DSG Ansys R&D Meeting

Date: July 20, 2023
Time: 2:00 PM – 2:30 PM

Attendees: Aaron Brown, Pablo Campero, Tyler Lemon, and Marc McMullen

1. EIC test stand thermal analysis

Pablo Campero, Brian Eng, and Marc McMullen

1. Ran simulation with no inlet velocities for the inner volume; applied thermal natural convection for fluid zones of the inner volume of the heater pipe and the beampipe
   - Set configurations to simulate natural convection for the fluids in the heater pipe and beampipe inner volumes
   - Reduced heat source to ~1,365,516 W/m3 to achieve a temperature of 100°C in the beampipe
   - Implemented polynomial curves' coefficients to simulate thermal properties of the mineral oil (based on its specifications); resolved previous floating point exception errors by using piece polynomial with range parameters
   - Results of velocity and temperature contour plots
     – Silicon temperature is 30.22°C, beampipe temperature 100.13°C, and heater pipe upstream 112.4°C
     – Temperature differential between upstream and downstream of heater pipe is ~14°C
     – Maximum velocity at outlet of the annulus space is 3.4 m/s when inlet airflow is 210 L/min
     – Mass flow rates at the inlet connectors and at the outlet of the annulus space were 0.00408436 Kg/s and -0.00408439 Kg/s, respectively

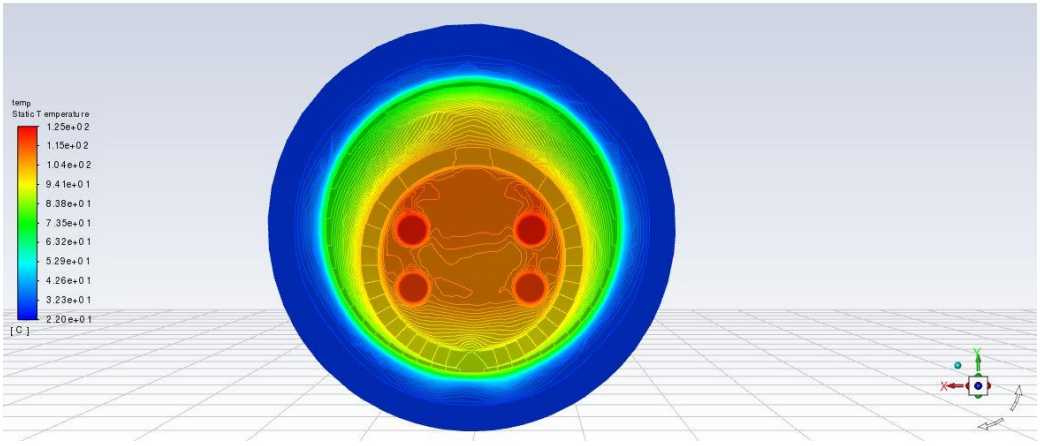

Fig. 1. Temperature contour plot, upstream/front view, *XY* plane, central section of the model when natural convection was simulated with no inlet velocity for heater pipe and beampipe inner volume fluids, and forced convection for the annulus space

2. More RTD temperature sensors were added to the test stand beampipe
   - Two sensors at the upstream side of heater pipe
   - One sensor to monitor the ambient

1. NPS thermal analysis

Aaron Brown and Pablo Campero

1. Ran transient thermal simulation in Ansys-Mechanical software for the crystal zone
    - Varied ambient temperature setpoints by 5°C
    - Plotted maximum temperature vs time, shows estimated time at which equilibrium is reached

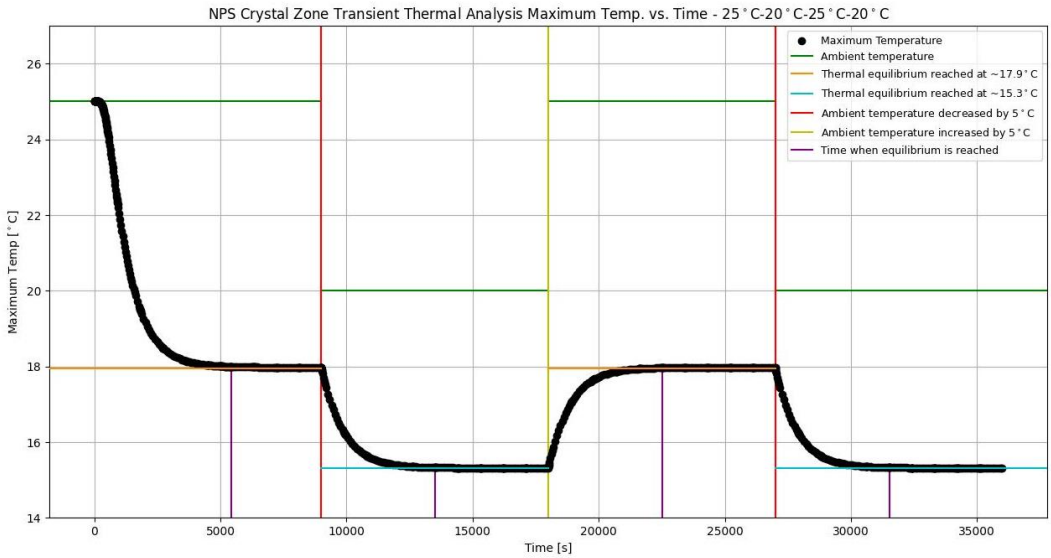

Fig. 2. Maximum temperature vs time plot for different ambient temperatures

2. Configuring pre-setup to simulate NPS cooling system and individual crystals in Ansys-Fluent
    - Completed modifying the model, which now includes the detector enclosure walls, the simplified cooling system components, and the 1080 individual crystal blocks
    - Removed the mu-metal dividers and carbon fiber dividers to reduce the number of parts in the model and allow a simpler mesh
        - Plan to use Shell option available in Ansys-Fluent to simulate the thermal effect of the dividers
    - Attempt to mesh the model but Ansys-Fluent with Meshing software stopped at 46% progress, with no error message; investigation is in progress