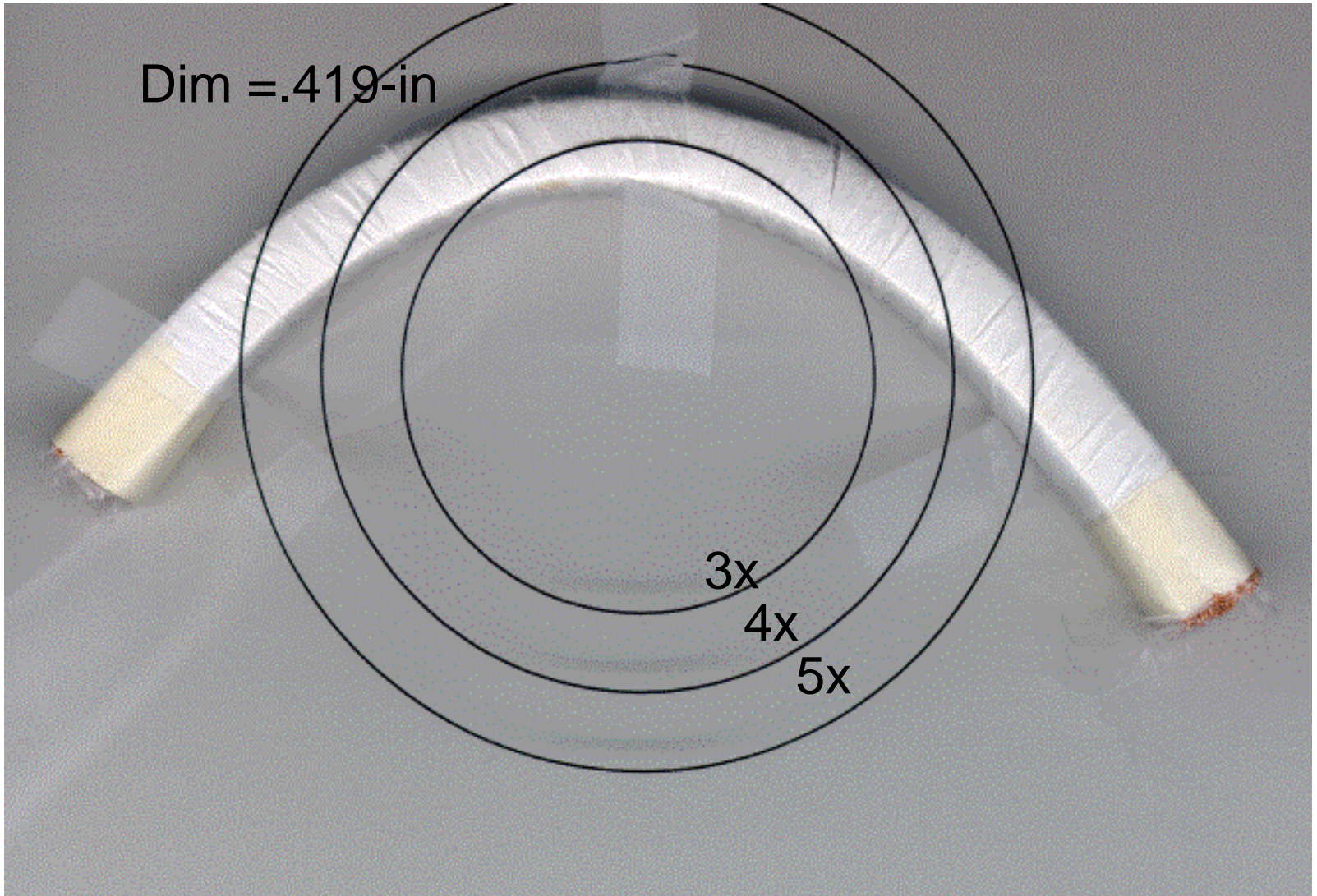
3x

Dim = .419-in

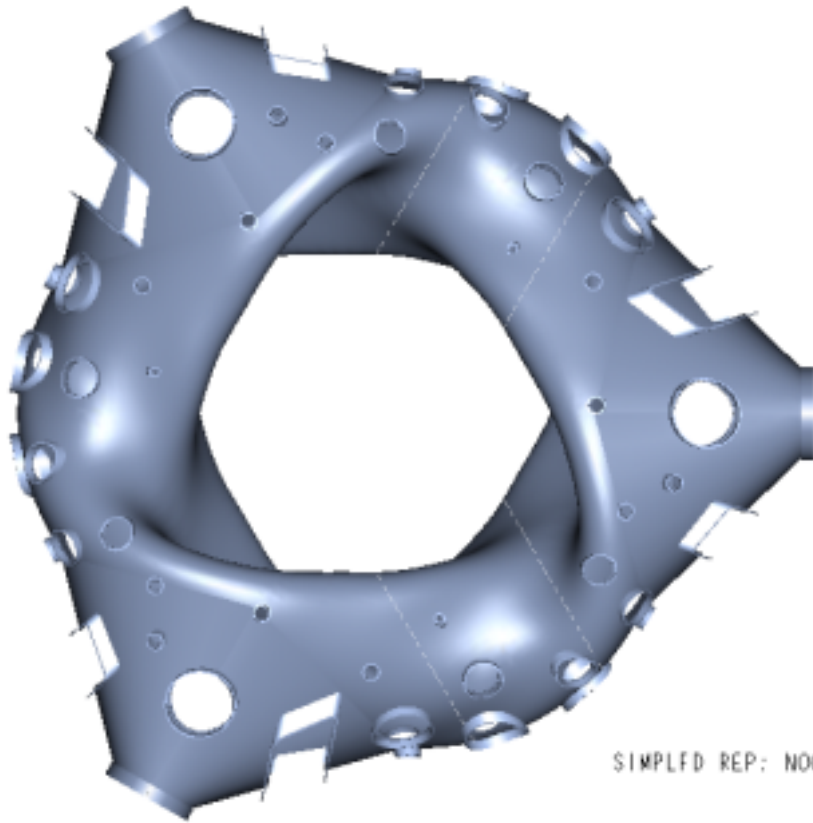
3x

4x

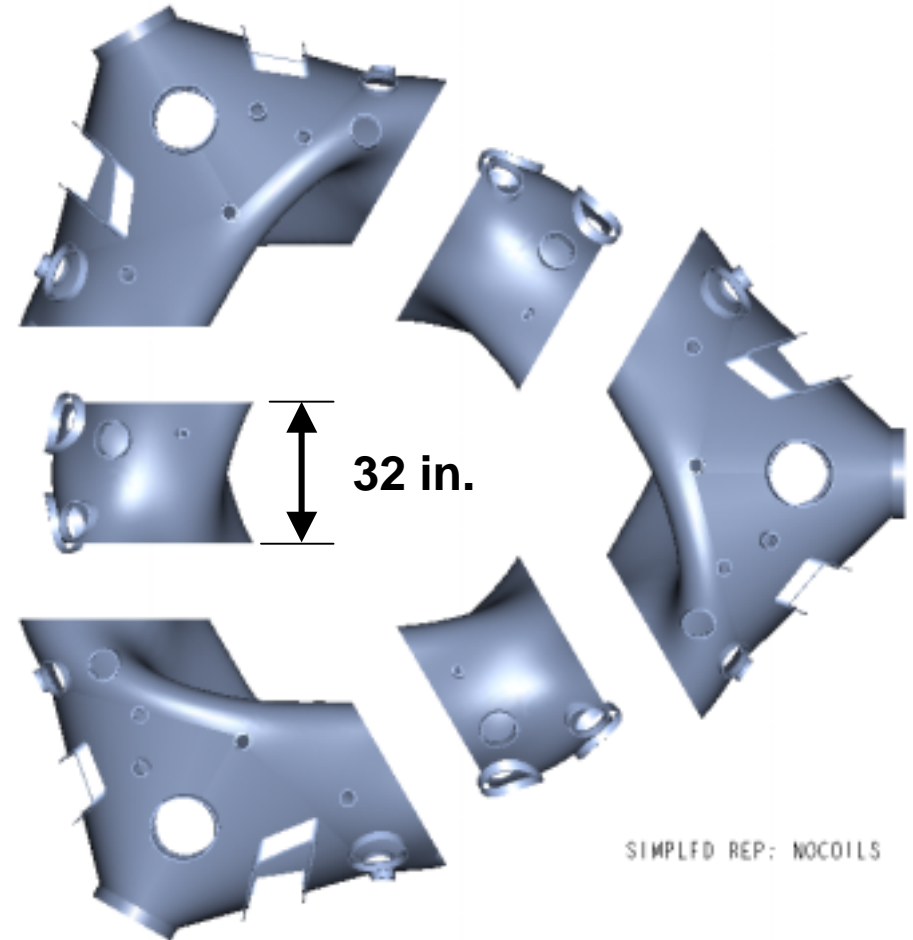
5x



Alternate VV segmentation



All segments assembled

