

# ***JANNAF Community Meets in Las Vegas for 56th JANNAF Propulsion Meeting and Joint Subcommittee Meeting (39th SMBS, 35th PEDCS, 26th RNTS, 24th SEPS, and 17th NDES)***

**T**he 56th Joint Army-Navy-NASA-Air Force (JANNAF) Propulsion Meeting (JPM), 39th Structures and Mechanical Behavior Subcommittee (SMBS), 35th Propellant and Explosive Development and Characterization Subcommittee (PEDCS), 26th Rocket Nozzle Technology Subcommittee (RNTS), 24th Safety and Environmental Protection Subcommittee (SEPS), and 17th Nondestructive Evaluation Subcommittee (NDES) Meeting was held Tuesday through Friday, April 14-17, 2009, at the Renaissance Hotel in Las Vegas, Nevada. Mr. Bruce R. Askins of NASA Marshall Space Flight Center (MSFC) in Huntsville, Alabama, chaired the meeting. Attendance was 522, with over 260 papers presented. There were 43 regular technical sessions, 2 specialist sessions, and 4 workshop sessions. All attendees received a complimentary copy of the second issue of the *JANNAF Journal of Propulsion and Energetics*.

Program highlights included a keynote address, "The Ares Launch Vehicles: Critical Capabilities for America's Continued Leadership in Space," by Stephen A. Cook, manager of the Ares Projects at NASA MSFC. Mr. Cook described progress on the Ares I system, which will transport the Orion crew exploration vehicle into space and deliver cargo payloads to space – key to U.S. space exploration objectives.

The Ares Project Office is responsible for the overall integration of the launch vehicle system, including development of a first stage derived from the current space shuttle booster and a new upper stage powered by a J-2X engine. The project office is also responsible for development of NASA's future Ares V cargo launch vehicle and Earth Departure Stage, which will carry heavy-lift payloads to space for use by exploration missions on the moon and beyond.

After the keynote address, several individuals were honored for their contributions to the JANNAF Propulsion Community. Dr. Robert C. Corley of the Air Force Research Laboratory (AFRL) at Edwards AFB received the JANNAF Executive Committee (EC) Lifetime Achievement Award for his outstanding support to JANNAF as well as his 50-plus years of leadership and achievement in propulsion technology. Dr. Allan J. McDonald, retired from ATK and now a consultant, also received the Lifetime Achievement Award in recognition of his 50 years of significant contributions to the propulsion industry, to the advancement of technology, and to the sustainment of capabilities. Dr. McDonald was unable to attend the meeting; David Riemer of ATK accepted the award on his behalf.

Certificates of Appreciation were presented to JANNAF Session Chairs Mr. Frederick J. Borrell and Mr. Richard S. Muscato, both of the Naval Surface Warfare Center-Indian Head Division; Dr. Benjamin Greene of Jacobs Technology, Inc.; and Dr. Tom W. Hawkins of AFRL-Edwards AFB.

In addition to the regular sessions, George Hopson and Len Worlund of the NASA Engineering and Safety Center (NESC) and National Institute of Aerospace presented a two-day course, "Space Propulsion Systems: Learning from the Past and Looking to the Future." The tutorial was held April 16-17.

## ***56th JPM Technical Program***

The JPM program consisted of 10 JPM-only sessions and 10 sessions combined with 1 or more subcommittees. Session topics were: The Integrated High-Payoff Rocket Propulsion Technology (IHRPT) program, gun propulsion, technology and manufacturing readiness levels (a specialist session), solid propellant test methods, propellant process engineering, rocket motor technologies, tactical rocket propulsion, Ares launch vehicles, scramjet technology, propulsion concepts for space exploration, solid rocket motor performance prediction, missile defense / strategic propulsion, and launch abort motor technology.

## ***39th SMBS Technical Program***

SMBS conducted five sessions independently and four sessions with JPM and other subcommittees. Session topics were material properties and characterization, aging and service life, technology and manufacturing readiness levels, the business case for system health monitoring, and wireless sensors.

Technology and manufacturing readiness levels (TRLs and MRLs) comprised a specialist session, which was conducted jointly by JPM, PEDCS, and SMBS. In 2008, the Department of Defense conducted a tri-service study to investigate reducing the time required to develop and qualify new tactical rocket motors. Recommendations included the establishment of descriptions of appropriate TRLs and MRLs for solid propellant rocket motors, so as to assist program planners in the early stages of development. At the workshop, various industry and government metrics of readiness levels for energetic ingredients, propellants, case materials, nozzles, thrust vector control systems, igniters, arm-fire devices, devices for insensitive munitions compliance, and other aspects of solid propellant rocket motors were considered, in order to help identify tech-

nology or manufacturing availability shortfalls that must be resolved to allow weapons development to proceed on schedule and within budget.

