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# **PROPULSION DIRECTORATE**

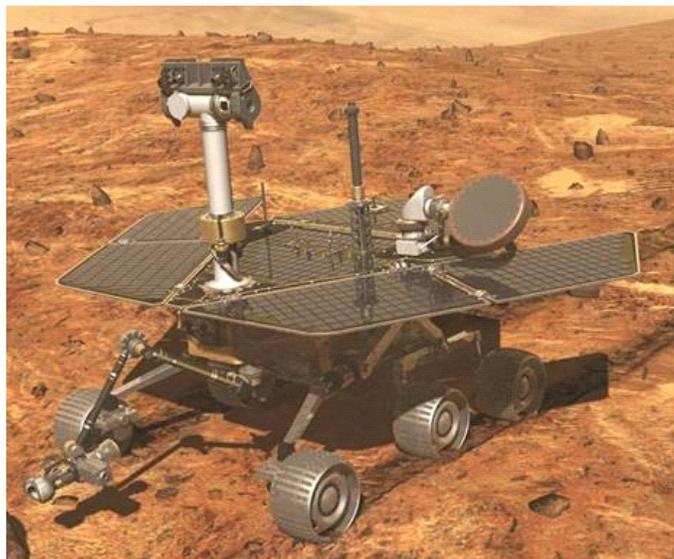
## **Monthly Accomplishment Report May 2004**

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LITHIUM-ION BATTERY TECHNOLOGY TRANSITIONS TO THE NAVY: An Air Force lithium-ion battery development program initiated in 1998 has led to power solutions for US military forces as well as new commercial products for the private sector. The most recent evidence of the propagation of this technology was the selection of Lithion, Inc./Yardney Technical Products for the US Navy's Phase II Advanced SEAL Delivery System (ASDS) Lithium-Ion Battery Program. The ASDS is a combat submersible intended to clandestinely carry Navy SEALs and their combat gear to and from hostile shores enabling a number of special operations missions. Lithion, Inc. explicitly credits the Air Force lithium-ion battery program with providing them the opportunity to succeed in this technology area, and they also acknowledge the Air Force as the most important partner in moving lithium-ion technology to real applications. Technologies developed as a result of the Air Force program have satisfied the power needs for NASA's Mars Exploration Rovers, the B-2 Bomber, several satellite applications, and now the Navy's ASDS application. Opportunities exist to expand lithium-ion technology further into areas such as unmanned aerial vehicles (UAVs) and Battlefield Air Operations (BAO) applications, as well as continuing development for the Joint Strike Fighter (JSF), directed energy weapons (DEW), and smarter electronic designs to meet critical needs. (LtCol J. Erno, AFRL/PRP, (937) 255-6178)



The B-2 bomber (top) and NASA's Mars Exploration Rover (bottom) are just two examples of systems that have benefited from lithium-ion battery technology developed by PR

TWO FORMER PR EMPLOYEES NAMED AS EXEMPLARS:

Two former Propulsion Directorate employees, Mr. D. Adam Dickey and Mr. Ernest C. (Cliff) Simpson, were recently selected as inaugural members of the Career Civil Service Exemplars. They were formally recognized in a

ceremony held at the Pentagon on 25 May 2004, where displays highlighting their career achievements were unveiled as part of the new DoD Career Civilian Corridor Exhibit. This exhibit includes photographs and narratives describing the accomplishments of outstanding career civilian employees. Of the nine individuals chosen as Exemplars, Messrs. Dickey and Simpson were the only two Air Force civil servants recognized. This inaugural event selected civil servants from 1789 to the present, and the Exemplars will only be "revisited" with nominations every ten years. Mr. Dickey had a distinguished career that spanned the period from

World War I to his retirement in 1957. He played a critical role in assuring US preeminence in the field of aircraft propeller design and development, and he received the first Defense Emblem of Exceptional Civilian Service Medal from then Secretary of War Henry Stimson in 1943. Mr. Simpson served in the US Army during World War II and Korea, and he then spent 34 years as an engineer in the Propulsion Directorate before retiring in 1980. He was legendary in the Air Force R&D community for his unique combination of technical expertise and leadership skills, and he played an integral role in advancing the technology of high bypass ratio turbine engines which enabled today's largest commercial airliners. He received the Exceptional Civilian Service Award, the highest honorary award a civilian employee of the Air Force can receive, and he was also a joint recipient of the prestigious Goddard Award in 1968. PR's annual award for outstanding technical achievement by a team, the E.C. Simpson Award, is named in his honor. (Mr. S. Cloyd, AFRL/PROP, (937) 255-0158)



Mr. D. Adam Dickey (left) and Mr. Ernest C. (Cliff) Simpson (right) were selected as two of the nine inaugural members of the Career Civil Service Exemplars