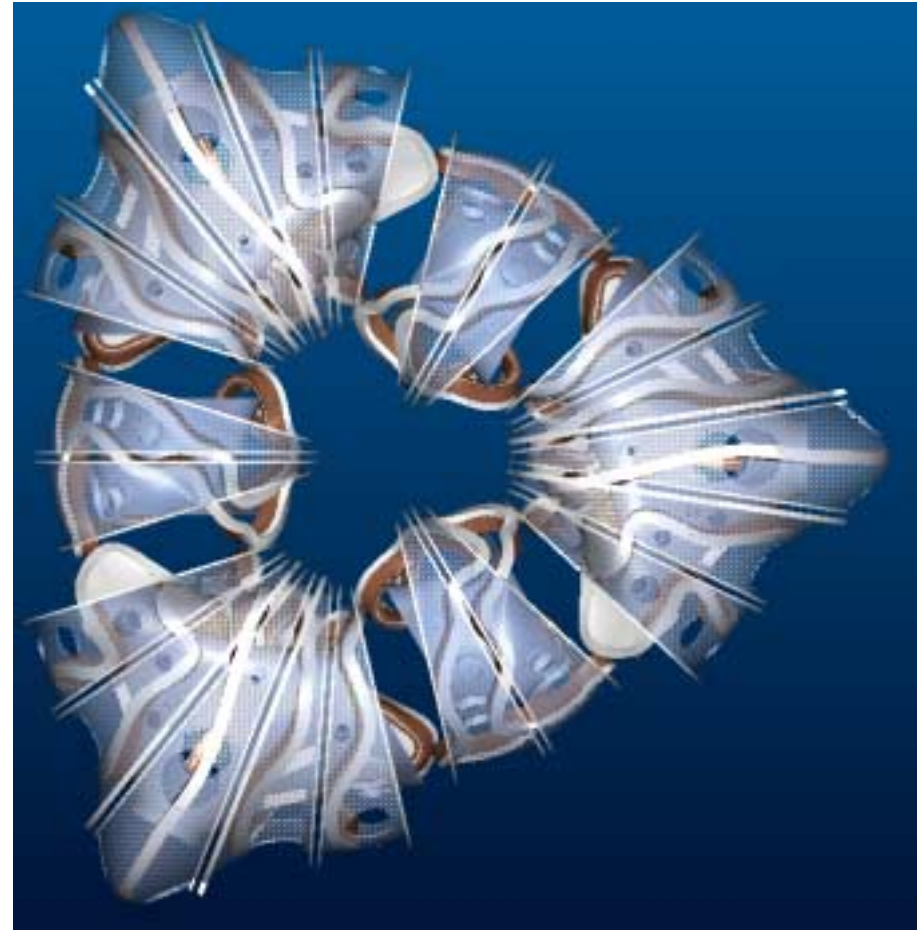


Larger segments retracted
20 inches radially

Alternate VV segmentation, w/coils

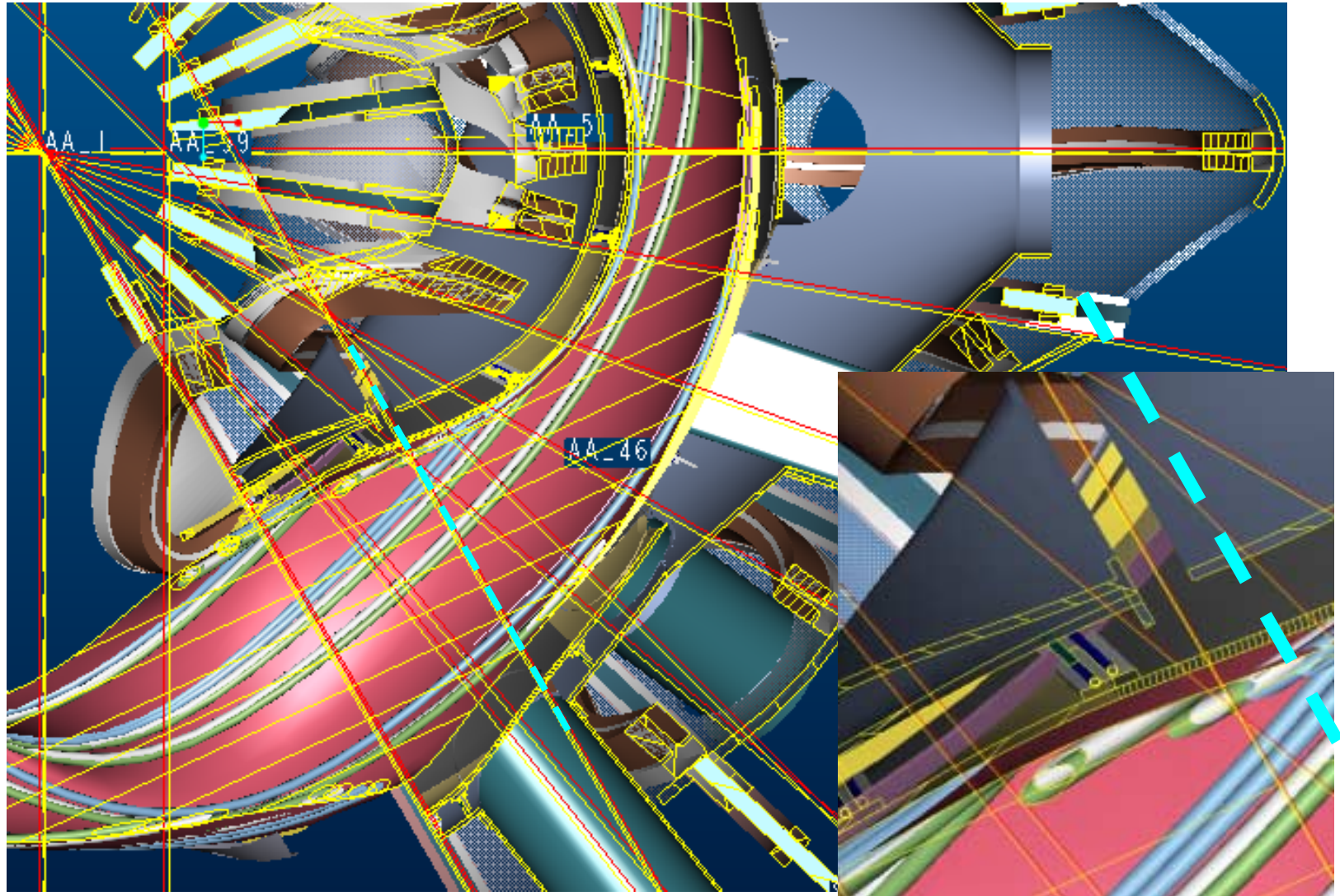


All segments assembled

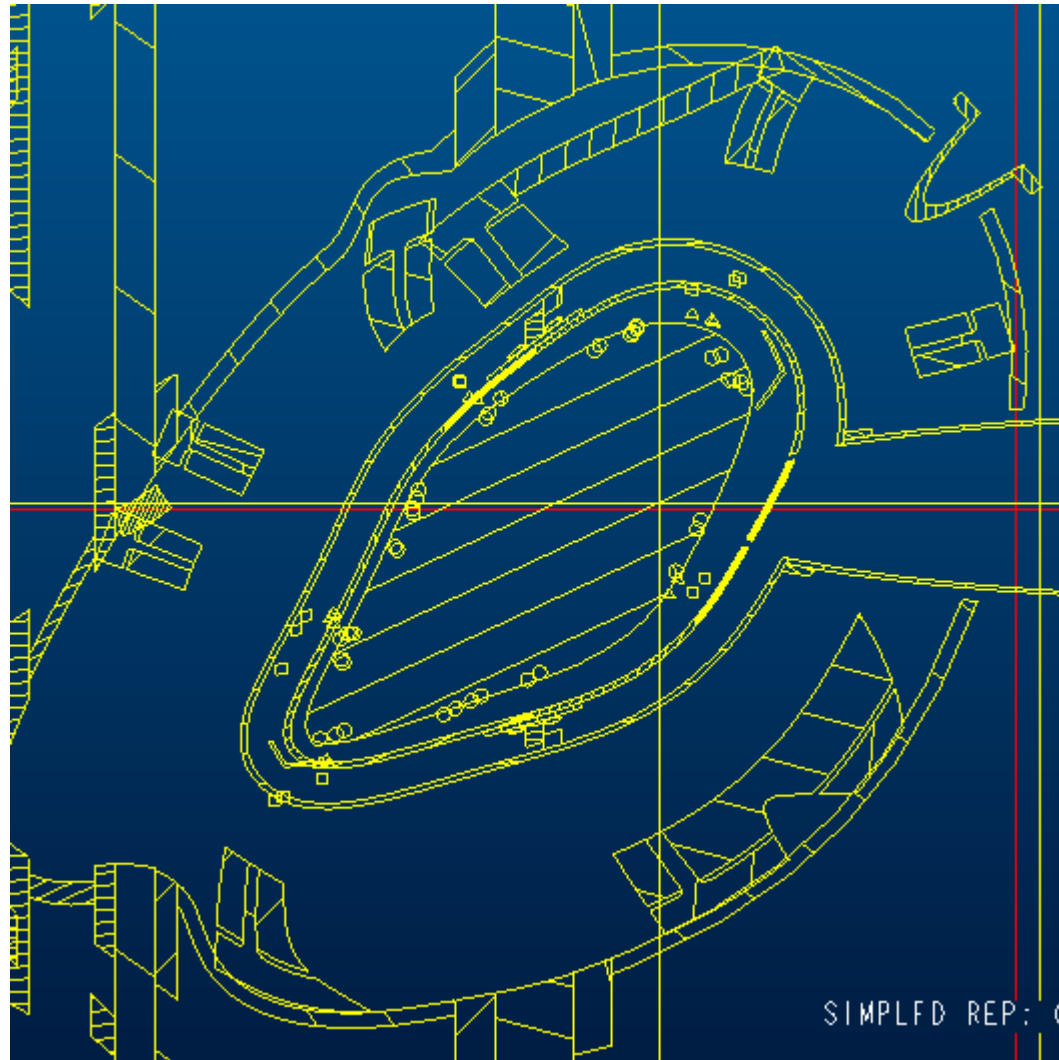


