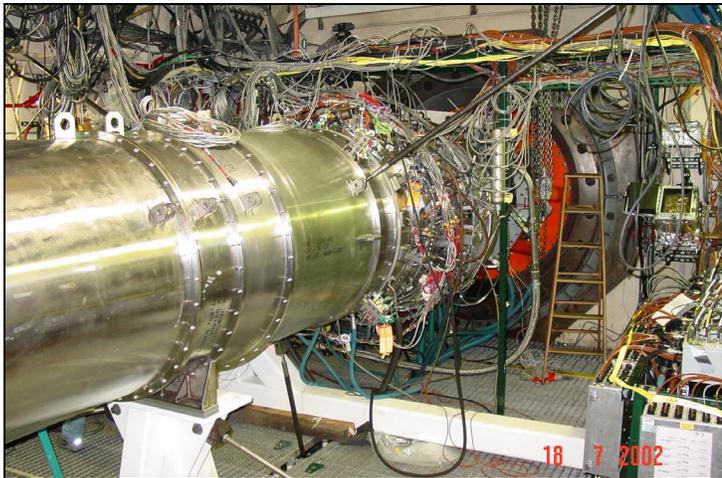
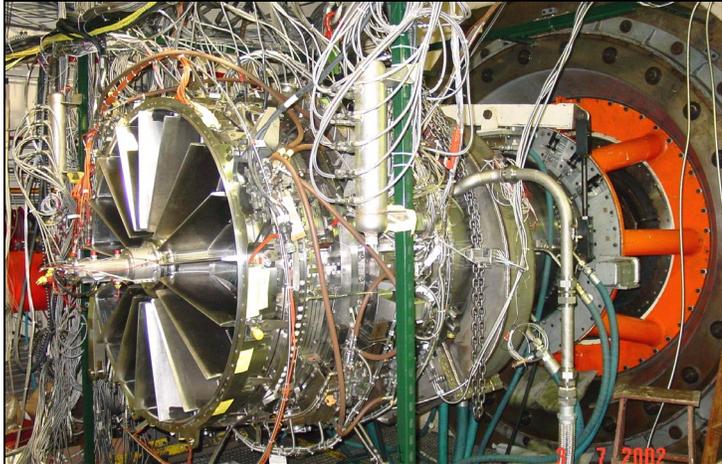

PROPULSION DIRECTORATE

Monthly Accomplishment Report February 2003



<u>Contents</u>	<u>Page</u>
<i>Largest Fighter Engine Fan Achieves 100% Design Performance.....</i>	<i>1</i>
<i>Historic Rocket Test Stand Reactivated at Edwards Research Site</i>	<i>1</i>
<i>New von Ohain Fuels and Combustion Center Unveiled.....</i>	<i>2</i>
<i>Revolutionary Class of Fluorinated POSS Polymers Evolved.....</i>	<i>4</i>
<i>Buckley Named Chairman of JANNAF Executive Committee.....</i>	<i>5</i>
<i>Next Generation Micro-Resistojets Delivered</i>	<i>5</i>
<i>Financial Management Team Honored by AFMC.....</i>	<i>6</i>
<i>Explosive Safety Detonation Test Successful</i>	<i>7</i>
<i>Liu Named Fellow in Society for Experimental Mechanics.....</i>	<i>8</i>
<i>Drake Honored for Leadership in Developing Novel Propellants</i>	<i>8</i>
<i>Hartsock and Jones Named Co-Winners of December Directorate Award</i>	<i>9</i>

LARGEST FIGHTER ENGINE FAN ACHIEVES 100% DESIGN PERFORMANCE: The Integrated High Performance Turbine Engine Technology (IHPTET) XTE67/1 three stage fan achieved its design speed performance objectives in recent testing at the Propulsion Directorate's Compressor Research Facility at Wright Patterson AFB, Ohio. The Pratt and Whitney fan achieved 100% of the intended design performance goals for efficiency, pressure ratio, and mass airflow. This is a significant achievement, as it is uncommon to meet 100% of the aeromechanical and aerodynamic design performance objectives in the first build of a configuration. Pratt and Whitney achieved these objectives in the largest fighter engine fan ever developed under the IHPTET Program. The advanced technologies and design tools demonstrated in this fan rig test are directly applicable to advanced fans and compressors for future engines, engines in development, such as the Joint Strike Fighter F135, and product improvement efforts directed at legacy engine systems. (J. Datko, AFRL/PRT, (937) 255-4100)



The XTE67/1 fan on the test stand

HISTORIC ROCKET TEST STAND REACTIVATED AT EDWARDS RESEARCH SITE:

