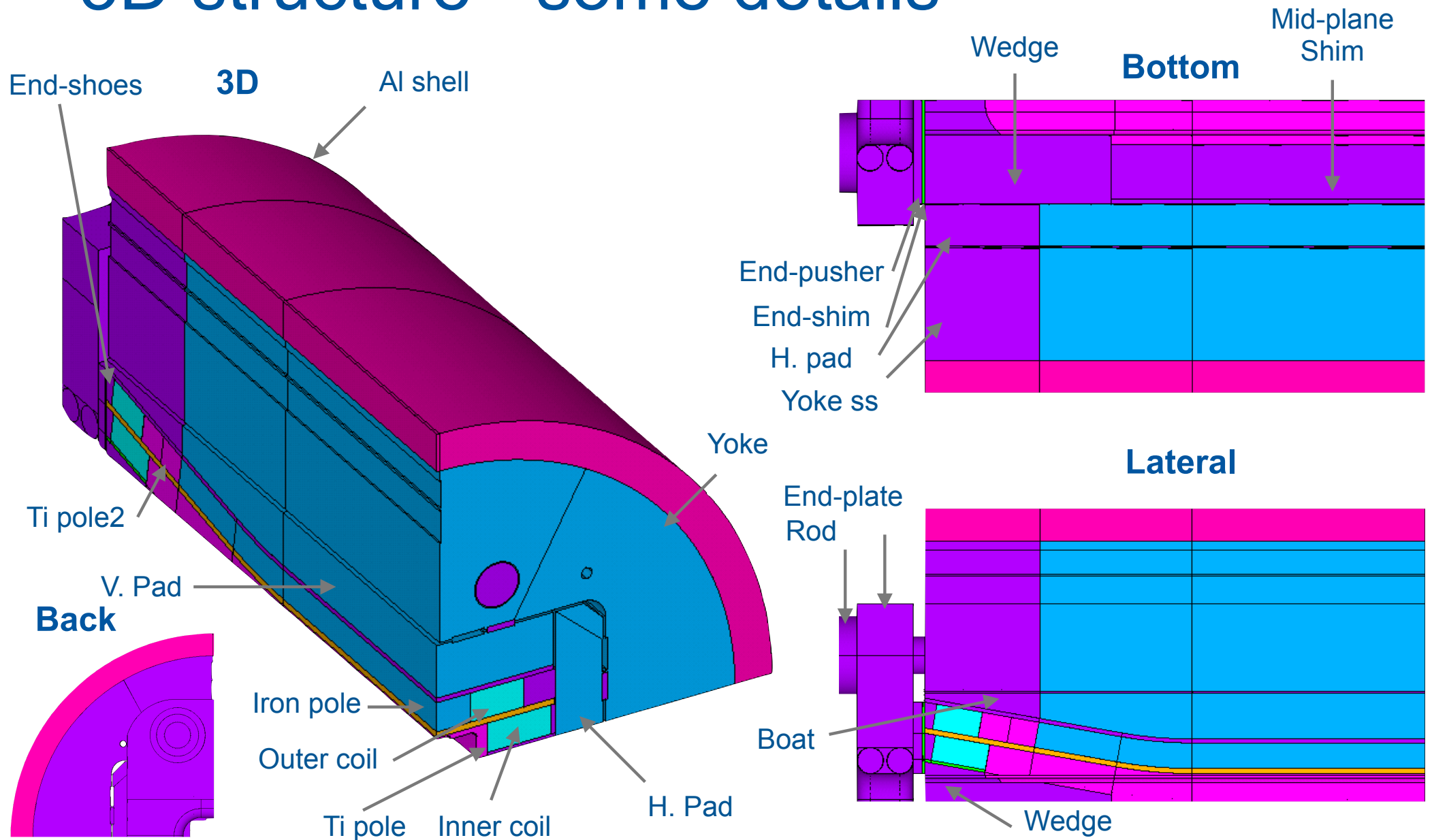


HEPDipo

Summary of 3D mechanical results

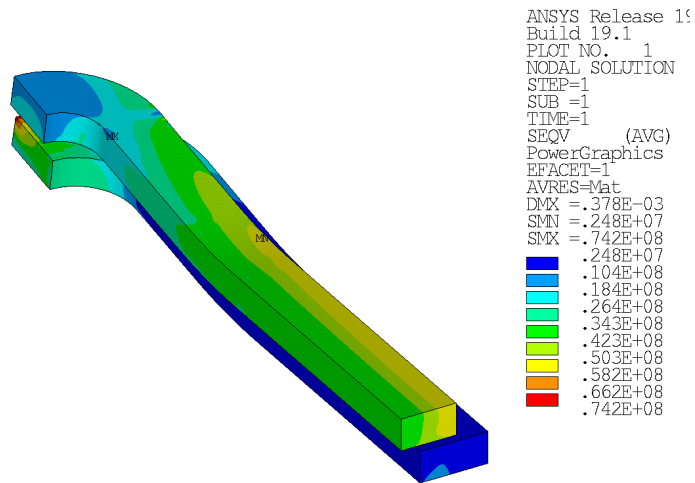
D. Martins Araujo
MSC-MDT

3D structure - some details



Coils - mech. analysis - S,SEQV

Room temperature

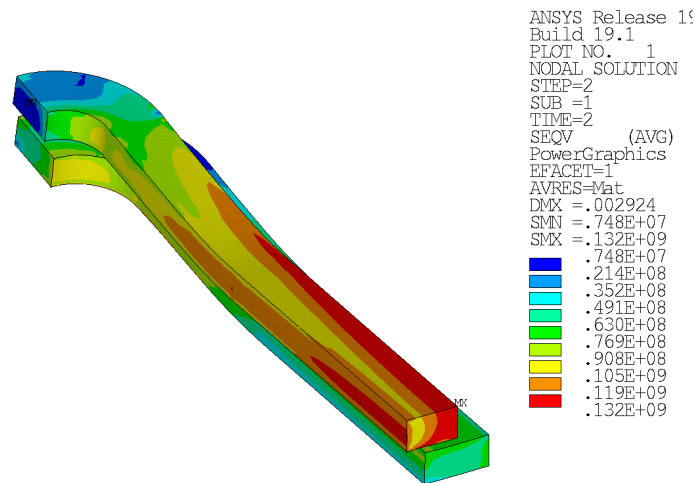