3-coil segments retracted
20 inches radially

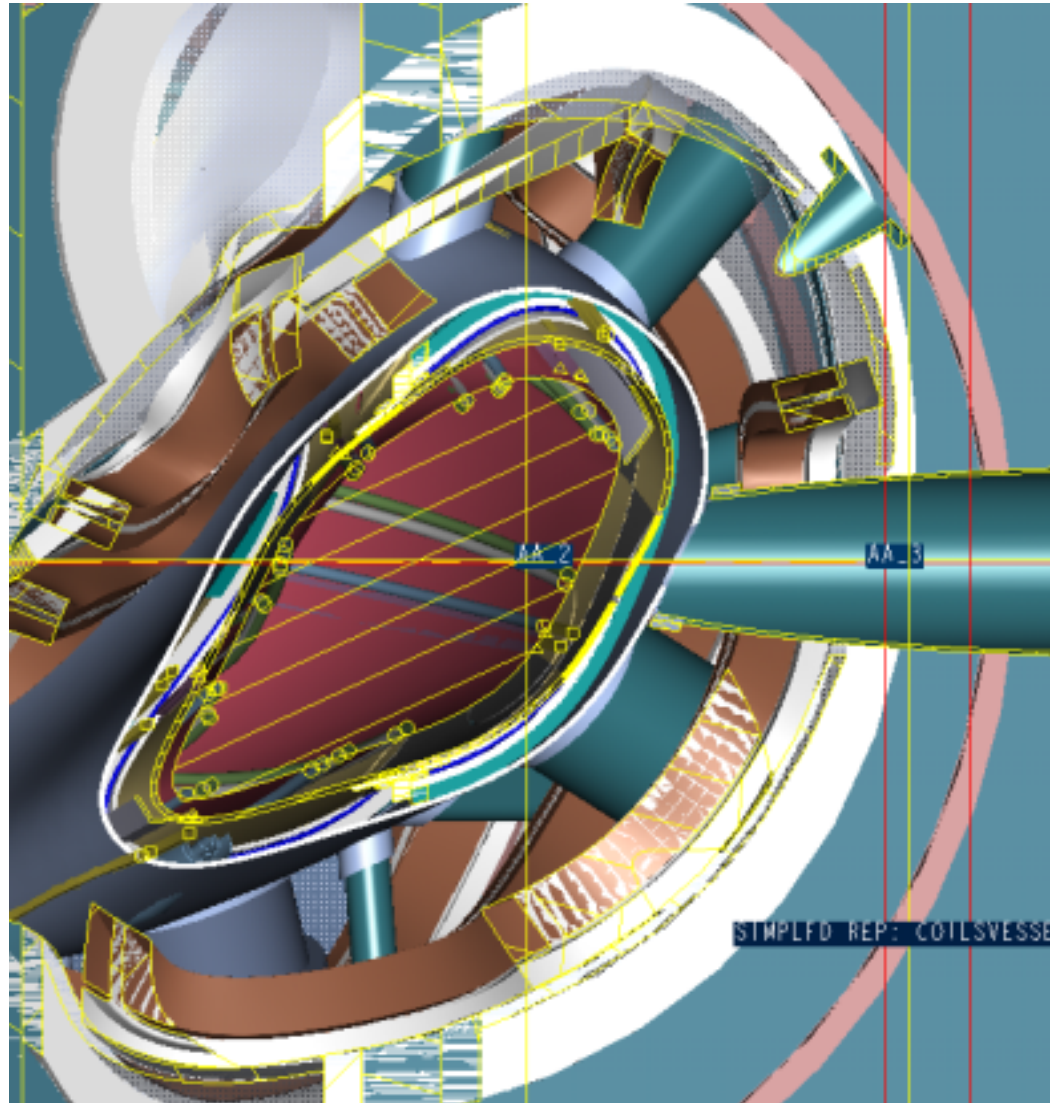
16 inch offset from 60 deg - plan



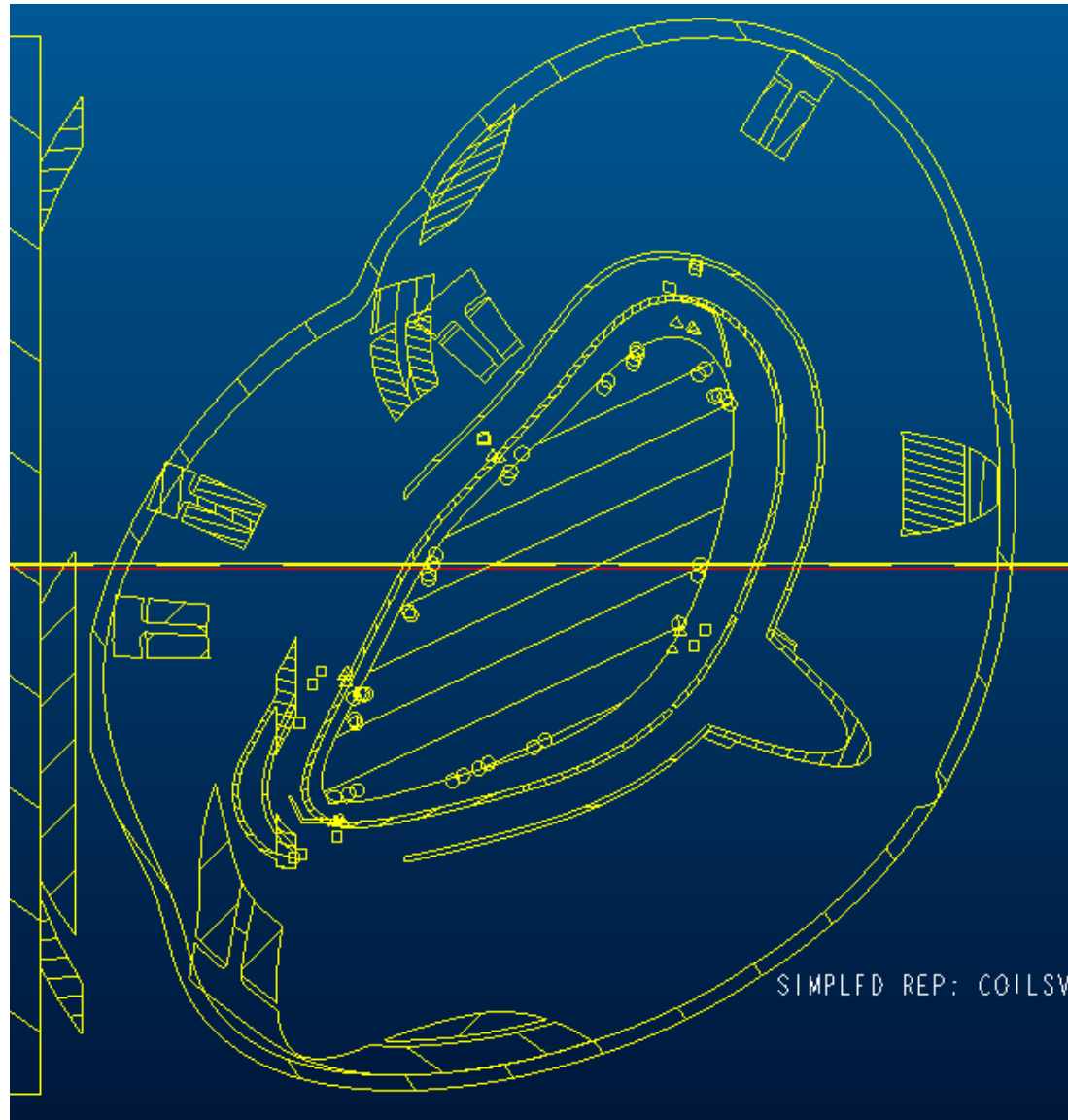
16 inch offset from 60 deg



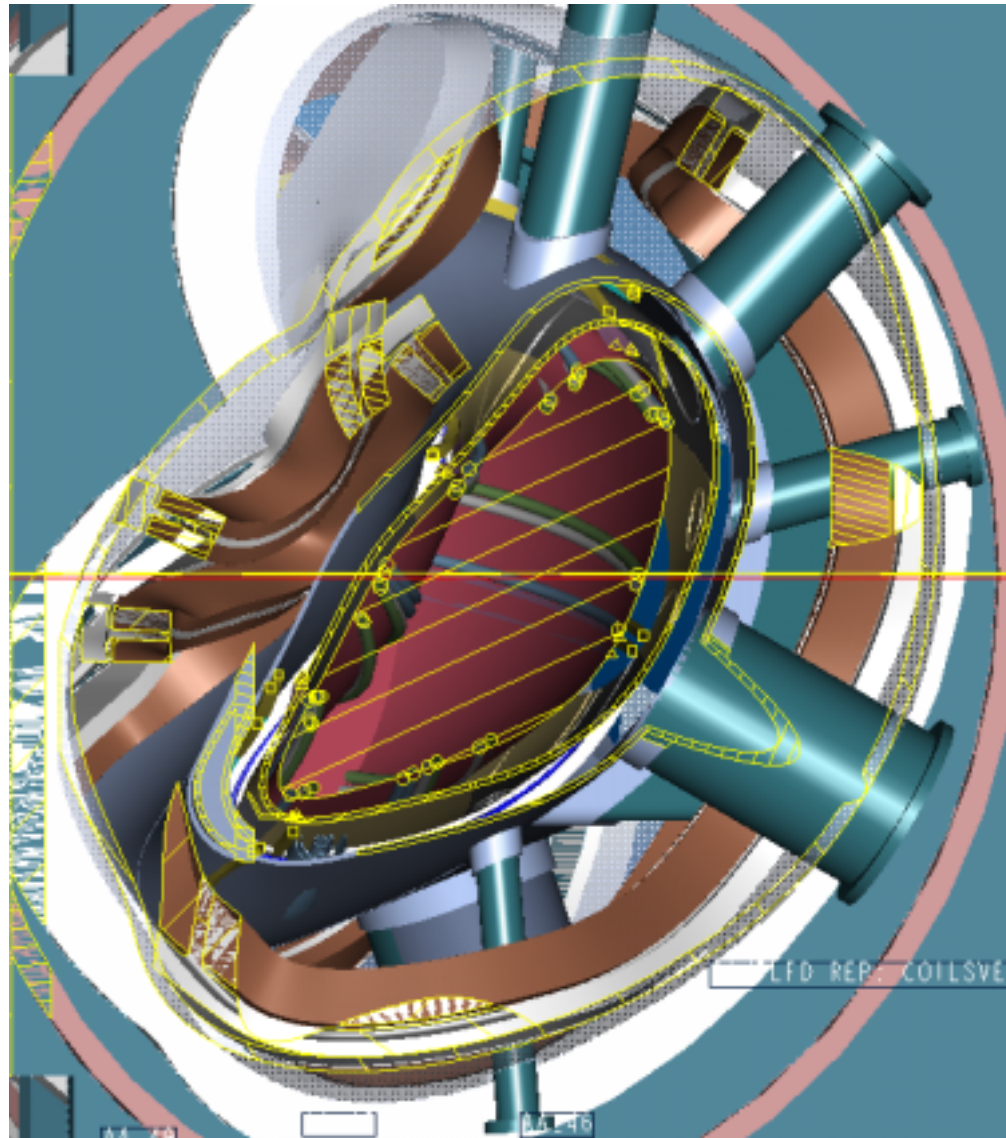
