An Overview of STS-132 MRM1 Cargo Element Thermal Model Development & Analyses

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STS-132 was launched in May 2010 and delivered the Russian Mini Research Module 1 (MRM1) cargo element to the International Space Station as part of the ULF-4 assembly flight. The cargo element consisted of the module outfitted with externally mounted Multi-purpose Laboratory Module (MLM) Airlock, MLM radiator, Portable Work Platform (PWP), and a European Robotic Arm (ERA) spare elbow. Prior to every Shuttle flight, hardware developers are required to determine compatibility of their hardware to thermal environments experienced during the Shuttle mission and once the element is integrated with the ISS. Thermal models are provided to the Shuttle program to determine the impact of the payload on the Orbiter hardware, as well as the ISS program to determine impacts on other ISS payloads in the Orbiter. Historically the Russian International Partner (IP) develops models in formats not compatible with software used by Space Shuttle or ISS programs. This prompted NASA and Lockheed Martin to develop a unique set of thermal models for the MRM1 cargo element. Subsequent ULF-4 mission analyses performed with the models assessed the launch to activation response, identified operational criteria documented in flight rules, and ensured compliance with the mission timeline and no hazards to the crew, orbiter, or ISS.
This presentation provides an overview of the work performed, depicts unique approaches in model development, discusses lessons learned, and issue resolution approaches. Though development and analysis efforts spanned over four years and presented various integration challenges it provided an example of successful collaboration with our International Partners.

Biographies

Miguel Fernando Perez is a Thermal Analyst with 22 years of experience in the Shuttle and ISS programs. He was project lead overseeing the development of the MRM1 cargo element thermal models. He is currently working for Lockheed Martin in Houston, Texas supporting thermal analyses for the Cargo Mission Contract as well as the Orion program.

Elias Azzi is an Environmental/Thermal Systems Lead Engineer with 20 years of experience in the Shuttle and ISS programs. He was flight lead for STS-132/ULF-4 overseeing the Launch to Activation thermal analyses. He is currently working for Lockheed Martin in Houston, Texas supporting thermal analyses for the Orion program.

Evgeny Menkin is an ISS Program Integration Representative with 22 years of experience in human spaceflight programs for MIR and ISS. He was the principal lead on the project and coordinator between NASA, Lockheed Martin, and RSC-E. He is currently working for Ares Corporation in Houston, Texas supporting the NASA ISS Vehicle Integrated Performance and Resources (VIPER) team.

Timothy B. Davies is a Thermal Analyst with 15 years of experience in the Shuttle and ISS programs. He was the ULF-4 flight lead for NASA ISS PTCS as well as the principal representative for NASA ISS PTCS providing technical oversight and ensuring requirements compliance. He is currently working for NASA JSC in Houston, Texas as system manager for Orion PTCS, and integration and verification of visiting vehicles for ISS PTCS.