Keys, rod

S,SEQV at RT

74 MPa

At cold

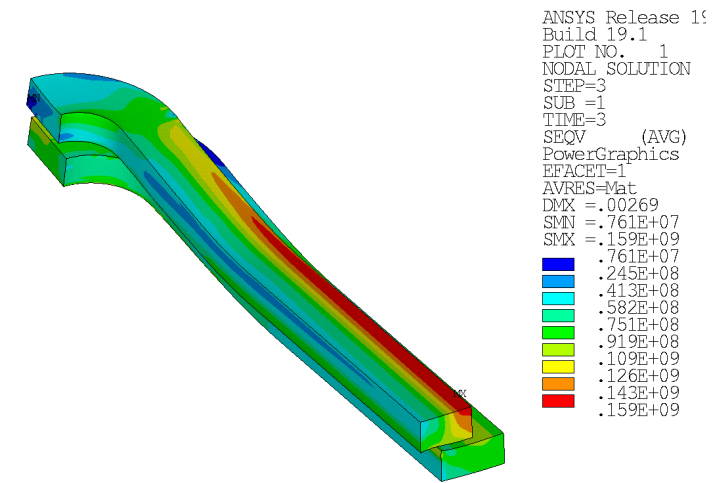


Cool-down to 4.5 K

S,SEQV at CD

132 MPa

15 T



Nominal field

S,SEQV at NF

159 MPa

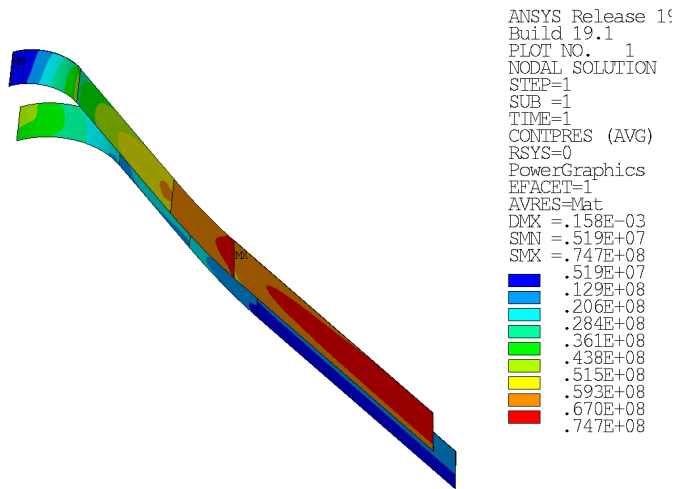
Bonded contact assumption between coils and poles