16 inch offset from 60 deg



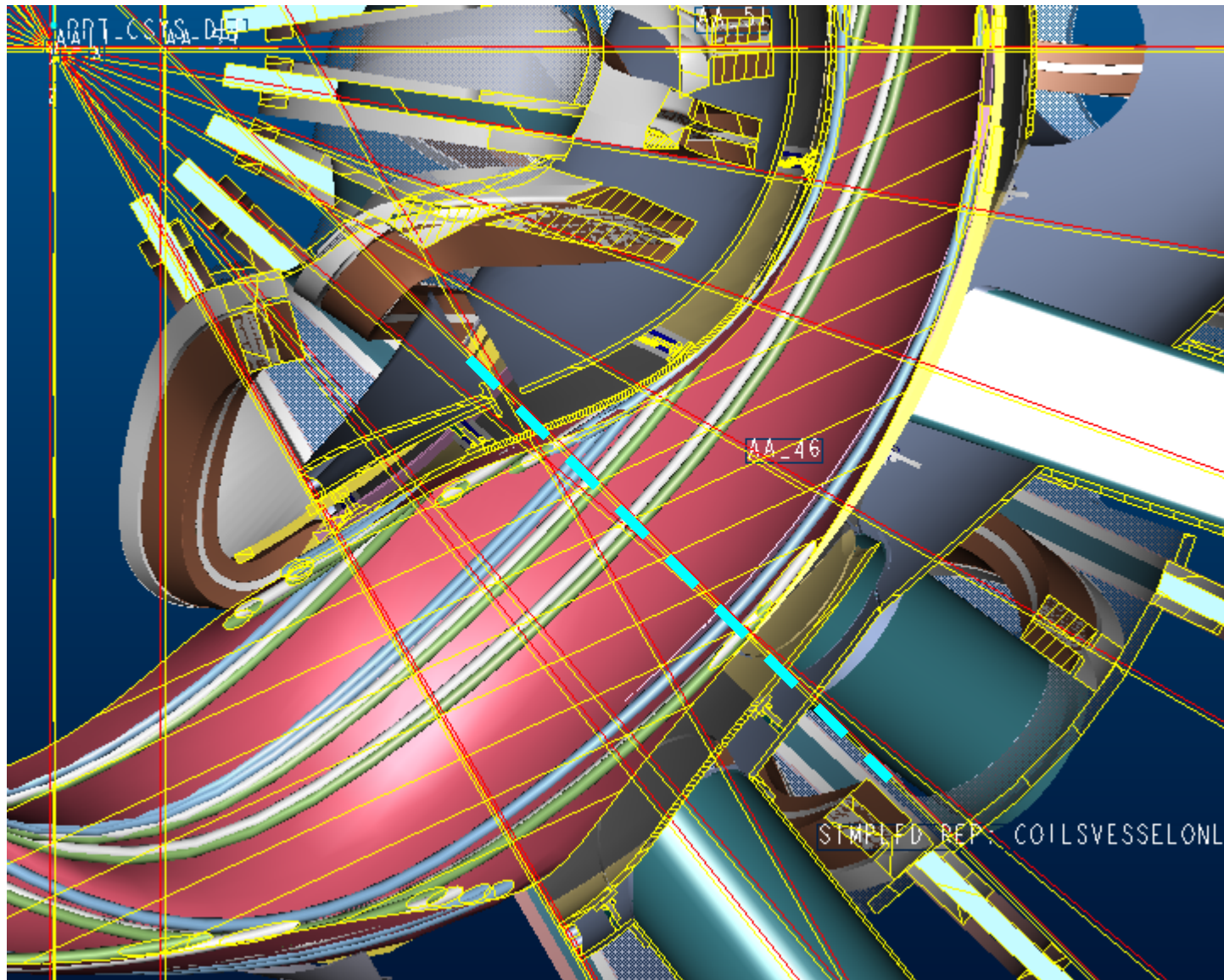
45 deg from 8 inch axis



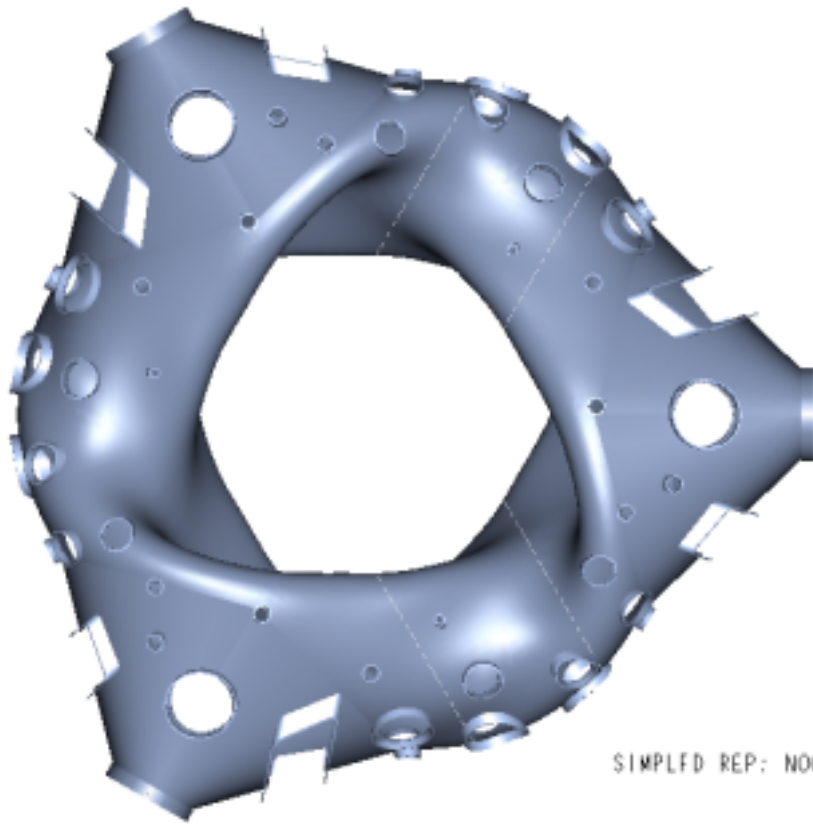
45 deg from 8 inch axis



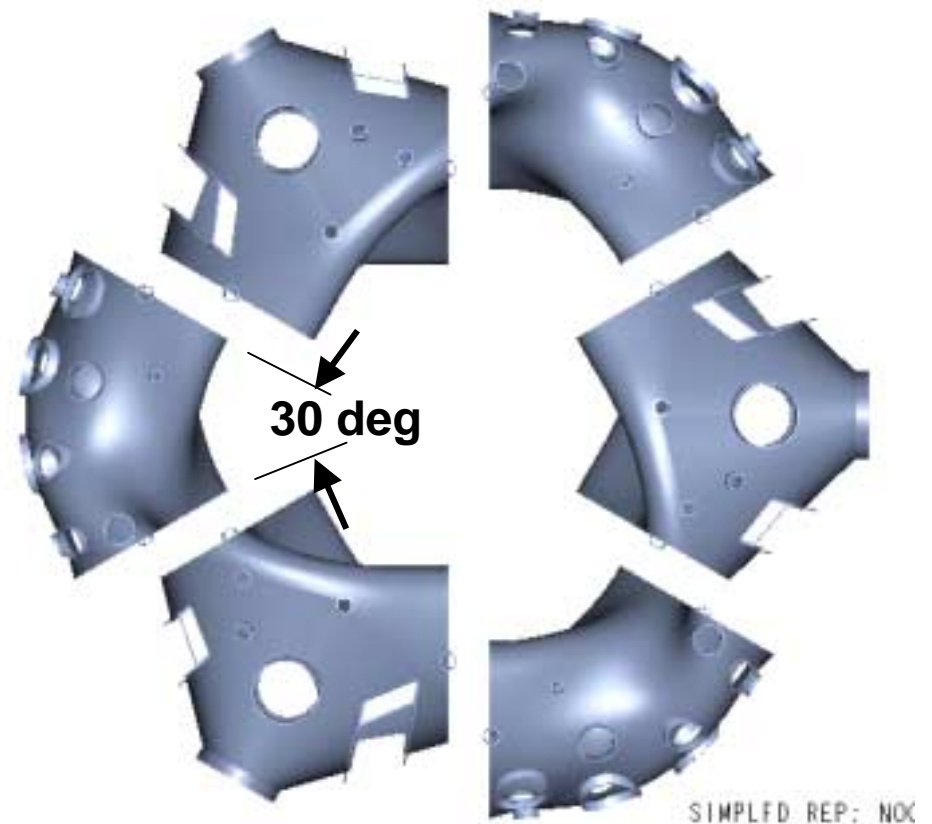
45 deg from 8 inch axis - plan



