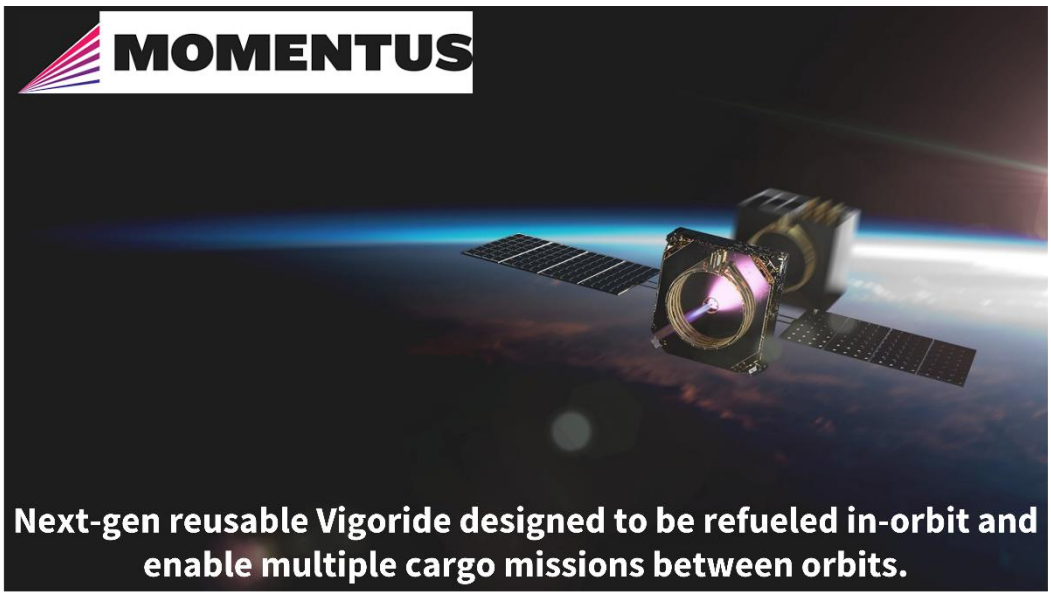
REDWIRE VERITREK

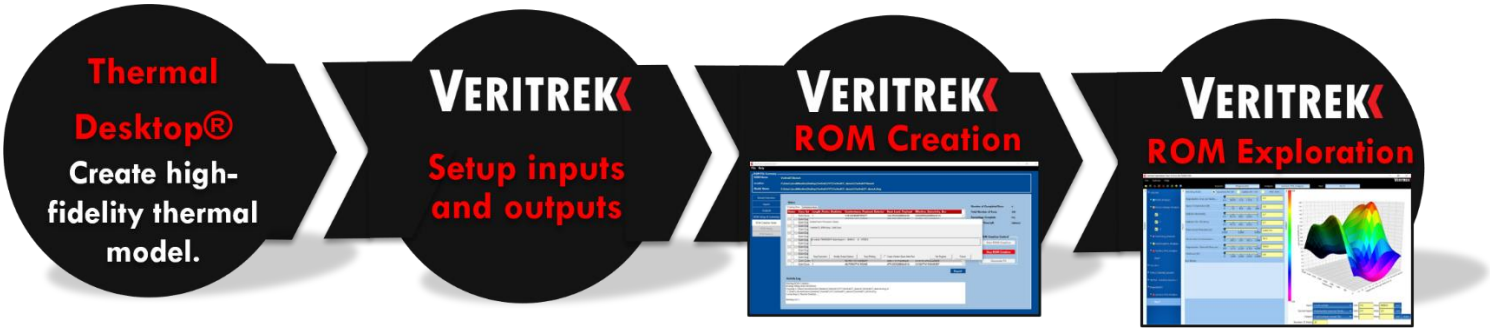
Make Confident Thermal Design Decisions

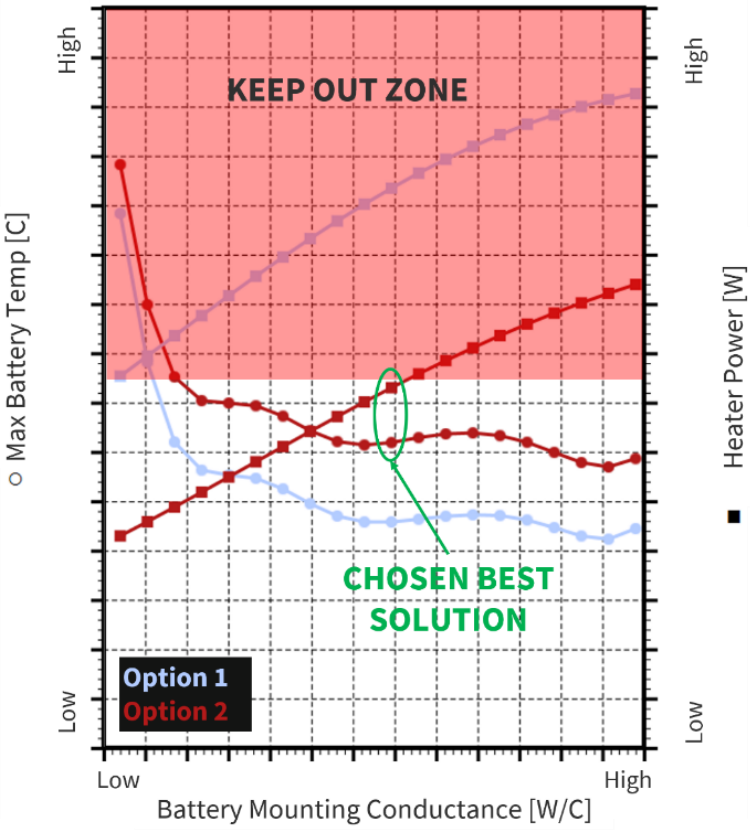
Momentus is a space-infrastructure company that plans to provide in-space transportation as a core service. In preparation for a Critical Design Review, thermal analysts leveraged Veritrek's unique capabilities to confidently analyze and understand their next generation power propulsive space tug system, Vigoride, in the following ways:

