Update on ESB cooling

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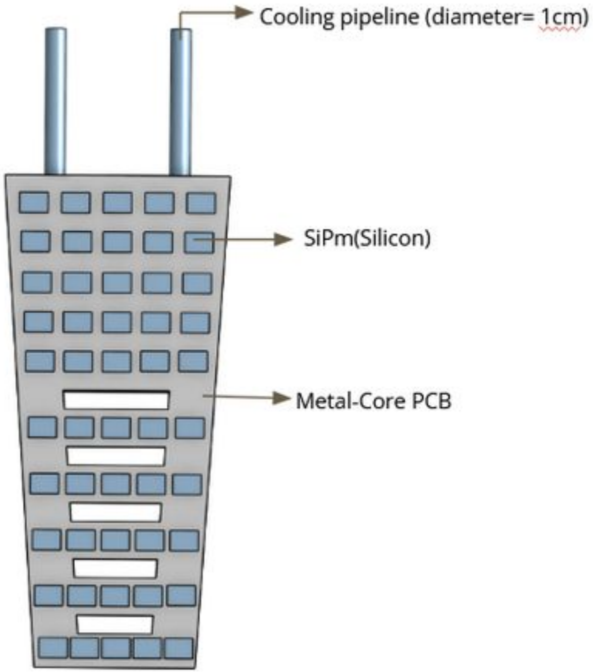
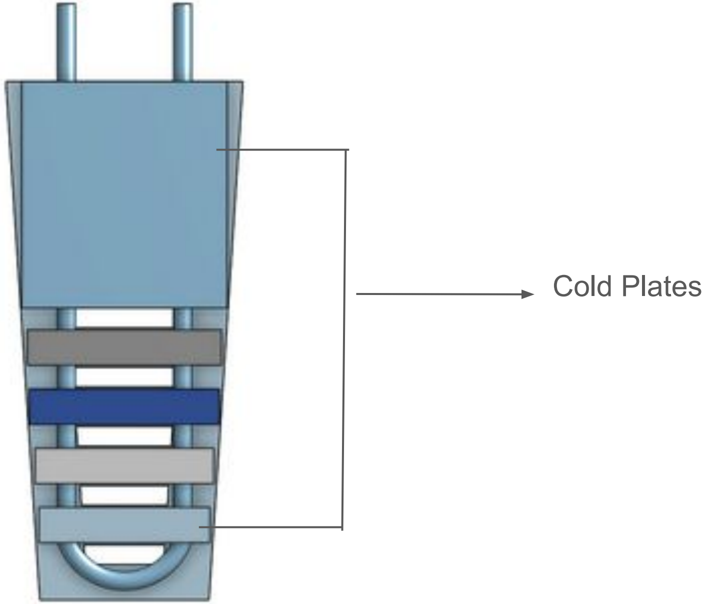
Previous design for the cold plate

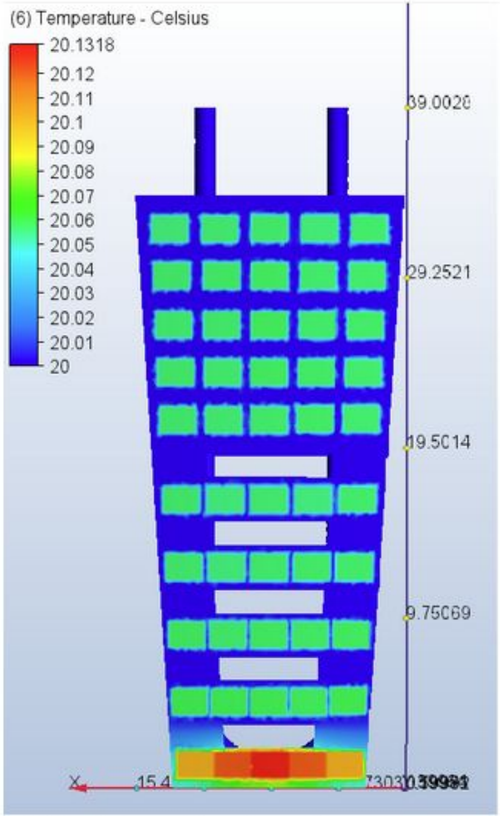


Front View



Back View

Thermal simulation results



Thermal Simulation with volume flow rate as 2 gal/m

Volume Flow Rate (gal/m)	Max. Temperature attained (°C)	Pressure at Inlet (N/m^2)
1	20.1327	0.35
1.5	20.1321	0.73
2	20.1318	1.25
2.5	20.1316	1.89

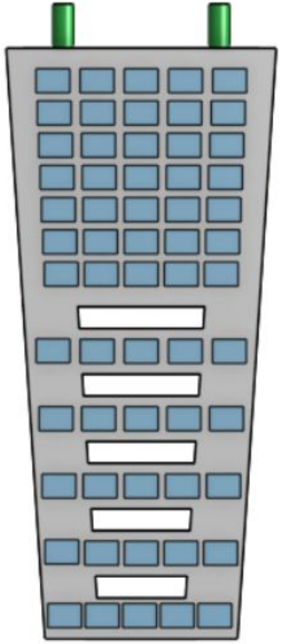
Changes in the new model

1.) **SiPM Count**: Increased from 50 to 60 in the updated model.