Contact pressure - mech. analysis

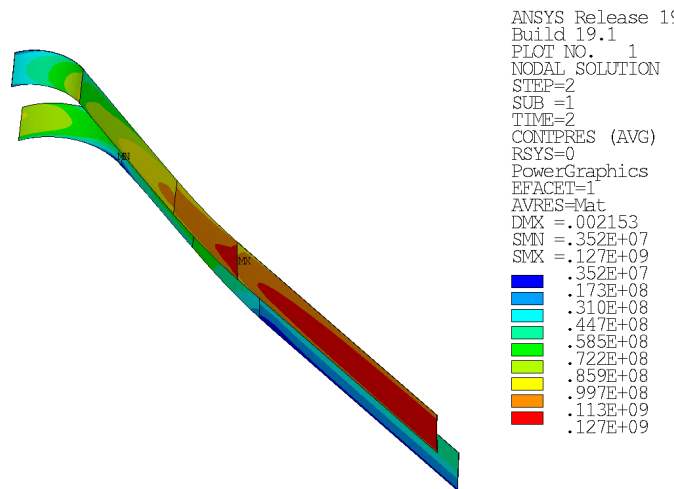
Room temperature

At cold

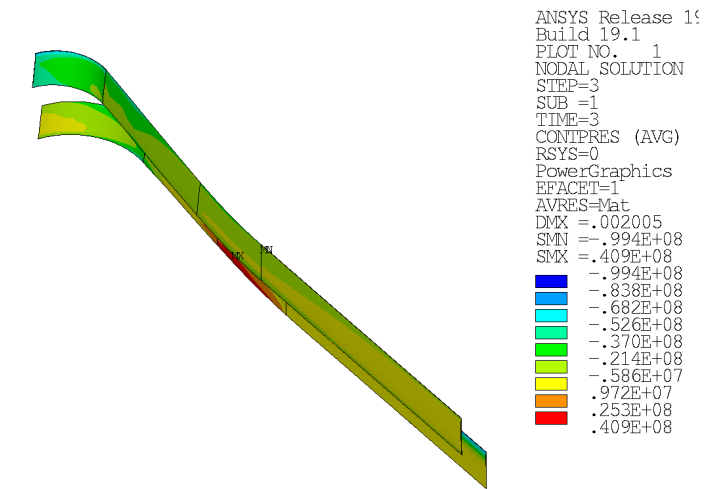
15 T



Keys, rod



Cool-down to 4.5 K



Nominal field

Straight section

-10.6/ - 4.1 MPa

Hard-way bend

