International Planetary Probe Workshop 9

NASA Thermal Performance Data Services

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology

Richard T. French
Jet Propulsion Laboratory, California Institute of Technology
Richard.T.French@jpl.nasa.gov

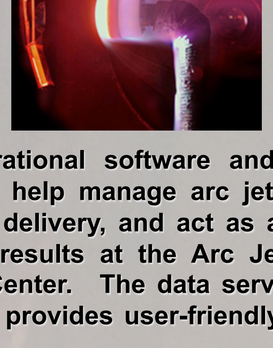
Myron R. Grover
Jet Propulsion Laboratory, California Institute of Technology
Myron.R.Grover@jpl.nasa.gov

Michael J. Wright
NASA Ames Research Center
Michael.J.Wright@nasa.gov

INTRODUCTION

The Thermal Performance Data Services (TPDS) is a new data management system to facilitate arc jet test data processes including test preparation, test data delivery, and archival of test data sets. Due for a first operational deployment in mid-summer 2012, the system was born from a need for a thermal performance data central repository identified during the Crew Exploration Vehicle (CEV) TPS advanced development project (ADP). Under co-leadership by NASA Ames Research Center (ARC) and the Jet Propulsion Laboratory (JPL), the project was initiated by the NASA Engineering Safety Center (NESC) and has benefited from the support of both the NESC and the NASA Ames Arc Jet Complex (Code TSF). Envisioned as a tool highly integrated into material performance assessment processes, TPDS could significantly increase efficiently across the TPS community and provide for additional discipline advancement, making it a tool of high potential value for NASA, academia, industry and other elements of the thermal performance community.

OVERVIEW



TPDS consists of operational software and secured servers designed specifically to help manage arc jet test facility data, facilitate customer data delivery, and act as a secure relational database for historical results at the Arc Jet Complex at the NASA Ames Research Center. The data services are accessed via a Web interface that provides user-friendly access to arc jet test data products. The system also provides interface tools to arc jet test facility staff for upload of test data as tests are completed. Users of the data services are granted access to the system via a combination of authorizations from data owners, the TPDS administrators and the NASA Account Management System (NAMS). Data access within the system is strictly controlled via a user privileges system to ensure users have access to only the data they have been given authorization to access.

The version of the data server planned for deployment in 2012 contains a number of features developed in cooperation with the NASA Ames arc jet test facility team. These features include a data browser (Figure 2), tools for uploading single data files and multi-file test data packages, test photo previews (Figure 3), a shopping cart feature for collecting desired data products for download (Figure 4), a run sheet interface for arc jet test procedure generation, and linking between test data and instrument records of instruments used in the tests. In addition to these initial features, many additional features have been identified for future development that further facilitate arc jet testing data management. To date, TPDS has been populated with initial test data sets, with historical data sets and new data sets to be added once TPDS is operational.

TPDS physically resides at NASA Ames and is maintained by the NASA Advanced Supercomputing (NAS) facility.

DATA FLOW

Key Data Service Products
- Arcjet Test Plans
- Arcjet Test Data Sets
- Arcjet Test Photos & Videos
- Sensor Histories
- Thermal Analyses

Key Data Service Customers
- Principal Investigators
- Test Facility/Sensor Lab Staff
- Thermal Analysts
- Technology Decision Makers