1. Confidently sweep through multiple thermal inputs to find a thermal design configuration that satisfied all output requirements.
2. Quickly assess the changes required to both the thermal design and CONOPS procedures, in order to satisfy output requirements in various future missions.



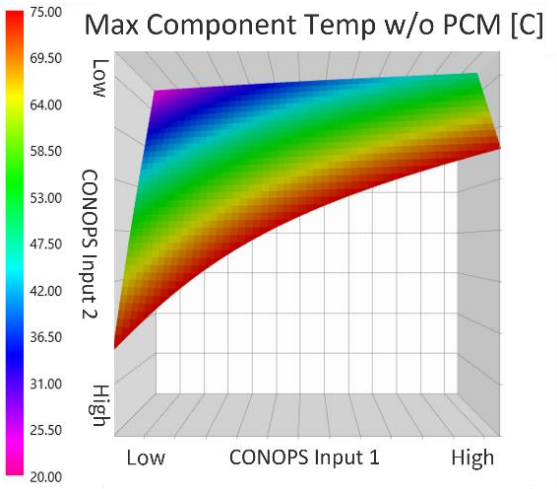
Veritrek's statistical approach to thermal analysis enables users to quickly evaluate thermal design sensitivities, rapidly identify design risks, and find better engineering solutions. Leveraging the power of reduced-order models (ROMs), Veritrek improves understanding of a thermal design and can be used throughout the design's life cycle. By sacrificing a greater upfront time investment of generating the ROM from the high-fidelity model, Veritrek then prioritizes providing a complete understanding of a thermal model's design space and minimizing mission risk, by giving users access to thousands of simulation results in seconds.

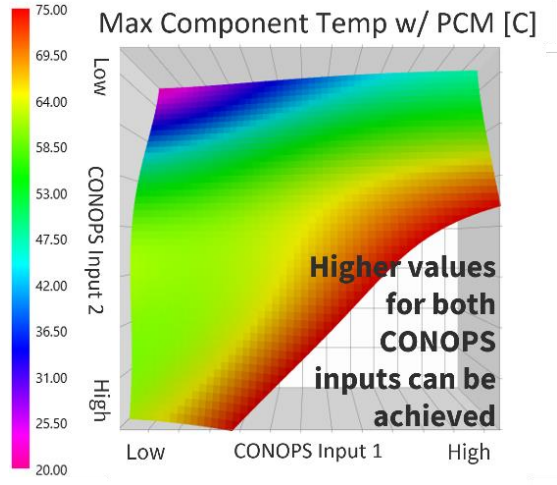




Momentus needed to finalize a thermal design that balanced temperature and energy requirements within a complex multi-dimensional design space. One example was interest in reducing battery temperature and minimizing required heater power. While battery mounting options with high conductance values help reduce battery temperature in the hot-case, they also require more heater power to maintain temperature in the cold-case.

Using Veritrek, multiple design options were quickly and easily compared. On the left, Option 1 (blue) is solely in the keep out zone for Heater Power, whereas some of Option 2 (red) proves viable. The best solution can easily be visualized by increasing the battery mounting conductance until the limit for Heater Power is met. Being able to sweep through a range of values allowed for the identification of an optimal solution, as opposed to estimating a "good enough" solution from a few data points. Veritrek gave Momentus confidence that their design solution met both battery temperature and heater power requirements.





Future high-power Momentus Vigoride missions may require changes from the nominal-power thermal design, in order to continue to meet temperature and energy requirements while maximizing the value of multiple CONOPS inputs. Performing these design trade studies requires analyzing multiple significant changes to the thermal design. With just a handful of data points from a few analysis runs, this can lead to a lack of understanding and confidence.

Veritrek was used to quickly produce thousands of simulation results in order to perform comprehensive and more-confident design trade studies. On the left, surface plots were used to compare different combinations of two CONOPS inputs, both without (top) and with (bottom) phase change material (PCM). Momentus wanted to maximize each CONOPS input, while still maintaining temperature requirements (identified by the red edge of the surface plots). Each plot is built on 2500 simulation results and can be generated within a few seconds, making it easy to see how utilizing PCM can allow for much higher values of both CONOPS inputs and maximize the potential of mission operations. Having access to so much data, so quickly, provided Momentus with more confidence and understanding in the necessary changes to meet future mission requirements.