-7.6/ - 11.5 MPa

Ramp

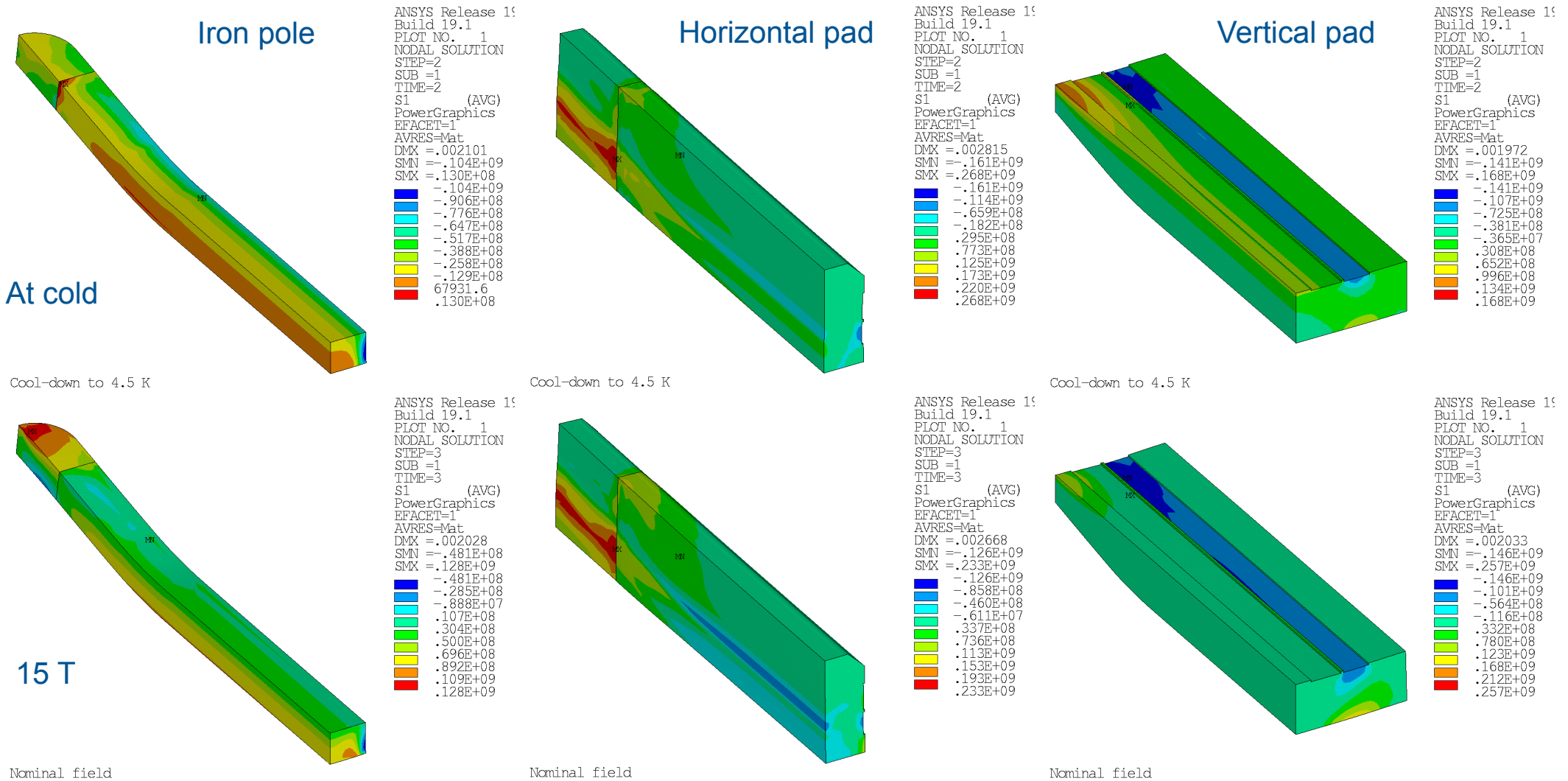
-19.7/ - 19.2 MPa

Easy-way bend

-18.5/ - 16.3 MPa

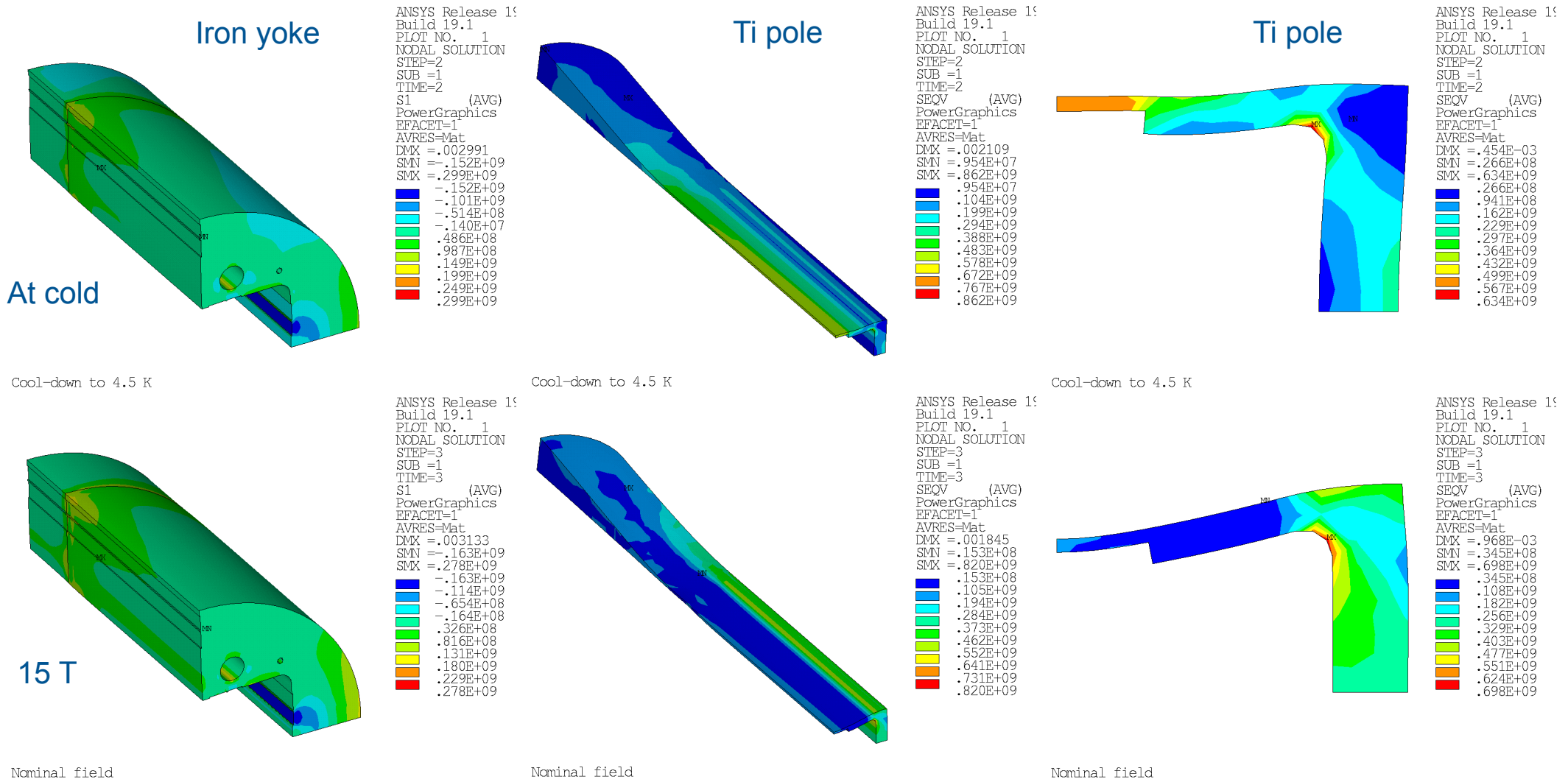
Respecting the criterium of a maximum of 20 MPa on average 15 T inner / outer coils