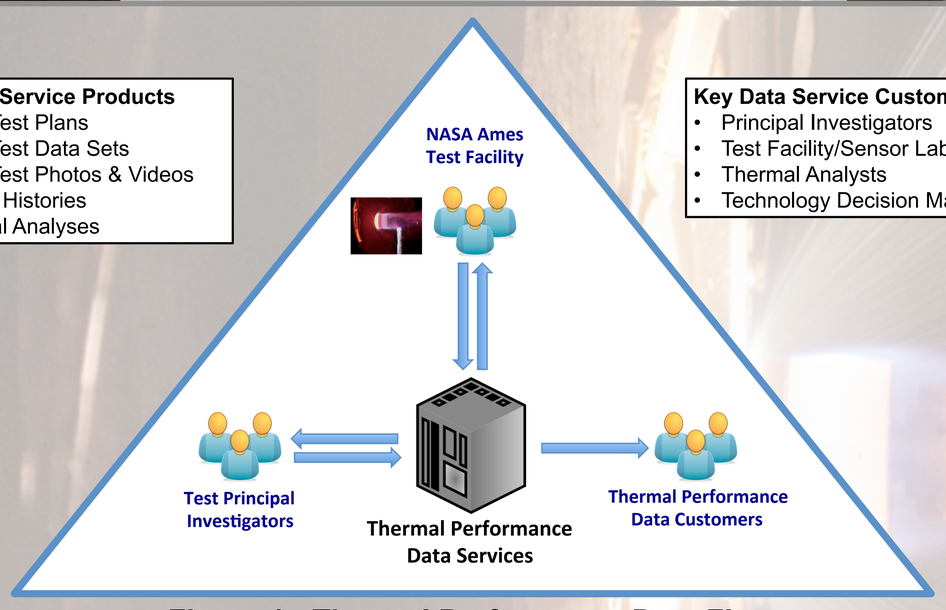


Figure 1 - Thermal Performance Data Flow

As shown in Figure 1, the TPDS will be central to thermal performance data flow, being utilized by principal investigators, test engineers & test facility staff, and thermal performance data customers including thermal performance analysts. Upfront test series products including test plans, pre-test analyses and facility procedures will be flowed into the database. Once executed, test series data including sensor data, calibration data, photo documentation and video documentation are also be be ingested into the database archive where it can be accessed by principal investigators. Test data will flow to thermal analysts and results of thermal analyses will flow back to the database, providing a thorough archiving of thermal performance testing and analysis. The database then provides a centralized repository of thermal performance data accessible by authorized users of the thermal performance community.

For historical data from tests conducted in the past, the TPDS effort includes ingestion of available data packages into the database, providing to the degree possible a collection of thermal performance data reaching to the beginning of the space age.

