

Anslys Transient Thermal Analysis of the Cooling System Designed for Hall C's NPS

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2023-04

The results of the Ansys Steady-State thermal simulation of the cooling system for Hall C's NPS showed that the temperature of the central crystals was dependent on the ambient temperature [1]. Since the steady-state simulation did not take into account temperature fluctuations (the ambient temperature was held to a steady 20°C for the duration of the simulation), it was decided that we would do a transient thermal simulation for comparison.

A transient thermal simulation allows for the temperature to fluctuate during the run of the simulation. Initially we ran the simulation for ~2 hours with the same initial conditions as the steady-state simulation [2] and increased the ambient temperature from 20°C to 22°C halfway through the simulation. The results of this simulation were that the temperature of the central crystals (a smaller portion of the total crystals than in the steady-state simulation) was ~15.36°C, Fig. 1).

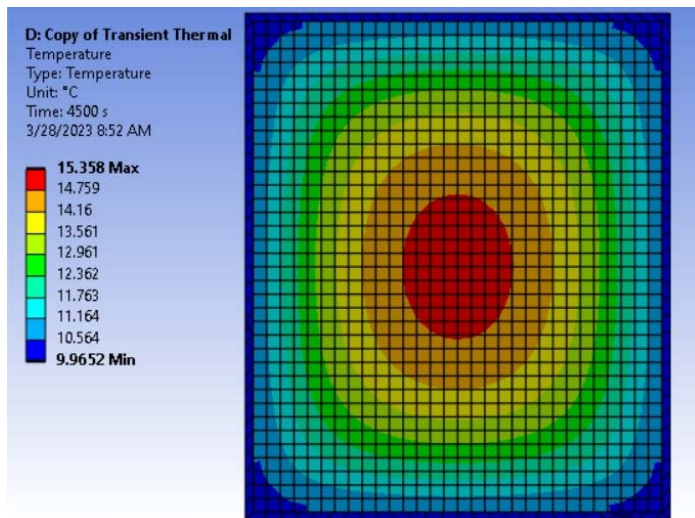


FIG. 1. Crystal array temperature profile after ~2 hrs transient thermal simulation

- **Performed an Ansys transient thermal simulation to compare with the steady-state thermal simulation**
- **The results of the transient simulation seemed to contradict those of the steady-state simulation**
- **An Ansys Fluent simulation will be conducted to see if new results hold**

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Another transient simulation was run for ~48 hours and the ambient temperature was held constant at 20°C. This simulation was done to see if perhaps the reason for the results of the steady-state and transient simulations being different was due to the transient simulation not being run long enough for the system to reach equilibrium. The result was roughly the same, with the central crystal temperatures being ~16.37°C, Fig. 2.

The next step will be to run an Ansys Fluent thermal simulation. The goal will be to see if circulating 10°C water through the cooper cooling shell will result in a temperature similar to the steady-state simulation or the transient thermal simulation.

[1] [Brown, Aaron DSG Note 2022-11](#)

[2] [Brown, Aaron DSG Note 2022-02](#)

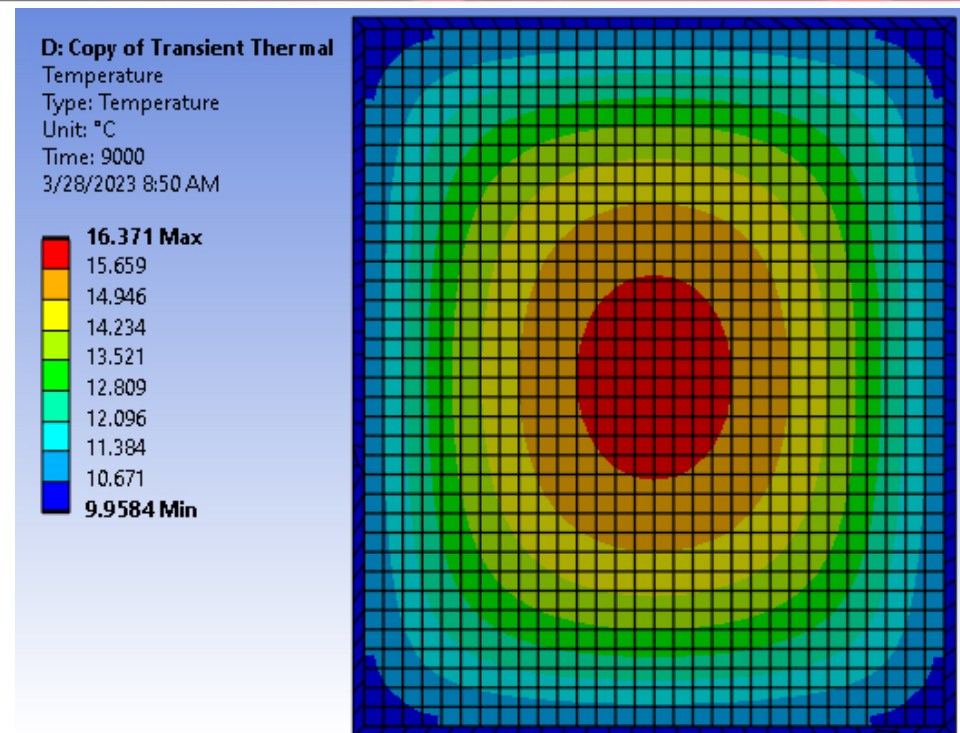


FIG. 2. Temperature profile of crystal array at the end of ~48 hour transient thermal simulation