The business case for system health monitoring was a workshop. The Air Force Research Laboratory (AFRL) is funding Consensus Technology LLC to conduct a business case study for Integrated Health Management in the chemical propulsion arena, including both solid and liquid systems. The study will require interested individuals to work with the primary investigator, James H. MacConnell, to evaluate the potential benefits of health management. Workshop participants established the evaluation process. Others interested in participating may contact Mr. MacConnell at 206-524-8555.

Wireless sensors encompassed a two-day workshop. The workshop presented case studies on the use of wireless technology to transmit sensor data, including technology to detect impact on the wing leading edge of the Space Shuttle Orbiter. A panel discussion was held to consider the benefits of wireless versus wired sensor technology, the current state of the art, and obstacles to the implementation of wireless sensors.

### ***35th PEDCS Technical Program***

PEDCS conducted 12 sessions independently and 10 sessions with JPM and other subcommittees. Session topics were green energetic materials, environmental protection, the status of selected propellant ingredients, propellant process engineering, technology and manufacturing readiness levels (joint specialist session – see SMBS Technical Program), solid propellant test methods, guns and high-gas-output devices, explosives formulation and development, tactical rocket propulsion, aging and service life, liquid propellants, and novel solid propellant ingredients.

The status of selected propellant ingredients constituted a specialist session. It was one in a series of specialist sessions that have been conducted at JANNAF meetings to inform the propulsion community of changes and trends in the availability and quality of certain propellant ingredients, which are selected on the basis of their critical roles. Representatives of eight suppliers of propellant ingredients gave presentations that included background/history of ingredient production, current products of interest, production capabilities with emphasis on unique technologies, areas of expertise relative to ingredient production, current and potential environmental issues, topics of current research and development, government programs supported by the supplier, reasons and circumstances regarding any past disruption of production, future prospects or trends in production of ingredients of interest, and contact personnel. A critical materials update from the 2009 meeting of The Technical Cooperation Program (TTCP) was also provided.

### ***26th RNTS and 17th NDES Technical Program***

RNTS conducted three sessions independently and five sessions with either JPM or NDES. Session topics were the Integrated High-Payoff Rocket Propulsion Technology (IHRPT) program; inspection and evaluation; rocket motor technologies; new rocket nozzle technologies; and nozzle design, test and evaluation. The sessions on inspection and evaluation were conducted jointly by NDES and RNTS.

### ***24th SEPS Technical Program***

SEPS conducted three sessions independently and two sessions with PEDCS. Session topics were green energetic materials; environmental protection; toxicology; occupational and environmental health; demilitarization, reclamation and reuse technology; and hazardous material management.

### **Subcommittee Panels**

The PEDCS held seven panel meetings. Variability of hydroxyl-terminated polybutadiene (HTPB) was the primary focus of the **Propellant and Explosive Process Engineering Panel** meeting. HTPB is a critically important solid propellant ingredient. Propellant manufacturers have encountered variations in propellant mechanical properties attributable to HTPB. In order to more effectively deal with the variability issue, the panel plans to conduct a HTPB Workshop at the JANNAF Propulsion Systems Hazards Subcommittee (PSHS) meeting in December 2009. Of particular interest to the **Solid Propellant Ingredients and Formulations Panel** are foreign developments in energetic materials and energetics databases administered by the Department of Energy (DoE). The panel also plans to work with the Propellant and Explosive Process Engineering Panel in conducting a future HTPB workshop. The **Chemical Test Methods Panel** decided to review the methods in the *CPIA Propellant Characterization Handbook* (CPIA Publication 507) to determine whether they are still appropriate and represent the state of the art. The panel also reviewed recent progress in the addition of spectral data to CPIAC's Propellant and Explosive Ingredients Database. Members of the **Guns and High Gas Output Devices Panel** meeting discussed the findings of a recent workshop on sub-scale insensitive munitions testing conducted under The Technical Cooperation Program (TTCP). The panel also decided to plan for a workshop on closed bomb testing to be conducted in conjunction with the 2010 TTCP meeting. Items of interest expressed at the Surveillance and Aging Panel meeting were a workshop on test methods for propellant aging, a workshop on relations between propellant chemical and mechanical properties as they are affected by aging, application of wireless sensor technology to surveillance, and collaboration with the Joint Propellant Safety and Surveillance Board. Attendees at the **Liquid Propellants Panel** meeting were interested in the continued need

for material compatibility studies, ground support equipment requirements for hypergolic bipropellants, quantity-distance criteria for liquid propellants, the status of military specifications for hypergols, and a study in the variability of RP-1 hydrocarbon fuel. The **Energetic Materials Development Panel** focused on following the development of specifications for CL-20 and NTO. It was also suggested that panel members look at CPIAC's online Propellant & Explosive Ingredients Database (PEID) and provide input to CPIAC regarding any new ingredients that should be added.