Alternate VV segmentation



All segments assembled

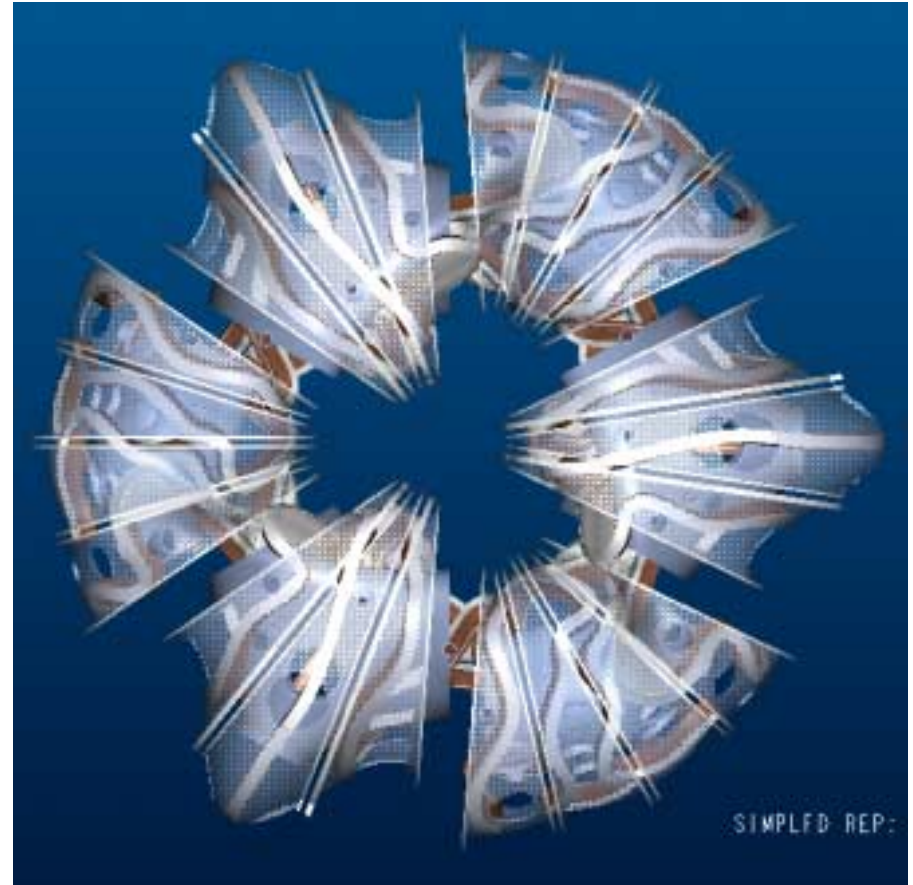


Larger segments retracted
20 inches radially

Alternate VV segmentation, w/coils

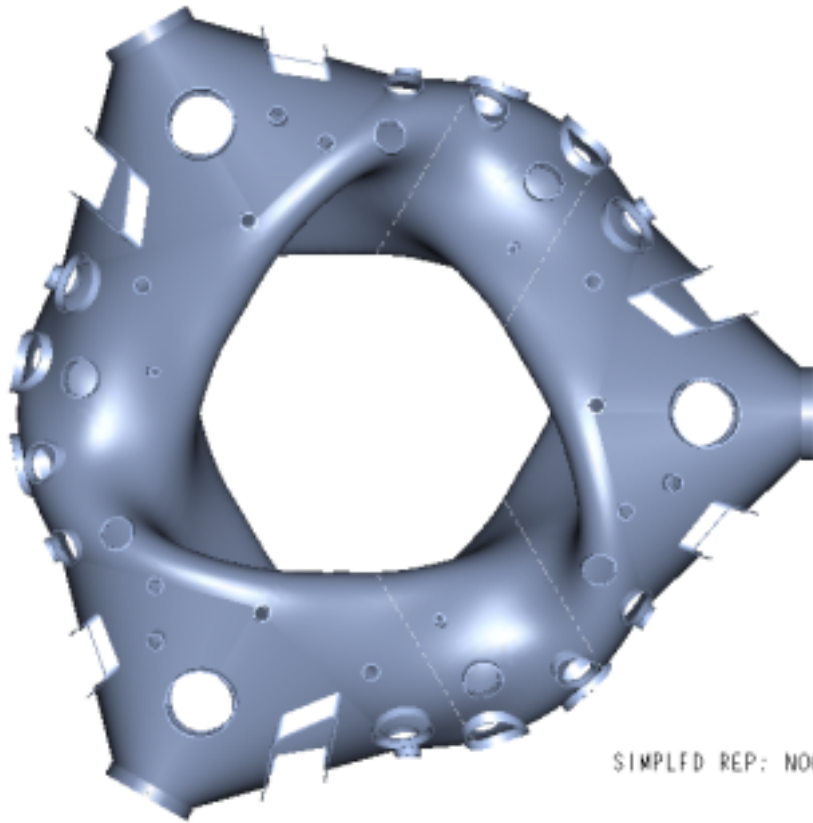