A ribbon cutting ceremony was held on 31 January 2003 to reactivate one of the Propulsion Directorate's largest and most historic rocket test stands at Edwards AFB, California. The liquid oxygen and kerosene-based, 15-story high Test Stand 1-D is now state of the art and capable of testing rocket engines and components with millions of pounds of thrust. With the refurbishment of Test Stand 1-D, PR's Space and Missile Propulsion Division (AFRL/PRS) is poised to help validate innovative technologies for current and future rocket engines. Originally built as an Apollo-era F-1 rocket engine test facility, Test Stand 1-D was taken from a mothballed storage state and modernized over a period of 18 months. The modernization effort cost approximately \$12 million, which is only a fraction of the estimated \$500 million needed to build a new test stand from scratch. Modifications to Test Stand 1-D included the installation of state-of-the-art data acquisition and control systems. Furthermore, environmental standards were met or exceeded for fuel tanks and plumbing as well as cooling water for the test stand. The test stand's capabilities fit into the overall DoD/NASA/industry Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Program, which is coordinated by AFRL/PRS and encompasses liquid rocket engine, solid rocket motor, and advanced



Test Stand 1-D at Edwards AFB



The ribbon is cut to reactivate Test Stand 1-D

propulsion technologies. IHPRPT's future large liquid rocket propulsion demonstrations can now use Test Stand 1-D's massive thrust capabilities to help attain the overall IHPRPT goal of doubling rocket propulsion capability by 2010. (R. Drake, AFRL/PRSO, (661) 275-5542)

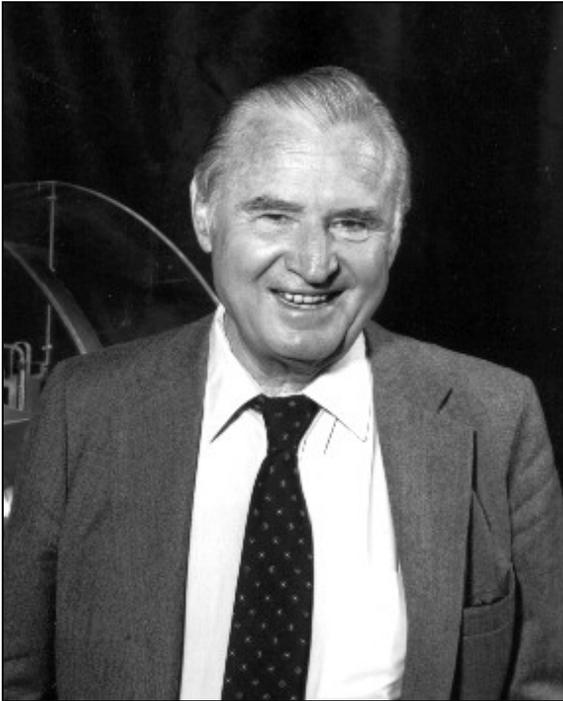
NEW VON OHAIN FUELS AND COMBUSTION CENTER UNVEILED:

On 21 February 2003, the University of Dayton (UD) held a press conference to announce the formation of the new von Ohain Fuels and Combustion Center. The center will enhance research that is performed by the University of Dayton Research Institute (UDRI) both on-campus at UD and off-campus at various Propulsion Directorate facilities at Wright-Patterson AFB, Ohio, by improving the educational outreach of the university. The overarching goal of the new center is work with the Air Force and industry to develop versatile fuel and combustion technologies that will allow future jet engines to operate more safely, efficiently, and emit fewer pollutants. In concert with this goal, advanced fuel technologies will be developed to cool hot engine components without forming deposits that can build up and clog aircraft fuel systems. It is envisioned that the technologies developed by the center will

be applicable to military and commercial applications alike. The center is named for Dr. Hans von Ohain, who is famous for co-inventing the jet engine in Germany in 1939.* Dr. von Ohain also served as the Chief Scientist for the Air Force Aero Propulsion Laboratory (now PR) for many years, and he ended his distinguished career as a professor and senior research engineer for UD. Dilip Ballal, the Hans von Ohain Distinguished Professor in UD's School of Engineering, has been appointed as director of the new center. Prof. Ballal founded UDRI's Fuels and Combustion Group in 1983, and he has had a long and fruitful relationship conducting research in association with PR. The center will help to continue this relationship, as UD is now one of the key regional

* Sir Frank Whittle is credited with inventing the jet engine in Great Britain around the time that von Ohain invented the jet engine in Germany.

