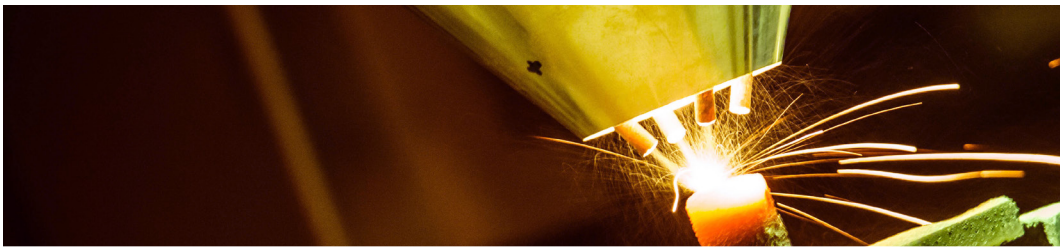


R·I·T
Center of Excellence in
ADVANCED & SUSTAINABLE MANUFACTURING

CASE STUDY

Thermal Analysis Modeling, Testing & Validation of Prototype Lead to New Product Orders

Council Rock Enterprises LLC is a small- to medium-size telecommunications engineering company in Upstate New York that designs, deploys, and maintains private wireless networks. Their solutions are ruggedized, modular platforms on which utilities and other industrial customers can build their own customizable highly secure, reliable, and scalable communication infrastructure. The company offers an off-the-shelf, open standards solution that meets industry protocols.

Client Challenge

Council Rock had developed a functional prototype for an enclosure to house radio communications equipment used in electrical grid and wellhead automation; however, there were concerns about the performance of this prototype at temperature extremes. These systems contain critical electronic components that are meant to be mounted outdoors and operate in very cold, dry environments and also on very hot, humid and sunny days. There was also the need to significantly reduce the size of the enclosure and evaluate the manufacturability of the design. Ideally the enclosure design would be able to support a family of different radio enclosure products that can be configured to specific customer requirements with different active electrical components. Council Rock turned to the Center of Excellence in Advanced & Sustainable Manufacturing (COE-ASM) to help them with mechanical design and analysis of the system. They recognized that they needed this work done, but lacked the capability to do it in-house.

COE-ASM Work Performed

A team of COE-ASM researchers and engineers worked with the staff at Council Rock to develop a plan for the project. The project consisted of several primary phases. The first phase looked at the baseline design concept and included a failure mode and effects analysis (FMEA) and extreme temperature testing of their prototype in order to identify potential system failure modes, the causes, and the resulting effects on the rest of the system. In order to effectively evaluate the impact of many different design factors on the thermal performance of the system, a thermal simulation model was developed taking into account conductive, radiative, and convective heat transfer. A transient case that coupled in the impact of solar loads over a complete daily cycle was also used for feature design comparisons. The validated thermal analysis model was then used to evaluate the design under extreme conditions (e.g., Phoenix, AZ, on a hot sunny day and Minneapolis, MN, on a cold winter evening).

CLIENT CHALLENGE

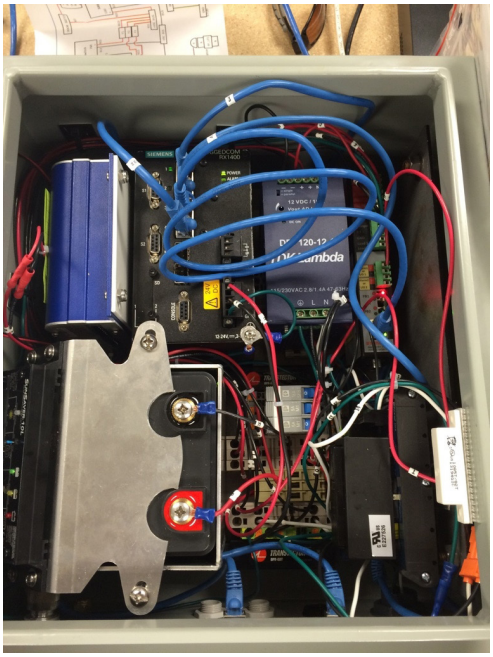
- Council Rock needed to test the reliability of their radio communications equipement prototype in extreme temperature conditions.
- Significantly reduce the size of the enclosure.
- Evaluate different radio communication products and configurations.

COE-ASM WORK PERFORMED

- Looked at the baseline design concept and included a failure mode and effects analysis (FMEA) and extreme temperature testing of the prototype.
- Developed a thermal simulation model to monitor conductive, radiative, and convective heat transfer.
- Evaluated alternative design considerations to simultaneously reduce enclosure size and improve performance at thermal extremes.
- Provided detailed design recommendations for a reduced-size enclosure with optimized thermal performance.

RESULTS

- Allowed to understand how design factors such as component placement, enclosure size, material, and color affected performance of the system in cold, hot, and sunny environments.
- The detailed design ensured the equipment will be protected and remain operational in even the most extreme conditions.
- Council Rock secured a large pilot order.



The second phase evaluated alternative design considerations to simultaneously reduce enclosure size and improve performance at thermal extremes. The final phase provided detailed design recommendations for a reduced-size enclosure with optimized thermal performance. Alternative battery technologies were also evaluated in the final phase as well as detailed designs for internal mechanical components.

Two primary tools were used to support the evaluation of different design configurations. A thermal testing chamber was used to assess the performance of prototype hardware at various temperature extremes. Thermal simulation of the enclosure and the active components was used to evaluate many alternate design configurations and features. Seventy-one separate thermal tests were run, and fifty different simulation configurations were evaluated.

Results

The simulation results allowed COE-ASM and Council Rock engineers to understand how design factors such as component placement, enclosure size, material, and color affected performance of the system in cold, hot, and sunny environments. Feedback from the model, coupled with functional testing of the electronics in the thermal chamber, resulted in design choices that ensure that the equipment will be protected and remain operational in even the most extreme conditions. The detailed design feedback also provided options for improved assembly and service as well as reduced manufacturing cost.

Almost immediately after the research project was completed, Council Rock secured a pilot order from a utility company out West. Those units will be deployed on the grid with the potential to lead to thousands of more orders. COE-ASM also connected Council Rock with the Clean Energy Incubator at RIT Venture Creations, which will provide additional business development support to take advantage of this growth opportunity.

TESTIMONIAL

"We turned to the Center of Excellence in Advanced & Sustainable Manufacturing to assist us with this new product, and I can say we are very pleased with the results. The COE-ASM was able to provide us with extremely valuable feedback that was used to improve the reliability of our product in deployments throughout the USA. Working with the COE-ASM proved to be a good business move, and as a result we have secured a pilot order that we believe will lead to thousands of additional sales of our product."

- David Rodriguez,
President, Council Rock Enterprises LLC

The Center of Excellence in Advance & Sustainable Manufacturing (COE-ASM) is a specialized applied research and development center dedicated to helping emerging and existing NYS manufacturers to enhance productivity and become more competitive through innovation and technology in sustainable products and processes. COE-ASM is located at the Golisano Institute for Sustainability and is a New York State Center of Excellence, a NYSTAR partnership.

A New York State Center of Excellence

NEW YORK STATE OF OPPORTUNITY. Division of Science, Technology & Innovation

For more information please contact us:

Tel: 585-475-4246
Web: www.rit.edu/gis/cesm
e-mail: sustmfg@sustainability.rit.edu
190 Lomb Memorial Drive
Rochester, NY 14623

R·I·T Golisano Institute for Sustainability
ROCHESTER INSTITUTE OF TECHNOLOGY