All segments assembled

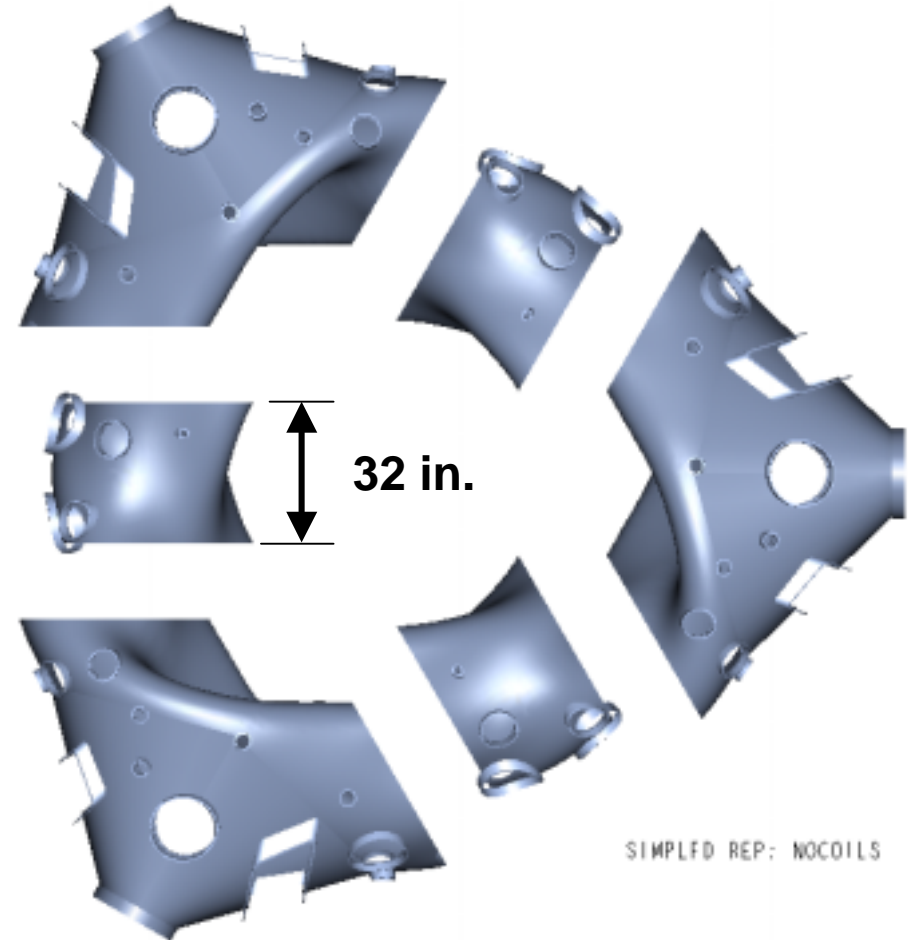


4-coil segments retracted
20 inches radially

Alternate VV segmentation



All segments assembled

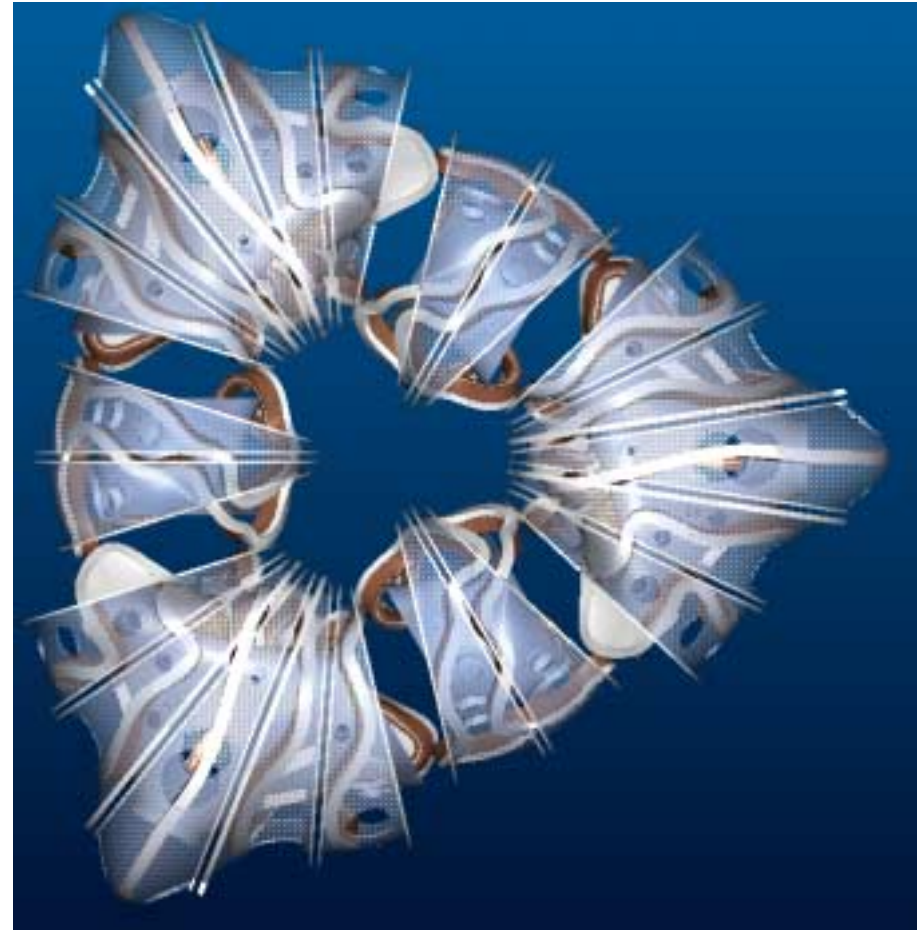