academic institutions working with the Air Force in this research field. (R. Hancock, AFRL/PRTS, (937) 255-6814 and W. Harrison, AFRL/PRTG, (937) 255-6601)



Dr. Hans von Ohain, namesake of the new von Ohain Center



Prof. Dilip Ballal, director of the new von Ohain Center



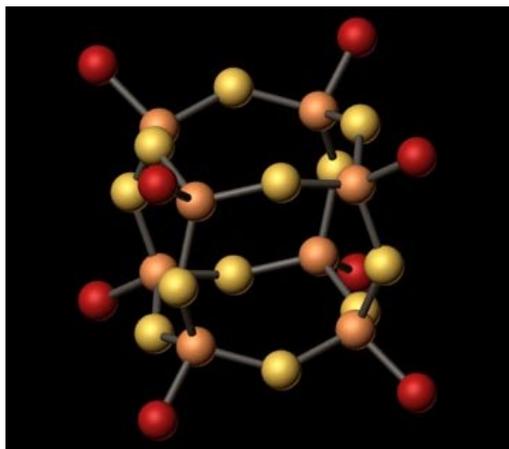
Col Alan Janiszewski, PR Director, makes remarks at the press conference announcing the new von Ohain Center

Want more information?

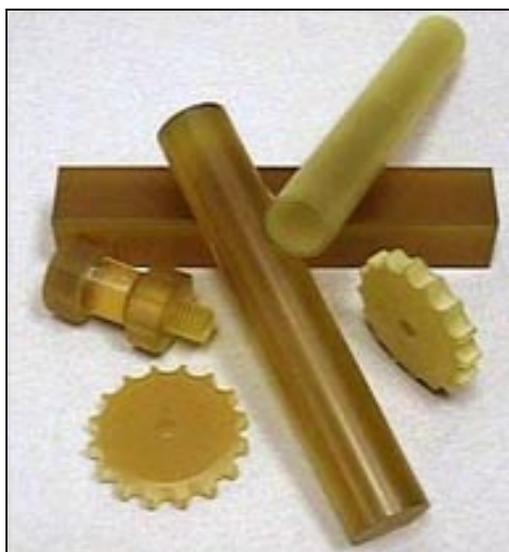
- ❖ A 28 February 2003 *Skywrighter* article written by PR on-site contractor Mr. Mike Kelly[†] is available [here](#).

REVOLUTIONARY CLASS OF FLUORINATED POSS POLYMERS EVOLVED:

Research by the Propulsion Directorate's Propulsion Materials Applications Branch (AFRL/PRSM) is helping to meet the Air Force's demand for a new generation of lightweight, high performance polymeric materials. Over the past decade, PRSM researchers have been pursuing the development of new chemical feedstock technologies based on Polyhedral Oligomeric Silsesquioxanes (POSS). A new class of fluorinated POSS compounds has recently evolved from this research. These compounds have the highest molecular weight yet produced in POSS research. Both fluoroalkyl and fluoroaryl POSS have the potential to blend with various fluoropolymers (e.g., PVDF, PTFE, and FEP). These mixes could be used in spacecraft coatings and low-creep seals. POSS research at Edwards AFB facilities is a rapidly evolving area of dual-use technology development, as it provides innovative plastic polymer materials to military and industrial users alike. POSS enhanced plastic polymers provide users with the ability to produce products with capabilities that were not previously possible. Because of its chemical nature, POSS technology is easily incorporated into common plastics via copolymerization, or blending, and requires little or no alteration to existing manufacturing processes. POSS additives radically upgrade the thermal and physical properties of most plastics. POSS technology derived polymers are revolutionary in their ability to mimic ceramic class attributes, and they demonstrate flame retardation by charring rather than combusting. In addition to their greater strength and abrasion resistance, they are also able to demonstrate space-survivable material features. As additives, they could be used in heat/abrasion resistant paints and coatings and fire retardants. In plastics they could be used in medical materials, space resistant resins, packaging/coatings, resins, and elastomers. POSS research has garnered the attention of the plastics industry, and PR's POSS spin-off company, Hybrid Plastics, was recently selected as



A POSS molecule



Parts fabricated from POSS polymers

[†] Mr. Kelly is an on-site contractor with Universal Technology Corp assigned to AFRL/PROP.

one of five finalists for the *Small Times Magazine's* 2002 Product of the Year Award. (J. Mabry, AFRL/PRSM, (661) 275-5857)

Want more information?

- ❖ An article on *Small Times Magazine's* Product of the Year Finalists is available [here](#).