Iron pole and pads - mech. analysis - S,1



Maximum principal stress at cold of 257 MPa

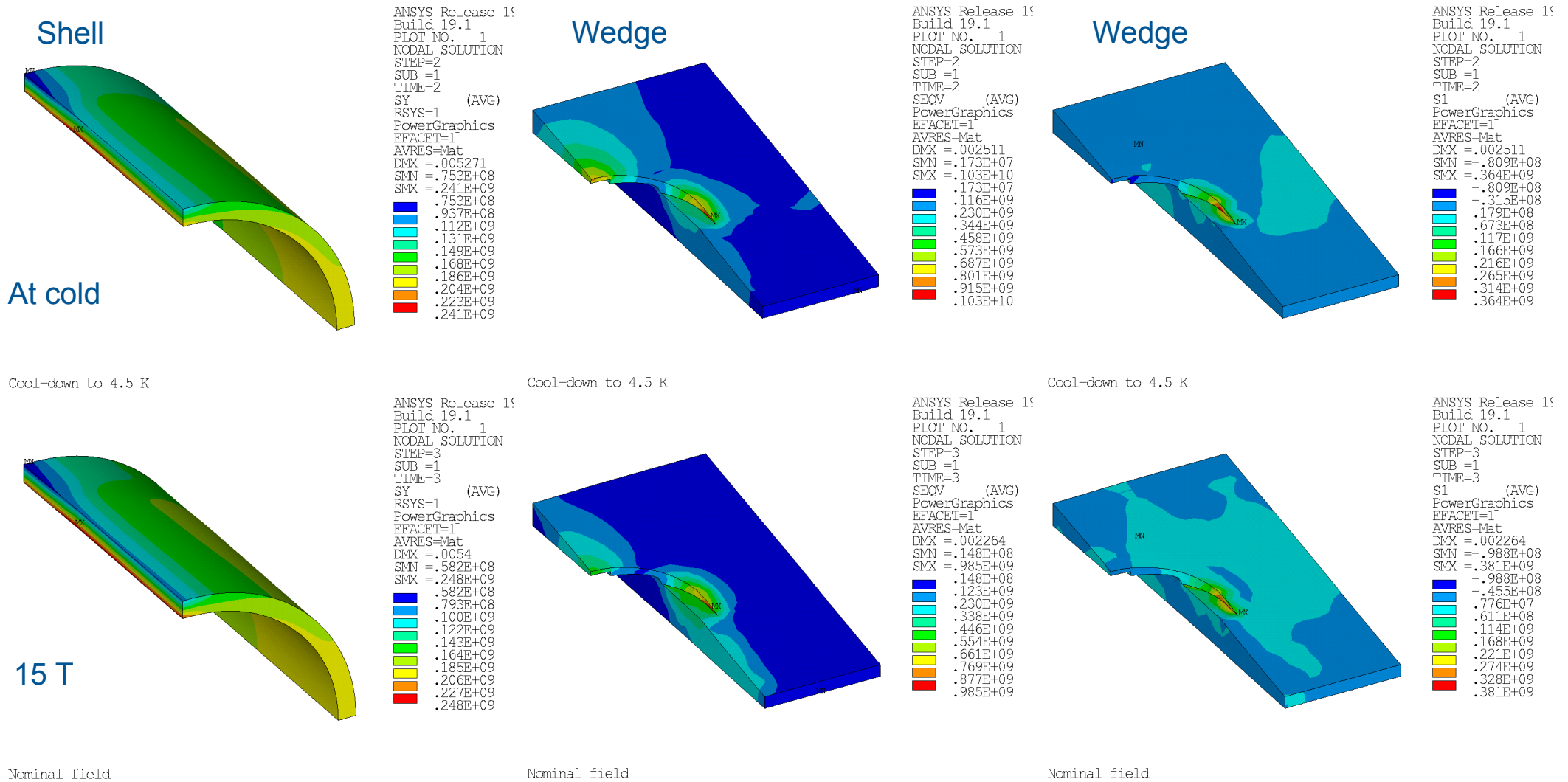
Iron yoke and Ti pole - mech. analysis



Yoke maximum principal stress at cold of 300 MPa

Ti pole maximum eqv stress: 862 MPa

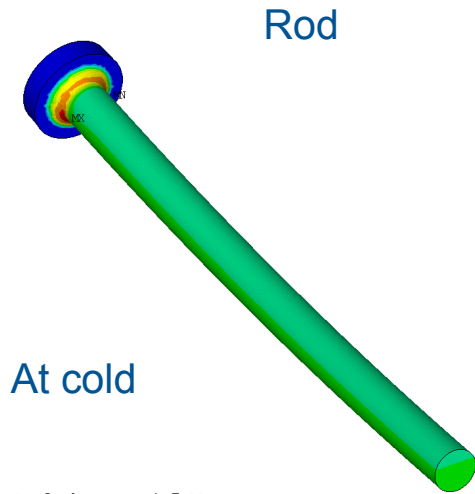
Shell and wedge - mech. analysis



Shell max azimuthal stress of 248 MPa

Wedge maximum principal stress of 381 MPa

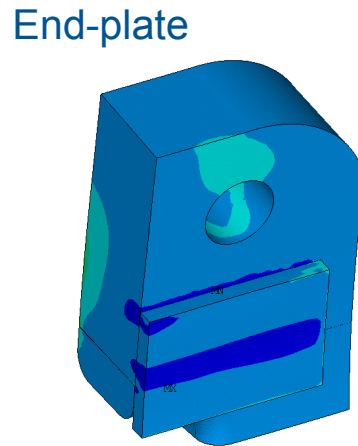
Rod and end-plate - mech. analysis



At cold

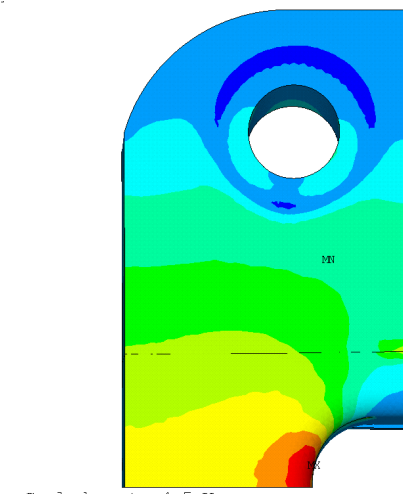
Cool-down to 4.5 K

```
ANSYS Release 19.1
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=2
SUB =1
TIME=2
S1 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.005799
SMN =-.209E+08
SMX =.636E+09
-.209E+08
-.521E+08
