DESIGN AND FABRICATION OF THE PEFP DTL II*

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Abstract

The PEFP DTL II which accelerates a proton beam from an energy of 20MeV to 100MeV is now under fabrication. The DTL II which has some similar specifications to the DTL I, which accelerates a proton beam to an energy of 20MeV, is made of seamless carbon steel with an internal Cu electroplating. The DTL tank is divided into 3 sections whose length is about 2.2m. We verified its mechanical and thermal stabilities using the ANSYS code, and we established a fabrication process for its drift tube. The DTL II is now being fabricated.

DTL TANK

DTL II Tanks have similar features to the DTL Tanks. The main difference is that the length of the DTL II tank is about 7m which is longer than the DTL tank. Considering the fabrication issue, the length of the tank section is limited to 2.5m, so the DTL II tank is divided into 3 sections when compared to the DTL Tank which is composed of 2 sections[1]. The special features are summarized in Table 1.

Table 1. Special features of the DTL II Tank

Material	Seamless carbon steel
Slug tuner	12
Vacuum port	6
RF pick up	5

We verified the thermal stability and the thermal deformation of the DTL II Tank by using a thermal analysis code. RF duty was assumed as 9%. As shown in figures 1 and 2, the maximum temperature increase was 12degree at the bottom of the tank. The increase of the tank diameter by a thermal deformation was 20μm. A frequency change due to a thermal deformation is expected to be about 10kHz which is in the known controllable range.

Now, the tanks are under fabrication. Figure 3 shows a tank section right after a Cu plating process

DRIFT TUBE

Drift tubes of the PEFP DTL II contain an EQM(electro-quadrupole magnet) which is made of a hollow conductor as shown in figure 4. We design that the EQM body plays a role to form a part of a cooling channel to simplify an internal structure of a drift tube as shown in figure 5. Some parameters of the drift tube which are used for its physical design are shown in table 2.

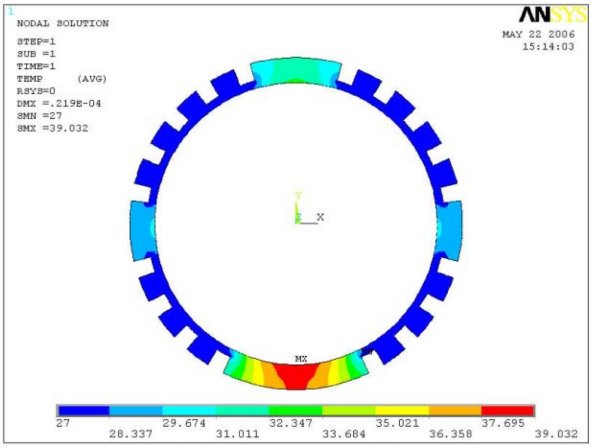

Figure 1. Temperature increase of the Tank

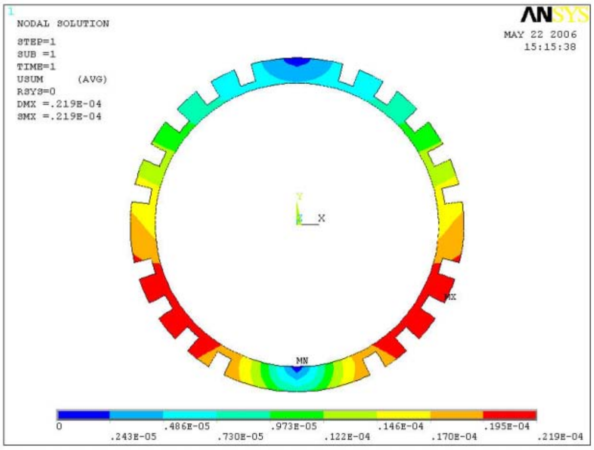

Figure 2. Thermal deformation of the Tank

Figure 3. The DTL tank in a fabrication process

We also verified the structural and thermal stabilities of the DTL tank. The maximum temperature increase was 3° relative to the coolant temperature as shown in figure 6 and the maximum equivalent stress was 19MPa as shown in figure 7. The deformation due to the temperature increase and the cooling water pressure was 9micron which is also a controllable value, as shown in figure 8.