BUCKLEY NAMED CHAIRMAN OF JANNAF EXECUTIVE COMMITTEE: The Propulsion Directorate's Mr. Parker L. Buckley was recently named the chairman of the JANNAF Executive Committee. JANNAF, which stands for Joint Army-Navy-NASA-Air Force, is an organization that exists to promote and facilitate exchange of technical information, establish standards, and



Mr. Parker Buckley was recently named the chairman of the JANNAF Executive Committee

effect coordination of research and development programs in the areas of missile, gun, and space propulsion. The JANNAF scope includes propulsion systems based on chemical or electrical energy release, which are intended for use in missiles, rockets, boosters, spacecraft, satellites, or guns. The JANNAF Executive Committee is the governing body of the JANNAF Interagency Propulsion Committee. As such, it is responsible for the establishment, modification, and dissolution of subcommittees; the monitoring of the activities of the subcommittees; and the promulgation of guidelines for their operation. Mr. Buckley currently serves as the Chief of PR's Aerospace Propulsion Division (AFRL/PRA), which has responsibility for the development of ramjet and supersonic combustion ramjet (scramjet) technologies and the integration of these technologies into combined cycle engines. Applications for these technologies include high-speed weapons systems and low-cost, on-demand access to space. (Col A. Janiszewski, AFRL/PR, (937) 255-2520)

Want more information?

- ❖ An article on Mr. Buckley's appointment to this post was printed on page 6 of the January 2003 issue of the *CPIA Bulletin*, which is available [here](#).
- ❖ More information on JANNAF can be found at the JANNAF homepage by clicking [here](#).

NEXT GENERATION MICRO-RESISTOJETS DELIVERED: The next generation of Free Molecule Micro-Resistojets (FMMR) has been fabricated at NASA's Jet Propulsion Laboratory in Pasadena, California, and delivered to the Propulsion Directorate at Edwards AFB. The FMMR is

a micropropulsion system that addresses the need for low-mass, low-power, efficient, simple, and robust thrusters for microsattellites. The new FMMR features a MEMS (microelectromechanical systems) thruster that uses water as a propellant and expels gaseous water molecules at high speeds through slits, thereby inducing a thrust in the opposite direction. Initial testing suggests that the new FMMR heater chips survived temperatures exceeding 450°C (842°F), which is a significant improvement over previous versions. The new FMMRs will be packaged as part of the Traveler I sub-orbital experimental payload to be launched on a sub-orbital vehicle during the fall of 2003. Traveler I is a joint mission between PR's Aerophysics Branch (AFRL/PRSA), Microcosm, Inc of El Segundo, California, and the University of Southern California's Microsatellite Program. This experiment will test the survivability of the MEMS packaging in a relatively harsh launch environment; however, the entire FMMR system will not be flown in a configuration that can generate thrust since the flight experiment is contained within the launch vehicle envelope. (A. Ketsdever, AFRL/PRSA, (661) 275-6242)



The next generation FMMR

FINANCIAL MANAGEMENT TEAM HONORED BY AFMC:

A team from the Propulsion Directorate's Financial Management Division (AFRL/PRF)

was honored at the recent FY02 Air Force Materiel Command (AFMC) Financial Management and Comptroller Annual Awards. The winning team, representing both PR's locations at Edwards AFB, California, and Wright-Patterson AFB, Ohio, consisted of Mr. David Harder,[‡] Ms. Colleen Robinson,[§] and Mr. Eric Talley.^{**} This team received an AFMC/FM Special Act Award for their efforts to improve business practices in PR through the implementation of a web-based Electronic Information System (EIS). This system will be used as a prototype for AFRL/FM and should become the standard across all AFRL Tech Directorates. The system has helped to streamline financial management and has provided an improved level of support to all customers. By eliminating multiple sources of data entry, this system has markedly decreased the potential for entering erroneous data, required computer storage, and duplication of effort. It is noteworthy that this team was the only winner from AFRL at the AFMC awards. The winning team will now go on to compete for an Air Force level award. (C. Turner, AFRL/PRF, (937) 255-3044)

[‡] Mr. Harder is assigned to AFRL/PRF at Edwards AFB, California.

[§] Ms. Robinson is assigned to AFRL/PRF at Wright-Patterson AFB, Ohio.