**SECOND MICROGRAVITY FLIGHT EXPERIMENT COMPLETED:** A second microgravity spray cooling experiment was recently flown aboard NASA's KC-135A microgravity test bed as part of a collaborative research effort between the Propulsion Directorate and NASA Glenn Research Center's microgravity research group. Spray cooling offers a potential solution to the thermal management of high heat flux sources aboard air and space platforms. The purpose of these experiments is to investigate the effects of micro- and high-g environments on the performance of spray cooling systems. During this second flight test, heat loads up to  $90 \text{ W/cm}^2$  were successfully applied to the heaters demonstrating the potential for space and air vehicle cooling applications. (Lt R. Claycamp, AFRL/PRPS, (937) 656-4428)



Dr. Kirk Yerkes is shown aboard NASA's KC-135A microgravity test bed

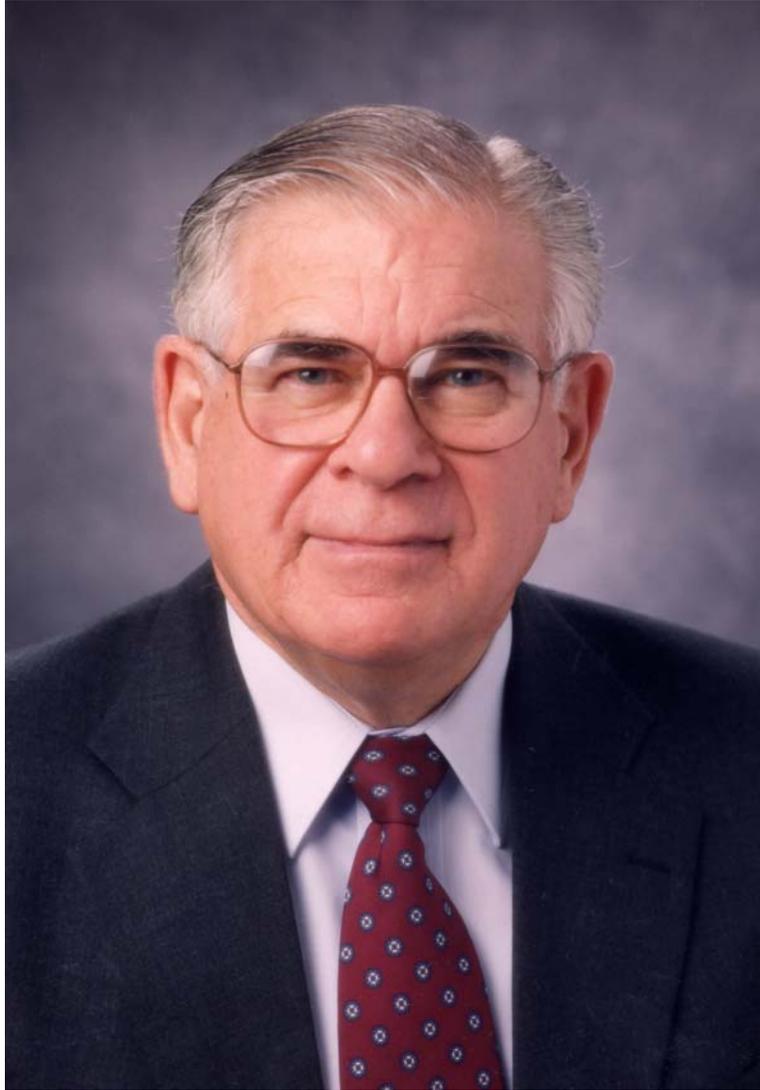


Microgravity spray cooling tests are conducted aboard NASA's KC-135A microgravity test bed

**FORMER PR DIRECTOR SELECTED FOR PRESTIGIOUS AIAA AWARD:** Dr. Edward T. (Tom) Curran was recently selected as the 2004 recipient of the prestigious American Institute of Aeronautics and Astronautics (AIAA) Air Breathing Propulsion Award. Established in 1975, this award is presented for meritorious accomplishment in the arts, sciences, and technology of air breathing propulsion systems. This award recognizes Dr. Curran for his long and distinguished career of achievement, much of which was spent in the Propulsion Directorate. Dr. Curran first came to PR in 1961 as a Royal Air Force (RAF) exchange officer. Following his retirement from the RAF in 1968, he joined PR as a civilian and advanced through the ranks to eventually become PR's Chief Scientist and then Director. He retired as PR's Director in 1997, but he remains active in the propulsion community. He was awarded a joint patent for his foundational work on the supersonic combustion ramjet (i.e., scramjet) engine. This work forms the basis for much of the hypersonic propulsion work being undertaken today. Dr. Curran is an Associate Fellow of AIAA and has been an AIAA member since 1957. He has co-authored two AIAA propulsion texts, he conceived and successfully advocated the *Journal of Propulsion and Power* while a member of AIAA's Air Breathing Propulsion Technical Committee, and he continues to serve as a reviewer for AIAA journals. (Col M. Heil, AFRL/PR, (937) 255-2520)

Want more information?