Two **RNTS** panels held meetings. Discussion topics of the **Nozzle Design and Evaluation Panel** included replacement of North American Rayon Corporation (NARC) rayon for the Reusable Solid Rocket Motor nozzle, the nozzle erosion Multidisciplinary University Research Initiative (MURI) program funded by the Office of Naval Research, the need to document char and erosion kinetics to maintain the knowledge base and archive lessons learned, and possible paths for funding nozzle material research and testing. Topics of interest to the **Rocket Nozzle Modeling Panel** were thermo-structural modeling of tape-wrapped composite parts, combined aerothermal/gas-dynamic analyses of nozzle components, and two-phase combustion gas interaction with nozzle materials.

The **SEPS** held four panel meetings, including a combined meeting of the **Instrumentation Panel** and the **Range Safety and Atmospheric Modeling Panel**. They considered various ideas for facilitating the updating of CPIA Publication 394 (*Hazards of Chemical Rockets and Propellants*). Topics of interest to the **Occupational Health and Toxicology Panel** were contribution to and review of the proposed *Green Energetic Materials Handbook* (more on this in the next paragraph), contribution to ASTM methods for evaluating toxicity, participation in the ASTM nano-materials group, coordination of nano-material environmental/safety/health issues within the JANNAF community, and contribution to the tri-service Toxicology and Risk Assessment Conference (TRAC). Attendees at the **Demilitarization, Reclamation, and Reuse Technology Panel** meeting expressed interest in the comparative economics of ammonium perchlorate conversion to perchloric acid versus chlorate salts, recovery of nitroguanidine from triple-base propellants, and reuse of nitrocellulose from SPD 16-in. gun propellant.

Panel meetings included the **Green Energetic Materials and Environmental Protection Panel**, which is governed jointly by PEDCS and SEPS. One of the tasks discussed by the panel is the development of a green energetic materials handbook that outlines the history of green energetics, lessons learned, and regulatory applicability. This task may lead to a procurement manager's guide to green energetics as well. Another possible task is the development of a guide to environmental tests needed in the course of implementing new energetic materials. The guide could include a flow chart showing the optimal progression of testing and a model time line to indicate which tests are needed and when. Panel members also shared information as to the best sources of environmental property data.

Four **SMBS** panels also held meetings. The **Structural Analysis Panel** is considering revision of CPIA Publication 612, which is a handbook of guidelines for determining rocket motor grain design margins of safety. The **Defect Evaluation Panel** has completed round-robin tests for propellant defect and analog wedge fracture analyses. They also prepared a Solid Rocket Motor Defect Summary Chart to supplement a defect detection capabilities document developed by NDES. The **Materials Properties and Characterization Panel** is looking to update CPIA Publication 21 (*Solid Propellant Mechanical Behavior Manual*) with new and revised testing procedures. The panel members would also like to create a digital version of the document and to verify that the procedures comply with NATO STANAG requirements. The **Service Life Panel** has cosponsored two workshops on missile system health monitoring. Additional tasks comprise formation of a users' group for Texchem (a computer program that models diffusion effects within complex structures), development of guidelines for the use of sensors in monitoring service life, and a joint workshop with PEDCS on material properties that need to be measured for service life characterization.

Although the Modeling and Simulation Subcommittee (**MSS**) did not have a full meeting at this time, its **Solid Rocket Motor Performance Prediction and Standardization Panel** met. The panel decided to collect BATES motor firing data conducted at AFRL as well as test data from the Tullahoma range, to create a database for comparison with predictions. The panel also agreed upon physical phenomena that need to be better understood and modeled to improve prediction. The next step is to identify specific models and down-select for validation.

### **Meeting Proceedings**

Meeting proceedings will be available soon on CD-ROM. Qualified customers may contact CPIAC at 410-992-7300 or by e-mail to [cpiac@cpiac.jhu.edu](mailto:cpiac@cpiac.jhu.edu) for more information or to order the proceedings.

### **Future Plans**

The next joint meeting of these subcommittees is planned for November or December 2010. The next JPM, which will include the Modeling and Simulation, Liquid Propulsion, and Spacecraft Propulsion Subcommittees, is tentatively scheduled for May 2010.

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