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Thermal and Shock Analysis of an RPS for Deep Space Missions

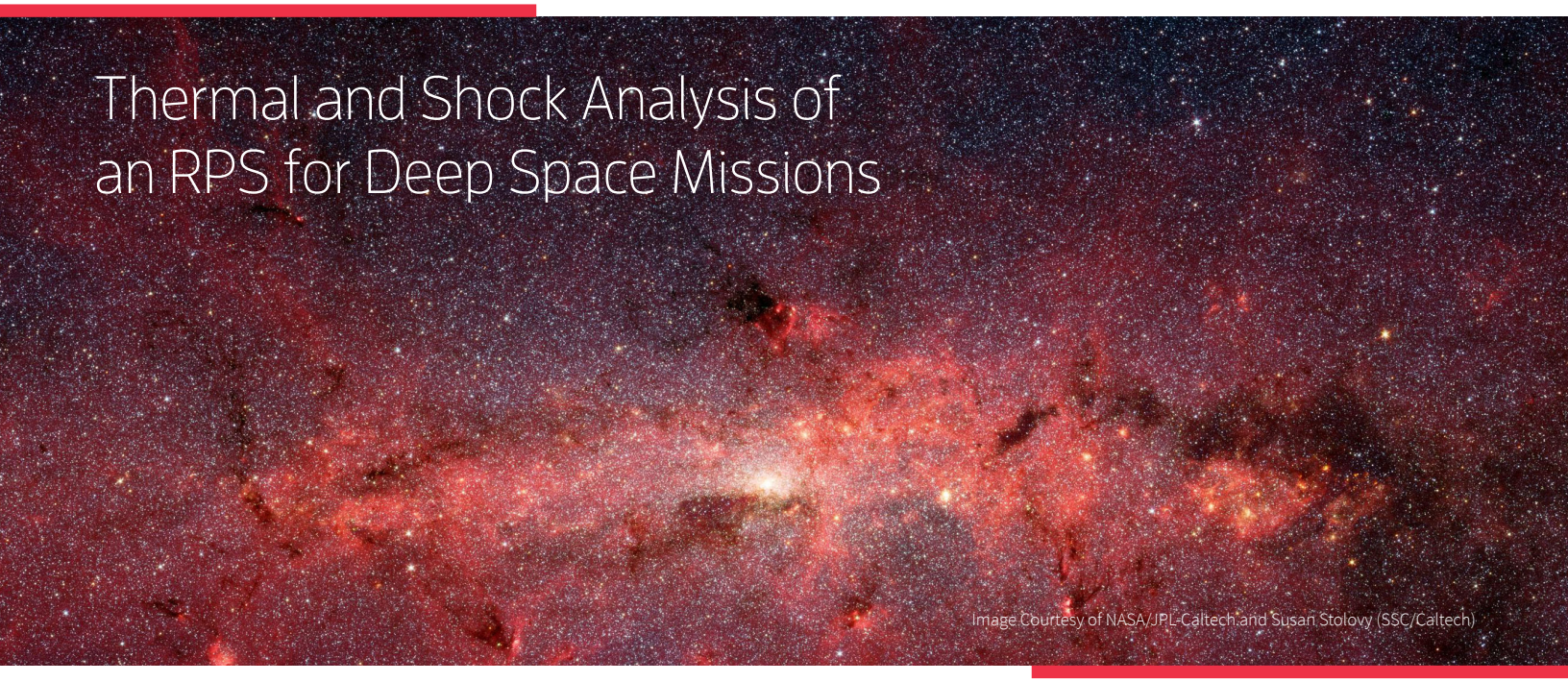


Image Courtesy of NASA/JPL-Caltech and Susan Stolovy (SSC/Caltech)

Case Study

OVERVIEW

ATA Engineering (ATA) provided Hi-Z Technology (Hi-Z) with thermal and shock analysis support to validate the design of their radioisotope power supply (RPS) developed for NASA. The RPS was designed to survive high g-level impact (up to 15,000 g) and to provide steady electrical power and heat for surrounding system components. The RPS could be used in a penetrator for deep space missions in which sunlight is not available to provide photovoltaic power, thereby enabling scientists to explore astronomical objects throughout our galaxy.

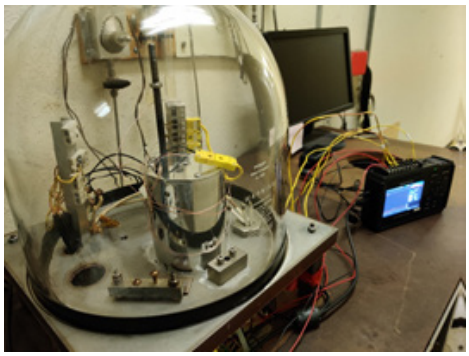
Continual thermal performance of the RPS is essential for supplying system components with electricity and heat, which is only possible if the RPS can survive high g-level impacts. Often, there are trade-offs between thermal performance or output power and structural performance. ATA helped Hi-Z reach an optimal thermal and structural design by performing numerous analytical trade studies and test–model correlations to validate the RPS for complex thermal and structural environments.

TASKS PERFORMED & KEY OUTCOMES

- Developed thermal models of various RPS designs
- Performed thermal analyses to compare the thermal performance of multiple RPS designs
- Correlated the RPS thermal model to thermal vacuum test results
- Used correlated RPS thermal model to predict thermal performance of updated design
- Developed structural models of various RPS designs
- Performed modal analysis to determine first bouncing mode frequency, shock and stress analysis to validate or improve structural design, and buckling analysis to eliminate buckling issues
- Provided recommendations for future RPS thermal and structural designs

"Hi-Z was quite impressed with ATA's ability to work through the RPS's complex thermal and structural characteristics. ATA was able to reach a satisfactory compromise between shock resistance and output power."

Jill Elsner, CEO of Hi-Z Technology



Hi-Z RPS in a thermal vacuum testing chamber