- ❖ For more info about AIAA's Air Breathing Propulsion Award and a list of past winners click [here](#).



Dr. Edward T. (Tom) Curran was selected as the 2004 recipient of AIAA's Air Breathing Propulsion Award

**MR. JEFF THORNBURG WINS 2004 ROTARY STELLAR AWARD:** The Propulsion Directorate's Mr. Jeff Thornburg\* was part of a team that recently won the 2004 Rotary National Award for Space Achievement (RNASA) Foundation Stellar Award. The Stellar Awards were established to recognize outstanding individuals and teams from industry and government who have made significant contributions to the future of the nation's space program. Mr. Thornburg was recognized for leading an integrated product team (AFRL, NASA, and industry) tasked to design, build, and test a new liquid rocket engine for use in space boosters. This program, the Integrated Powerhead Demonstration (IPD) program, is the first US liquid rocket booster

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\* Mr. Thornburg recently left AFRL for a job with industry.

program in over three decades. The IPD team encountered many technical difficulties, but it has overcome them to successfully build and test various IPD components. The team is now in the final stages of assembling the complete system and conducting engine testing. It is noteworthy that Mr. Thornburg and the IPD team were nominated for this award by NASA. (Mr. E. Koppisch, (661) 275-5198)

*Want more information?*

❖ More information on the Stellar Awards is available by clicking [here](#).



Mr. Jeff Thornburg and the Integrated Powerhead Demonstration Team received the 2004 Rotary Stellar Award

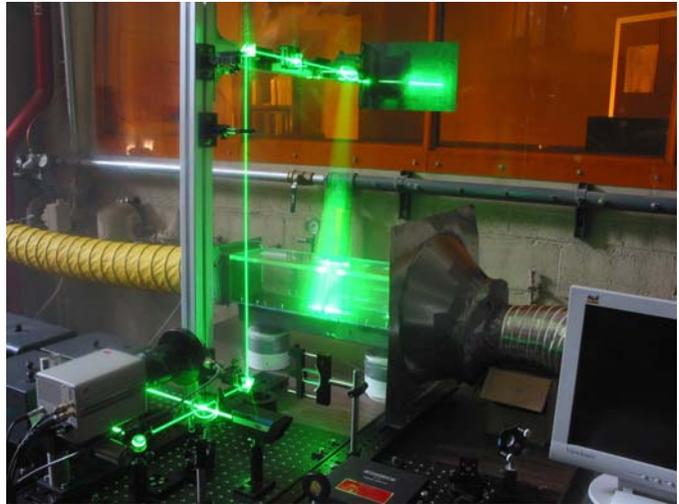
**DRIVING NEXT GENERATION ENGINE DEVELOPMENTS:** Engineers and contractors in the Propulsion Directorate have completed a study of jet penetration into a cross-flow air-stream assisting Rolls Royce using Particle Image Velocimetry (PIV), a laser diagnostic tool. These measurements are critical for validating computer design codes that will drive next-generation engine developments. Six configurations of varying cross-flow and jet flow rates with two different plate-hole geometries were tested. Consecutive images using a high speed camera were used to correlate particles seeded into the jet and cross-flow fields. Velocities were determined by measuring the distance seed particles traveled in a given length of time. Three PIV data sets

were acquired at each condition. Spreadsheets of test parameters and run conditions were collected from a data acquisition system documenting each test. Test results indicated good correlation between PIV data and expected test results. Visualization of jet penetration and mixing was also achieved. (Ms. A. Lynch, AFRL/PRTC, (937) 255-8433 and Mr. J. Miller, AFRL/PRTC (UTC), (937) 255-8469)