For the stem seal, we used 2 vacuum seals and 1 rf seal as shown in figure 9. We used 2 spacers so that we could move the stem to align the drift tube.

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Figure 4. EQM and its housing

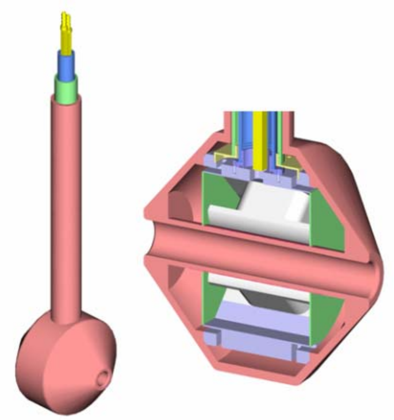

Figure 5. Drift tube and its inside structure

Table 2. Design Parameters of a Drift Tube

DT diameter	135 mm
Bore diameter	20 mm
DT face angle	40°, 50°, and 55°
Stem diameter	40 mm
B Field of a EQM	1.75 T (2T optional)

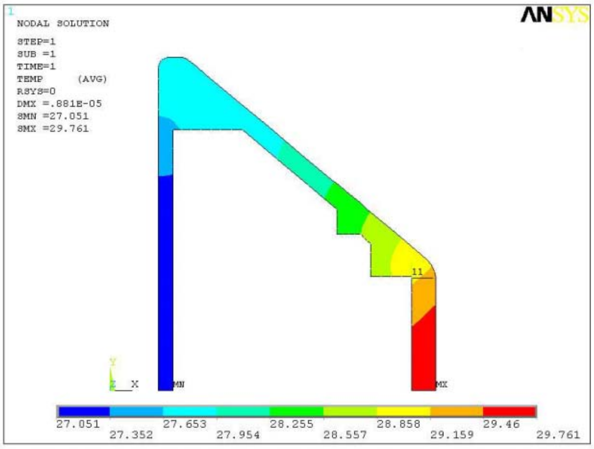

Figure 6. Temperature increase of the drift tube

As shown in figure 5, there are 3 stems to achieve a proper coolant path. The spaces between the outer, middle, and inner stems are used for the inlets and outlets for the coolant. The inside of the inner stem is used for a channel for the EQM current lead. Cooling manifold was designed as simply as possible, as shown in figures 10 and 11.