.125E+09
.198E+09
.271E+09
.344E+09
.417E+09
.490E+09
.563E+09
.636E+09
```



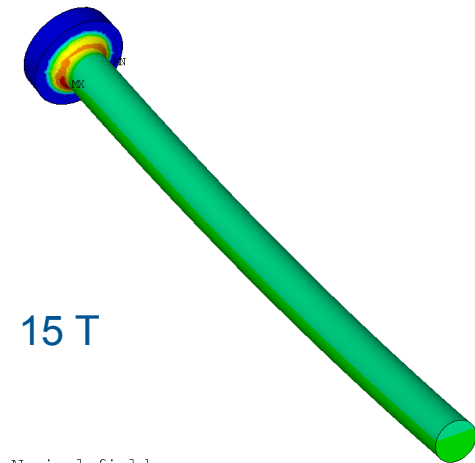
Cool-down to 4.5 K

```
ANSYS Release 19.1
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=2
SUB =1
TIME=2
S1 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.004856
SMN =-.125E+09
SMX =.738E+09
-.125E+09
-.293E+08
.666E+08
.163E+09
.258E+09
.354E+09
.450E+09
.546E+09
.642E+09
.738E+09
```



Cool-down to 4.5 K

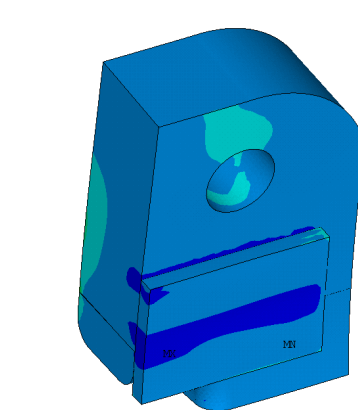
```
ANSYS Release 19.1
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=2
SUB =1
TIME=2
S1 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.004856
SMN =-.125E+09
SMX =.738E+09
-.125E+09
-.293E+08
.666E+08
.163E+09
.258E+09
.354E+09
.450E+09
.546E+09
.642E+09
.738E+09
```