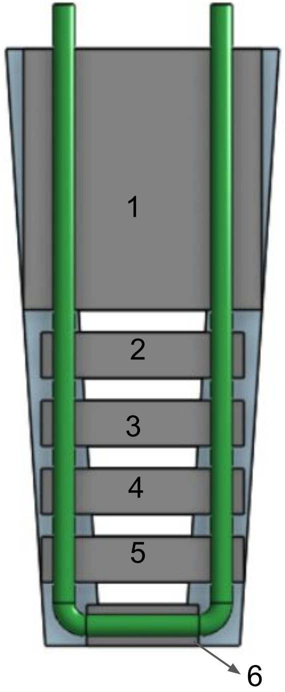
2.) **Cold Plate Design**: Width reduced by half to allow partial exposure of the cooling pipeline, simplifying manufacturing. It is easier to mill the cold plate and place the pipeline at designated slots using epoxy, rather than embedding it fully as it was intended in the previous design.

3.) **Cooling Pipeline**: Bending radius decreased to accommodate Cooling Plate #6 (see next slide).

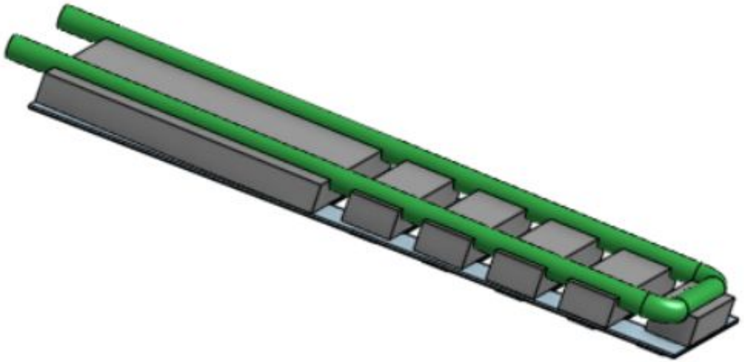
New design for the cold plate



Front View



Back View



Side View

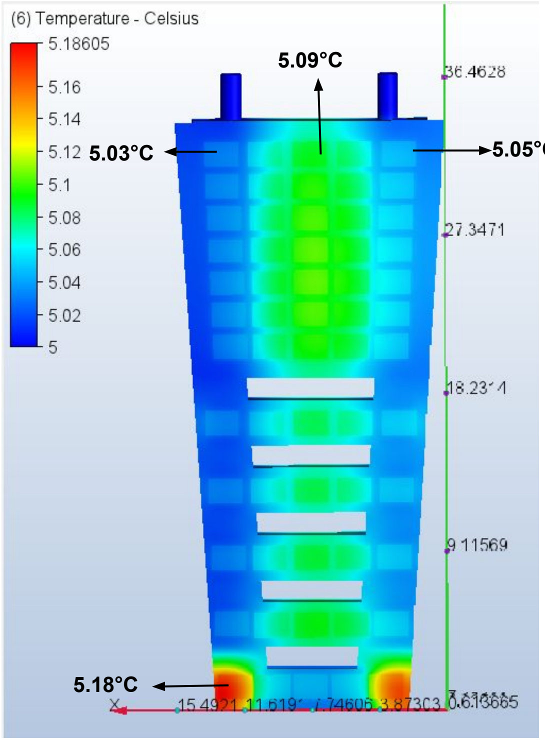
Boundary Conditions

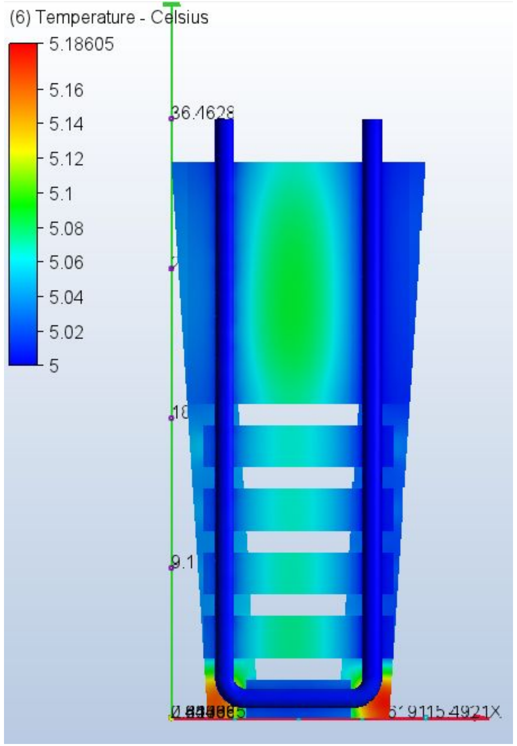
1.) **Inlet Boundary Conditions**:
a) Water is introduced at **5 °C**, as suggested in the **Mechanics and Sectors Meeting**.
b) **Volume flow rate** is set to **2 gal/min** at the inlet.

Outlet Boundary Condition:

2.) **Pressure** is fixed at **0 Pa**.

Thermal Simulation results





Interpretation of the Thermal Simulation

1.) From the simulation results, we observed that the temperature remains within the range of **5–5.2 °C**, staying below the **7 °C limit** recommended in the Mechanics and Sectors Meeting.
2.) The **SiPMs located near the center (azimuthally) in each layer** tend to be slightly warmer than those at the outer ends. This is likely because the SiPMs near the edges are closer to the water pockets and therefore cool more efficiently.
3.) We also noted a slight temperature increase in the **SiPMs located toward the outlet** of the cooling pipeline compared to those near the inlet. This is expected, as the water absorbs heat as it flows through the system.
4.) Finally, the **two SiPMs at the bottom shown in red** are the warmest overall, we expected this due to the absence of a cold plate in that region. However, their temperatures are not significantly high, as can be seen in the last slide.

Near-term Plans

1.) Run simulations with different flow rates to analyze how it affects the temperature gradients and pressure at the inlet of the cooling pipeline.