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MODEL-BASED SYSTEMS ENGINEERING IN NASA FACILITY REQUIREMENTS DEVELOPMENT

Abstract

The work described in this paper is for a project to restore the capabilities and improve the reliability of the 150 MW power supply of the Arc Jet Complex at NASA Ames Research Center after several disabling problems. The Complex has a long history of testing thermal protection systems for numerous space missions. To continue the power of this unique testing facility to support future missions, recapitalization and modernization efforts have been underway for a number of years.

Analytical Mechanics Associates, Inc. (AMA) was tasked to write a functional requirements document, considering the various stakeholder's desires for improvements, interfaces with existing equipment, and best practices in space systems engineering. The objective was to produce verifiable functional requirements in a limited time that would also improve the quality of the system design through the thoroughness and transparency of the methodology.

The team chose to use a model-based systems engineering methodology implemented through SysML. This approach enabled the team to do all the necessary steps in a single source of authority, including printing the latest version of the document deliverable through an automated report with a customized template. The team utilized the model to capture stakeholder input, create a multi-dimensional concept of operations and functional decomposition from the existing and suggested functionality and interfaces of the power supply and control system, directly trace the requirements to all this information, and track the development and traceability of the requirements.

Because the project involved integration into an existing facility, the team also used requirements to constrain the system to function within the existing larger system. By modeling the relevant parts of the existing system, including hardware, interfaces, and operations, additional required functionality was defined. By tracing these requirements, derived from a more detailed view, to the modeled stakeholder input, concept of operations, and functions, more "big picture" information, engineers could see gaps in requirements development or functional definition.

The different sources of functional requirements were easy to connect in a model, and allowed thorough requirements development with detailed traceability. By updating system definition and requirement elements in the model, the team could immediately see which other elements it might affect. It was completed in a few months when it could have taken a year for a requirements flow and document management process without MBSE. The NASA customer appreciated the speed and completeness of AMA's methodology to apply modern space systems engineering practice.