15 T

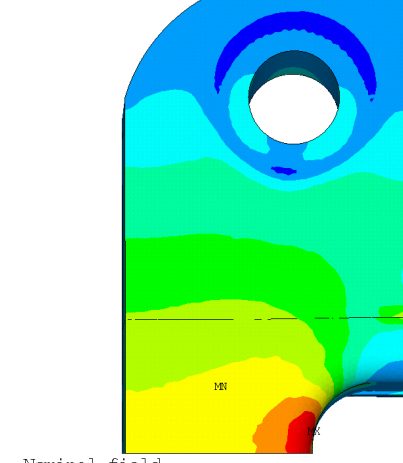
Nominal field

```
ANSYS Release 19.1
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=3
SUB =1
TIME=3
S1 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.006138
SMN =-.222E+08
SMX =.667E+09
.545E+08
.131E+09
.208E+09
.284E+09
.361E+09
.438E+09
.514E+09
.591E+09
.667E+09
```



Nominal field

```
ANSYS Release 19.1
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=3
SUB =1
TIME=3
S1 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.004846
SMN =-.134E+09
SMX =.811E+09
-.134E+09
-.291E+08
.759E+08
.181E+09
.286E+09
.391E+09
.496E+09
.601E+09
.706E+09
.811E+09
```



Nominal field

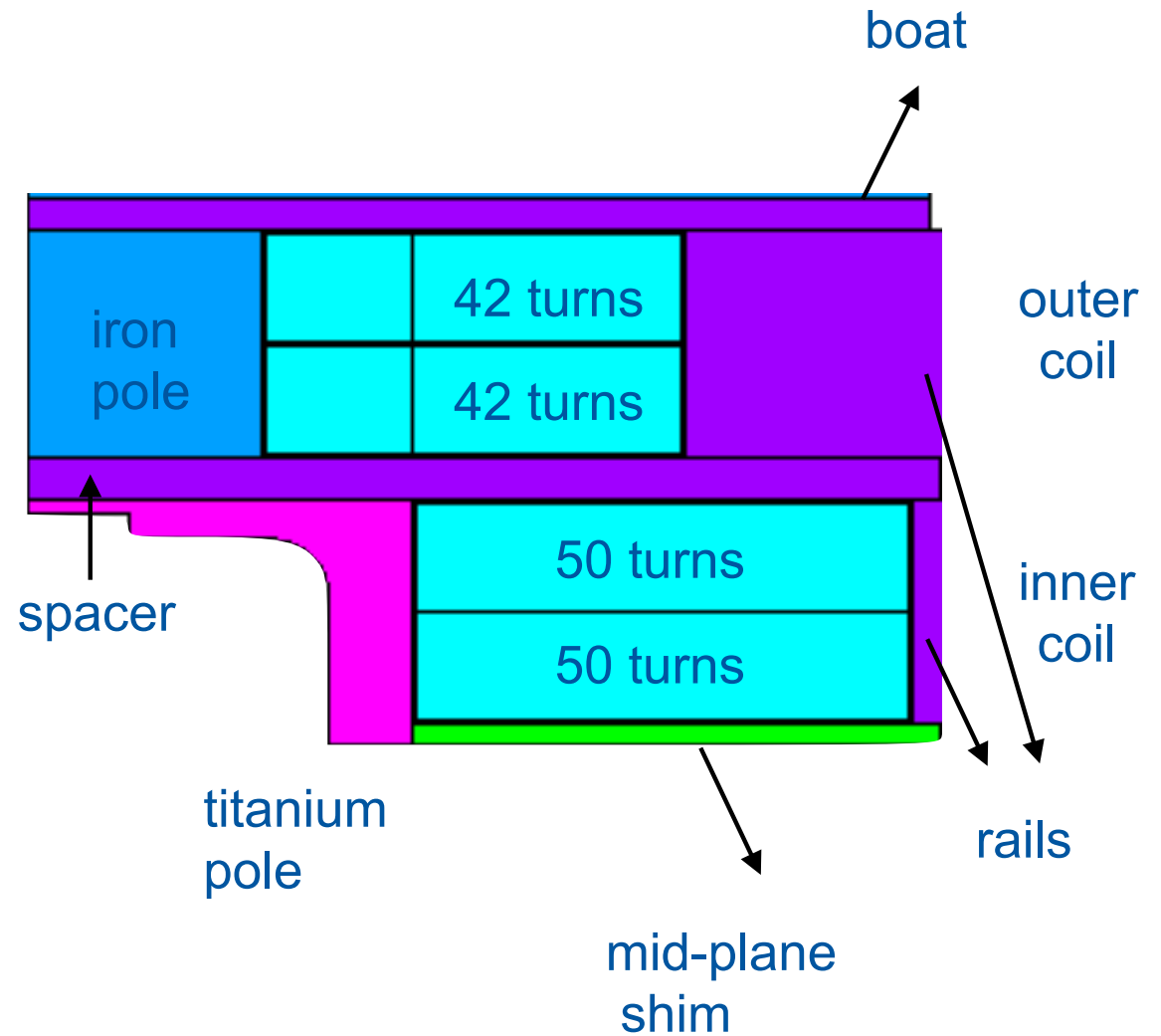
```
ANSYS Release 19.1
Build 19.1
PLOT NO. 1
NODAL SOLUTION
STEP=3
SUB =1
TIME=3
S1 (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.004846
SMN =-.134E+09
SMX =.811E+09
-.134E+09
-.291E+08
.759E+08
.181E+09
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.391E+09
.496E+09
.601E+09
.706E+09
.811E+09
```