DATA SERVER

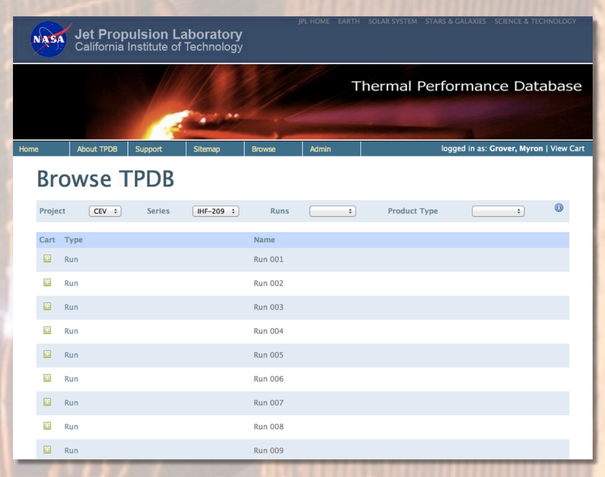


Figure 2 – Data Server Browser

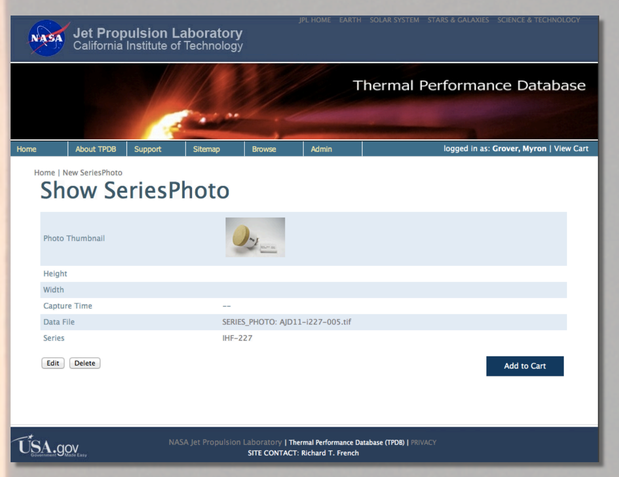


Figure 3 – Test Photo Page

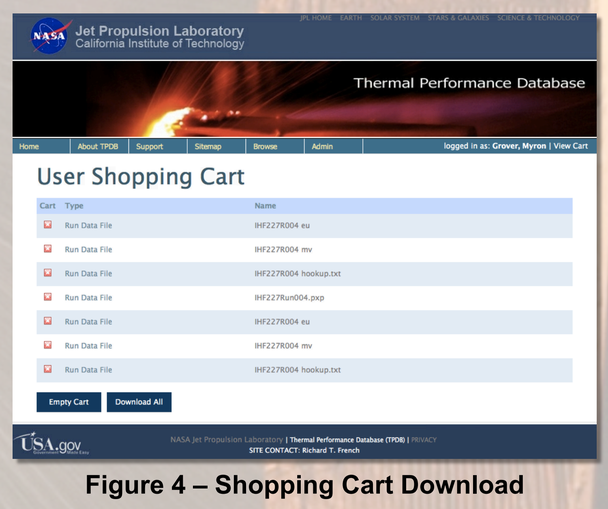


Figure 4 – Shopping Cart Download

The TPDB is based on Object-Oriented Data Technology (OODT)

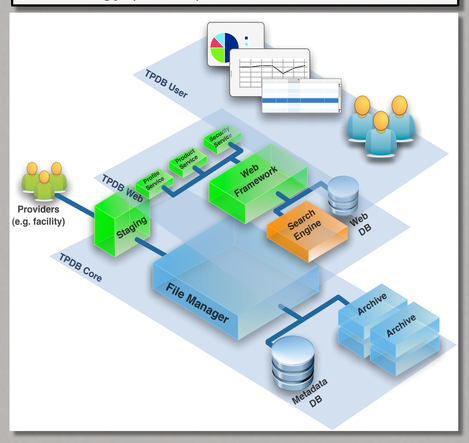
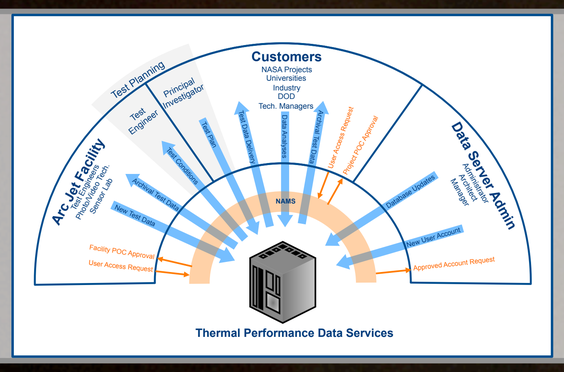


Figure 5 – TPDB Structure

OPERATIONS CONCEPT



Arc Jet Facility
- Deployed, operated, and maintained at the NASA Ames Research Center (ARC) Arc Jet Complex
- Archival data used by test engineers for test planning
- New test data uploaded to TPDS for archiving and delivery to test facility customers
- New test facility users authorized by test facility POC

Customers
- Customers include NASA projects, universities, industry, DOD and technical managers
- Customer test plans uploaded to data server
- Test result data retrieved by customers from data server
- Analysts' thermal performance analyses uploaded to server
- New user access approved by customer POC

Data Server Administrator
- Data server administrators include system administrators, server architect and project manager
- System maintenance and software updates deployed to server
- New user account deployments for authorized users

CONCLUSIONS AND FUTURE WORK

With a planned first deployment in mid-summer 2012, the Thermal Performance Data Services will provide a centralized repository for the thermal performance community, facilitating the task of performing and analyzing thermal performance technologies. TPDS has been designed to increase test facility efficiency, streamline facility-customer interaction, provide easy and secure access to data by the thermal protection system community, and enable discipline-advancing work. Future developments of TPDS could significantly increase efficiently across the TPS community and provide for additional discipline advancement. Connections to computational fluid dynamic simulation of arc jets will provide a validated archive of arc jet conditions based on a standard analysis approach. Thermal response modelers will have access to both validated environments and thermal response results for model development, verification, and validation. Statistical analysis evaluating model efficacy and material performance can be completed with confidence, and projects will have a data management tool that streamlines data delivery and archiving while securing the critical data necessary for Certificate of Flight Readiness.

CREDITS & FUNDING

The Thermal Performance Data Services is funded by the NASA Engineering Safety Center & the NASA Ames Arc Jet Complex (Code TSF)

In collaboration with CEV and MSL TPS arc jet test principal investigators, CFD, thermal analysis, test planning systems analysis, and certification; Ames Research Center Arc Jet Complex; Johnson Space Center Atmospheric Reentry and Structures Evaluation Facility; and Analytical Mechanics Associates Inc.