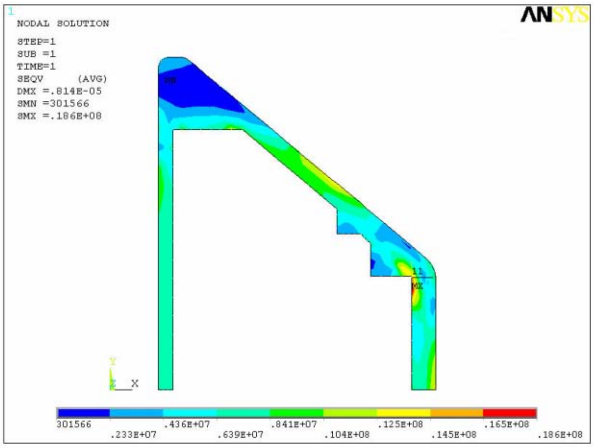

Figure 7. Equivalent stress of the drift tube

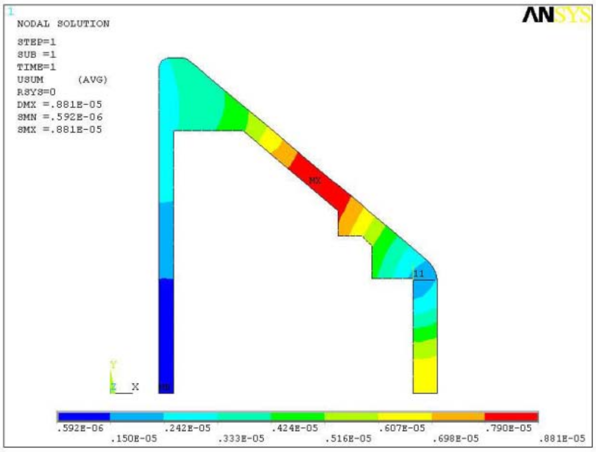

Figure 8. Deformation of the drift tube

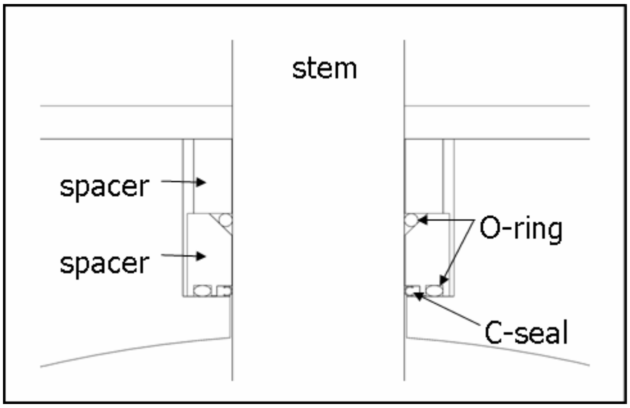

Figure 9. RF and vacuum seal structure of a stem

SUPPORT STRUCTURE

For the tank's support structure, we used 3 vertical supports, 2 horizontal supports, and 1 axial support to achieve not only an adequate rigidity but also an adjustability to align the DTL Tank, as shown in figure 11.

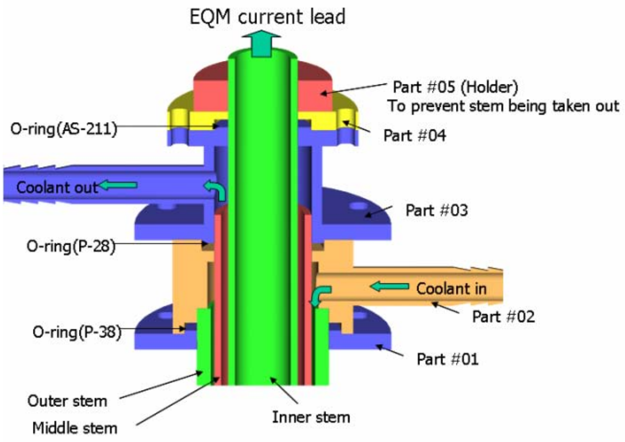

Figure 10. The Design of the Cooling manifold

Figure 11. Cooling manifold prototype

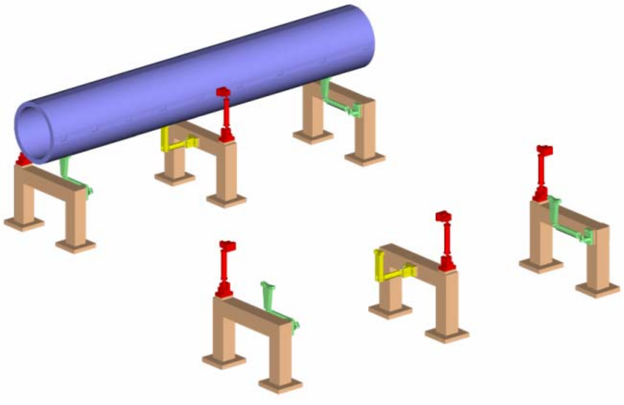

Figure 12. Support structure of the DTL tank

SUMMARY

- PEFP DTL II tank and its drift tubes were verified. They were found to satisfiy the structural and thermal requirements.
- We designed the DTL tank, drift tube, and supporting structure by considering an alignment
- PEFP DTL II tank and its drift tubes are now under fabrication.

REFERENCES

[1] M.Y. Park, H.J. Kwon, Y.H. Kim, J.H. Jang, and Y.S. Cho, 'DTL Fabrication status of PEFP Linac', Proceedings of APAC 2004, p375