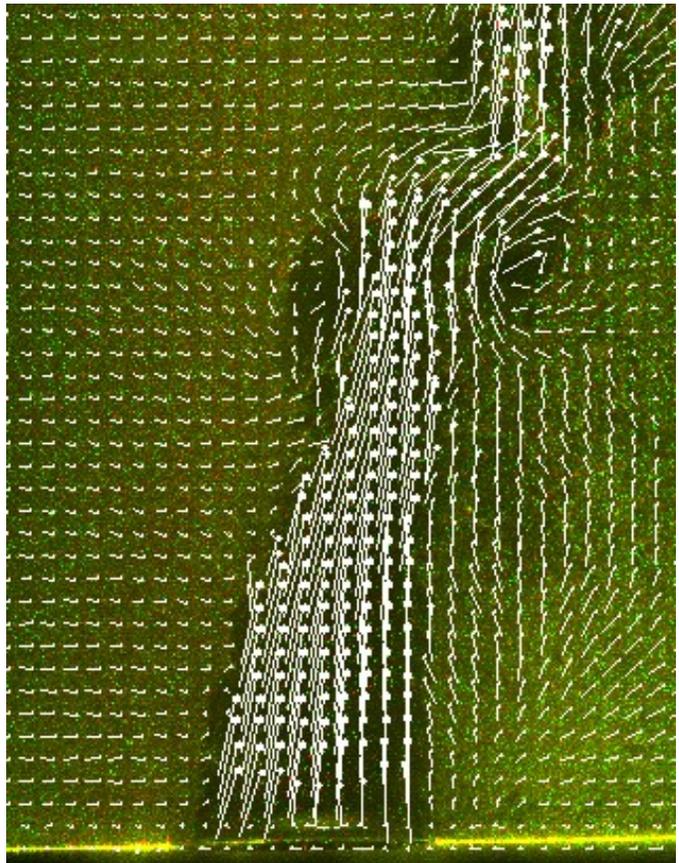
PR ALUMNUS ENTERS SPACE TECHNOLOGY HALL OF FAME:

Mr. Joseph F. Wise, a Propulsion Directorate alumnus, was named as one of the contributors to a technology that was recently inducted into the Space Technology Hall of Fame. AFRL<sup>†</sup> and [Spectrolab, Inc.](#) (A Boeing Company) are credited as providing the Innovating Technology Teams that developed the award winning technology dubbed Multi-Junction (MJ) Space Solar Cells. For over 15 years, AFRL sponsored research and development efforts to produce high efficiency MJ space solar cells in response to the need for higher efficiency solar cells. MJ solar cell technology provides a direct replacement for lower efficiency single-junction cells, resulting in reduced space mission life cycle costs as well as reduced customer costs for both military and commercial telecommunication, weather forecasting, and many other crucial services. Mr. Wise served in PR from the early 1950s through the late 1980s, and his renowned expertise in photovoltaics established the technical foundations

toward the development of MJ space solar cell technology. The Space Technology Hall of Fame was formed in 1988 to: (1) honor the innovators who have transformed technology originally developed for space use into commercial products, (2) increase public awareness of the benefits



PIV laser diagnostic experimental setup



PIV results for a jet in cross-flow

<sup>†</sup> Mr. Clay S. Mayberry and Dr. Kitt C. Reinhardt of AFRL's Space Vehicles Directorate (AFRL/VS) were also named as contributors to this technology.

of space spin-off technology, and (3) encourage further innovation. (Mr. S. Cloyd, AFRL/PROP, (937) 255-0158)

*Want more information?*

- ❖ More information on the selection of Multi-Junction (MJ) Space Solar Cells for the Space Technology Hall of Fame is available [here](#).

PR PERSONNEL CAPTURE SEVERAL LOCAL AIAA AWARDS: On 19 May 2004, the Dayton-Cincinnati Section of the American Institute of Aeronautics and Astronautics (AIAA) held its annual Honors and Awards Program. Several Propulsion Directorate personnel were honored at the ceremonies held at the University of Dayton in Dayton, Ohio. Dr. Joseph Zelina was presented with the Special Service Award for his outstanding service in the planning and execution of the annual Dayton-Cincinnati Aerospace Science Symposium (DCASS). Special Service Citation Awards were presented to Ms. Cynthia Obringer and Dr. James Gord. Ms. Obringer was recognized for her support of both local and national events associated with the Evolution of Flight celebration. Dr. Gord was recognized for his service as a former DCASS Chair and Honors and Awards Chair, and for his support of the Passport-to-Flight Program. Ms. Obringer and Dr. Gord were also members of the team that received the Chairman's Award for the planning and execution of the Passport-to-Flight program. In addition to these awards, Dr. Rengasamy "Pon" Ponnappan and Mr. Richard Norris were recognized as 25-year members of AIAA, and Ms. Obringer was also announced as the new Section chair. (Dr. J. Gord, AFRL/PRTC, (937) 255-7431)



Dr. Joe Zelina (left), pictured with Dr. Carl Tilmann, was presented with the Special Service Award by the AIAA Dayton-Cincinnati Section



Ms. Cynthia Obringer (second from the left) and Dr. James Gord (far right) receive Special Service Citation Awards from the AIAA Dayton-Cincinnati Section. Ms. Obringer and Dr. Gord were also part of the team that won the Chairman's Award.



Dr. Rengasamy (Pon) Ponnappan (left) and Mr. Richard Norris (right) were recognized as 25-year members of AIAA