Larger segments retracted
20 inches radially

Alternate VV segmentation, w/coils



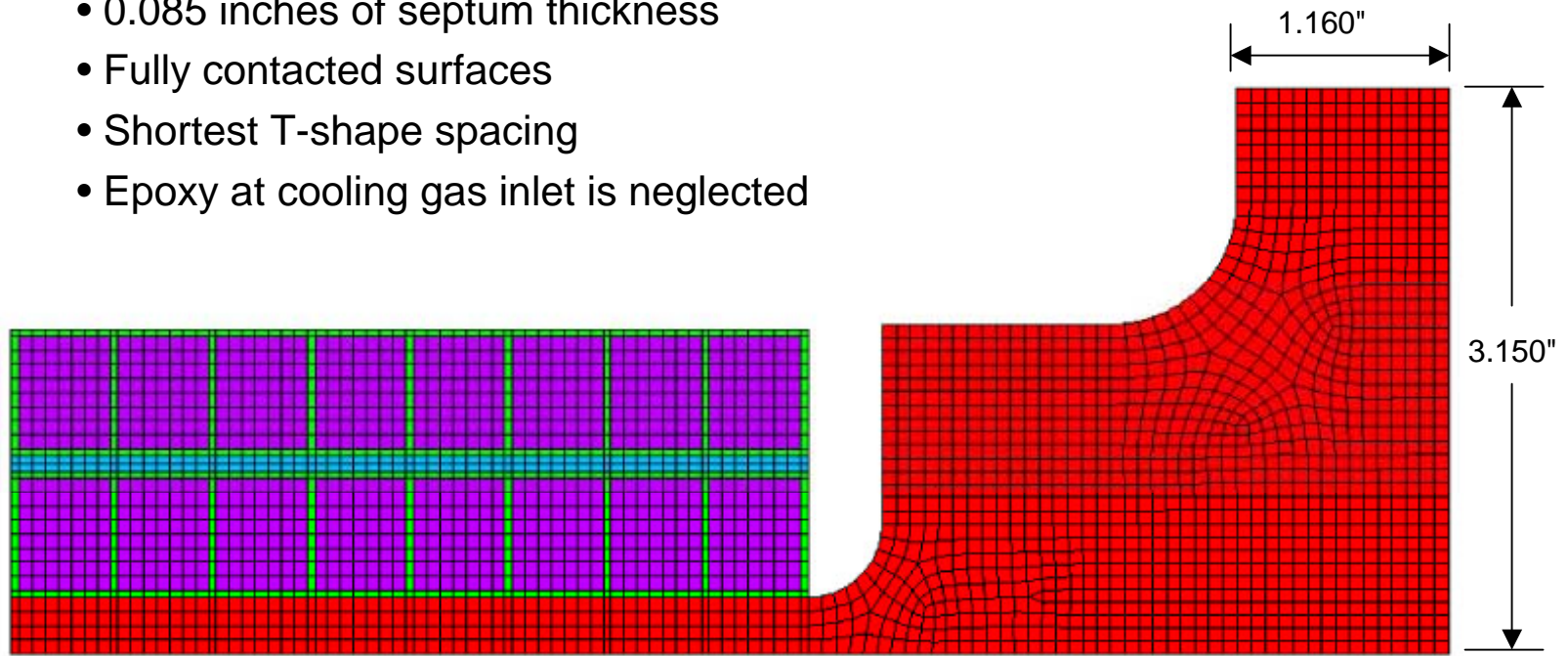
All segments assembled



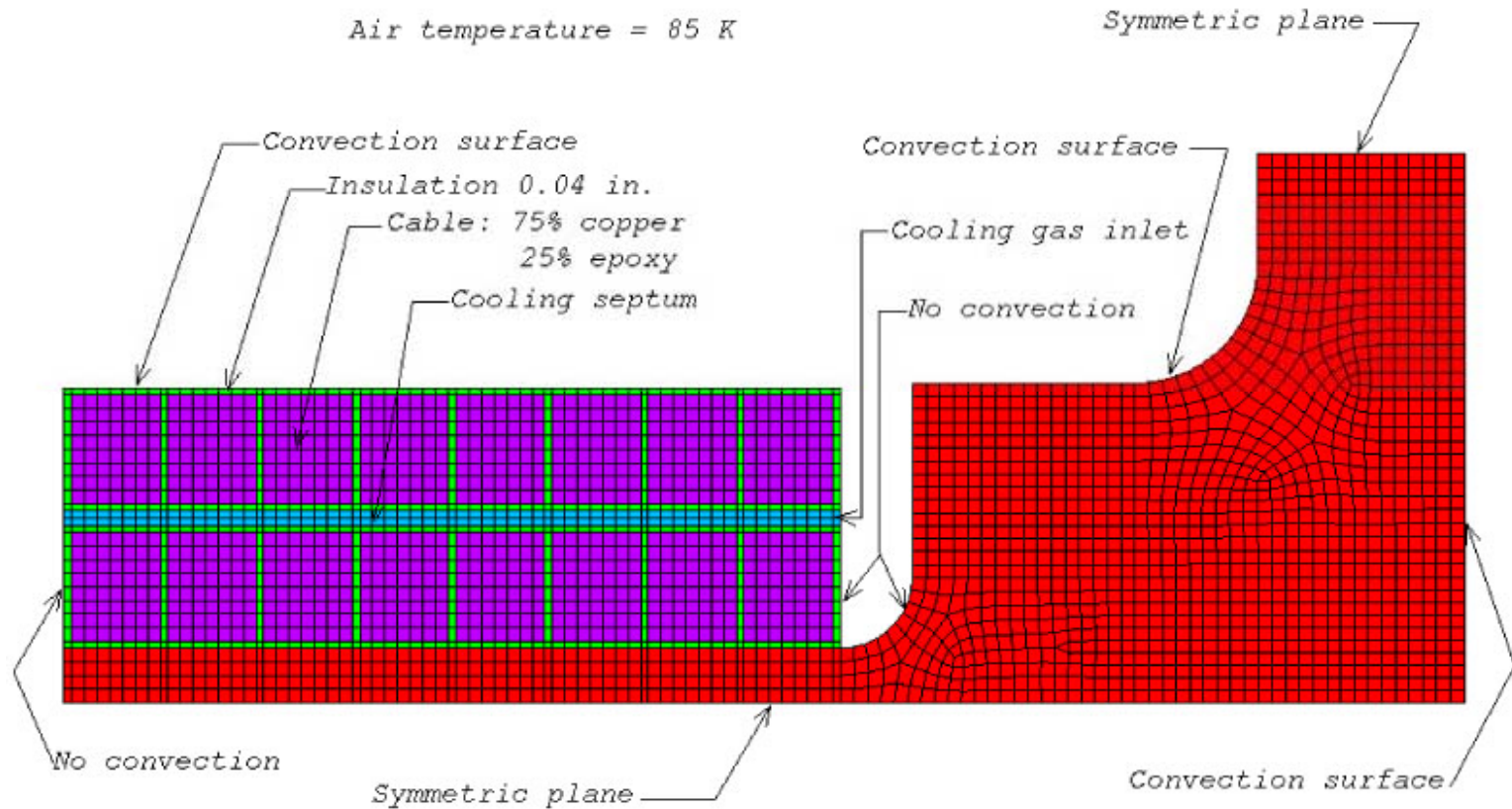
5-coil segments retracted
20 inches radially