Rod max principal stress of 667 MPa

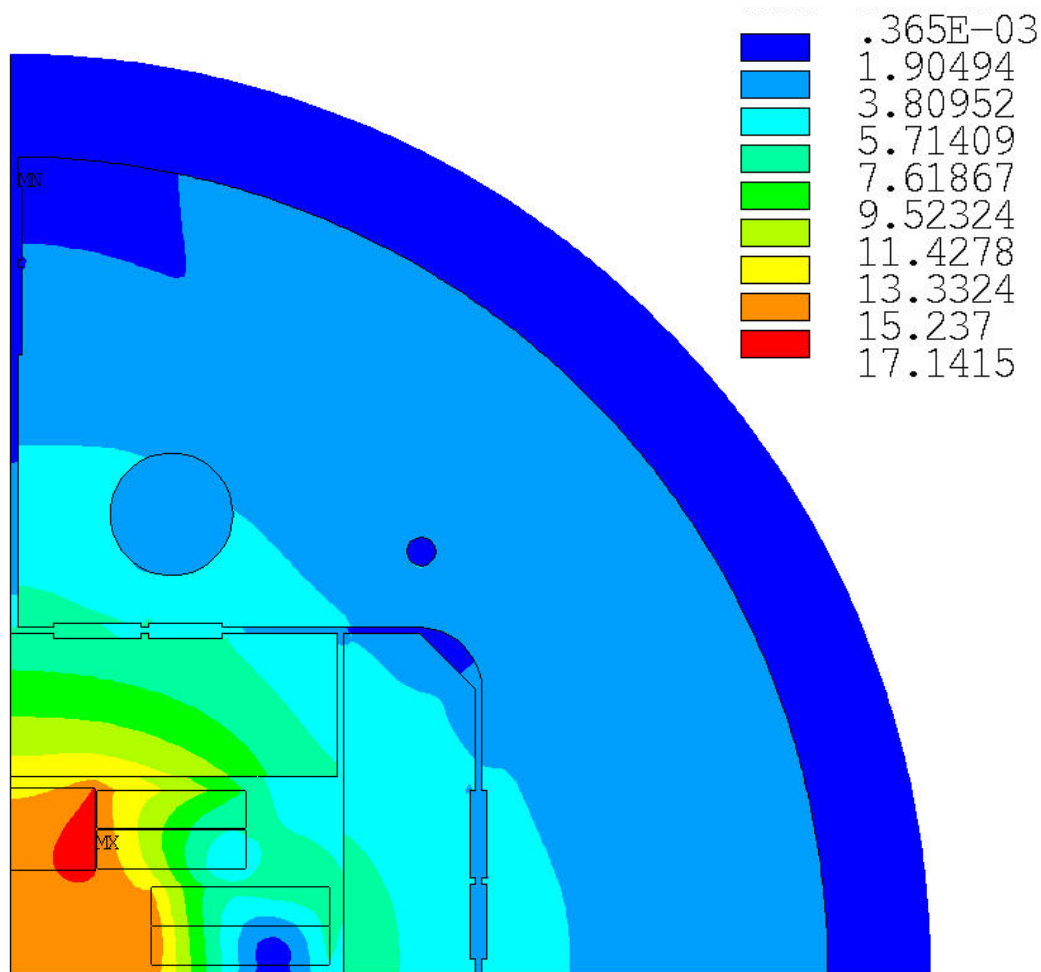
End-plate maximum principal stress of 811 MPa

Cable specification

Cable data	
d_strand	1.1 mm
number of strands	44
thickness	1.95 mm
width	26.2 mm
turn insulation thickness	0.15 / 0.20 mm
min coil insulation thickness	0.5 mm
Inter-layer insulation	0.5 mm
SC:Cu	1:1



4.2 K - 85% of the load line



B field in T

Bore field (B): 14.92 T

Max coil field (B): 15.19 T