Finite Element Model

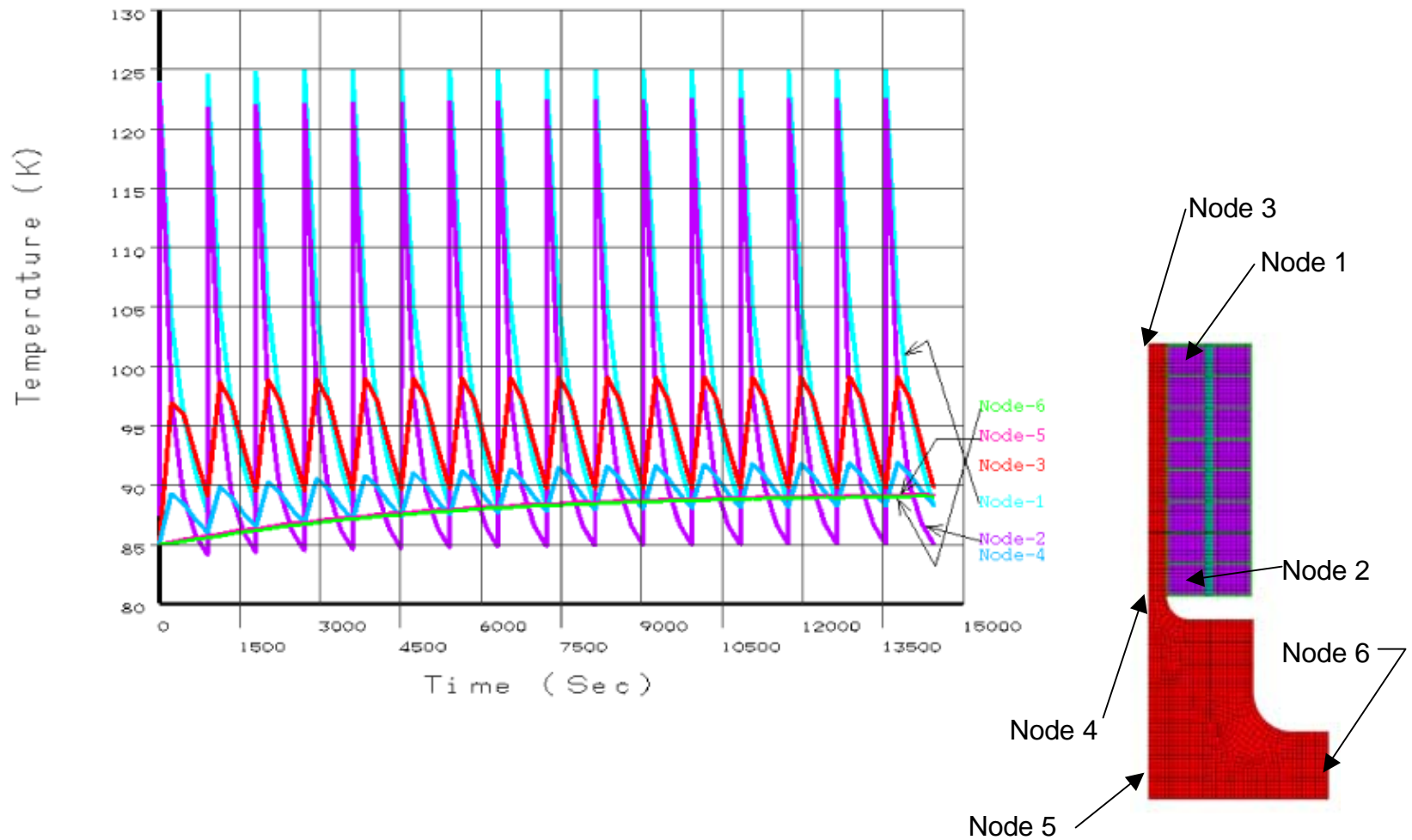
- 2-D model
- Half symmetry is used
- T-shape is cast into the shell
- Cable contains 75% of copper and 25% of epoxy
- 0.040 inches of insulation thickness
- 0.085 inches of septum thickness
- Fully contacted surfaces
- Shortest T-shape spacing
- Epoxy at cooling gas inlet is neglected



Boundary Conditions



Temperature vs. Time on Selected Nodes

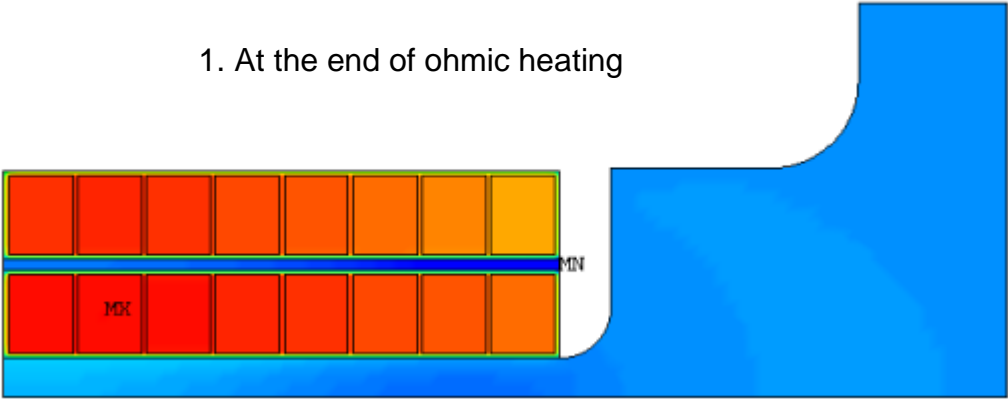


Temperature Distribution in The 16th Heating and Cooling Cycles

ANSYS 5.6.2
 JUL 24 2001
 09:47:09
 NODAL SOLUTION
 STEP=111
 SUB =3
 TIME=13551
 TEMP (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 SMN =80
 SMX =124.91

80
84.99
89.98
94.97
99.96
104.95
109.94
114.93
119.92
124.91

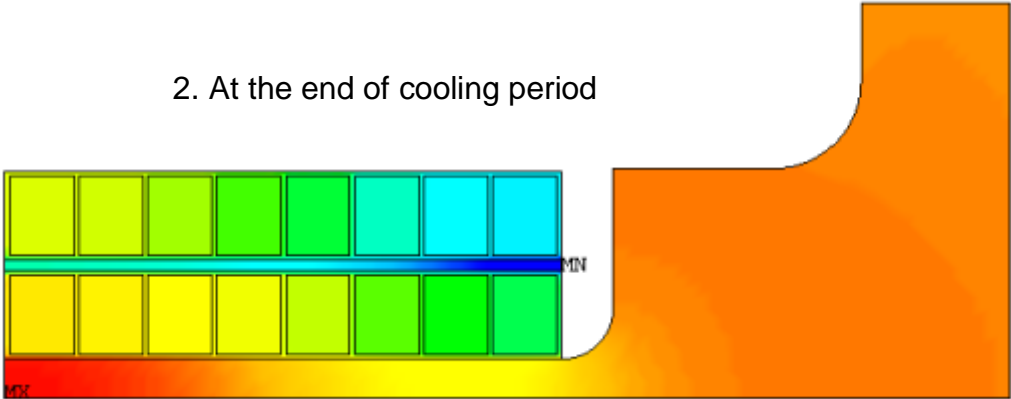
1. At the end of ohmic heating



ANSYS 5.6.2
 JUL 24 2001
 09:45:06
 NODAL SOLUTION
 STEP=112
 SUB =4
 TIME=14451
 TEMP (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 SMN =80
 SMX =89.793

80
81.088
82.176
83.264
84.352
85.44
86.528
87.616
88.705
89.793

2. At the end of cooling period



NCSX COOLING ANALYSIS SUMMARY

PL GORANSON 8/1/01

Best effort to date using N2 cooling

Current density	13.1 kA/cm ²
Equiv. square wave	1.2 sec

End cooled septum

N2	3 atmos, 88K, 30 m/s inlet vel.
Copper cycle	98 K to 133 K
Cooling surface	3.7 cm ²
Heat trans coef	0.063 w/cm ² -K
Septum thickness	0.2 cm

Results **Cooling time 18 minutes**

Transverse cooling through septum

N2	3 atmos, 88 K, 30 m/s inlet vel.
Copper cycle	98 K to 133 K
Heat transfer coef	0.088 w/cm ² -K
Septum passage	0.2 X 0.75 cm

Results **Cooling time 11 minutes**