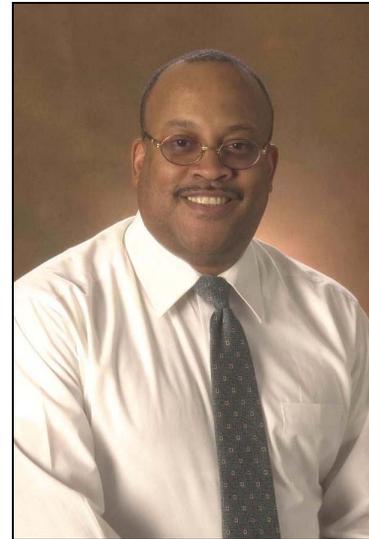
^{**} Mr. Talley is an on-site contractor with Universal Technology Corp assigned to AFRL/PRF at Wright-Patterson AFB, Ohio.



Mr. David Harder



Ms. Colleen Robinson



Mr. Eric Talley

EXPLOSIVE SAFETY DETONATION TEST SUCCESSFUL: On 13 December 2002, Propulsion Directorate researchers conducted an explosive safety test involving two Small ICBM ballistic missile stages. This test was conducted at Area 1-36 of Edwards AFB, California. The purpose of the test was to provide sympathetic detonation or reaction between two rocket motors, in this case, first and third stage Small ICBM motors. The motors were separated at representative distances found in storage bunkers, positioned in worst-case scenario conditions, and instrumented to provide scientific data for numerous users. The test provided Air Force System Operational and Safety organizations full-scale blast and fragment data for validating proper storage and explosive safety of national assets. The test used 22,240 pounds of a solid rocket propellant equivalent to 17.6 tons (35,139.2 lbs) of TNT. Test data was provided to Lawrence Livermore National Laboratory and other interested organizations to help validate Air Force and industry explosive shock hazards computer models and to provide data to develop a composite case fragmentation computer model. The test data also supported efforts to validate new NATO explosive hazard classifications for insensitive munitions. Furthermore, the test provided seismic calibration data to the US Geological Survey seismic measurement activities at Caltech. The seismic force of the test was measured by Caltech at a magnitude of 1.61 and created a twenty-foot deep crater at the test site. The experimental data on shock-to-detonation initiation



Two Small ICBM motors were detonated at Area 1-36 of Edwards AFB on 13 December 2002

pressures and fragment throw data is invaluable. By using real rocket motors, the data was designed to enhance storage and launch safety procedures for strategic missiles and space boosters. (F. McDougall, AFRL/PRSF, (661) 275-6417)

LIU NAMED FELLOW IN SOCIETY FOR EXPERIMENTAL MECHANICS: Dr. Chi “Jimmy” Liu of the Propulsion Directorate’s Propulsion Materials Applications Branch (PRSM) was recently elected a Fellow of the Society for Experimental Mechanics (SEM). The SEM is composed of international members from academia, government, and industry who are committed to interdisciplinary application, research and development, education, and active promotion of



Dr. Jimmy Liu was recently named a Fellow of the Society for Experimental Mechanics

experimental methods to: (1) increase the knowledge of physical phenomena, (2) further the understanding of the behavior of materials, structures, and systems; and (3) provide the necessary physical basis and verification for analytical and computational approaches to the development of engineering solutions. SEM defines a Fellow as an individual who has distinguished himself/herself in some field in which the society has interest, who has been a member of the society for at least 10 consecutive years, and whose contributions to the society and the technical community have justified this honor. Dr. Liu was recognized as a Fellow for his expertise in solid propellant fracture mechanics and service-life prediction. He previously won the prestigious Air Force-level Harold Brown Award for applying his expertise in these areas to increase the operational effectiveness of the Air Force’s solid rocket motor fleet. Dr. Liu’s selection for this honor places him in unique company, as SEM has elected only about 100 Fellows since the inception of this honor in 1975. (S. Phillips, AFRL/PRSM, (661) 275-6270)

Dr. Liu was recently named a Fellow of the Society for Experimental Mechanics

Want more information?

- ❖ Information on the Society for Experimental Mechanics is available at the website located [here](#).
- ❖ Specific information on SEM’s Fellows program is available [here](#).

DRAKE HONORED FOR LEADERSHIP IN DEVELOPING NOVEL PROPELLANTS:

Dr. Gregory W. Drake of the Propulsion Directorate’s Propellants Branch (AFRL/PRSP) at Edwards AFB, California, was recently selected to receive the Exemplary Civilian Service Award. This award recognizes Dr. Drake for his distinguished service as Senior Research Scientist and lead of the High Energy Density Matter (HEDM) group from 1 April 2001 to 31 October 2002. The HEDM group, which is an AFOSR Star Team, performs research into novel energetic

materials, developing the basic understanding of their chemistry and physics and applying this to the development of advanced rocket propellants. Dr. Drake is nationally known for his work and has unselfishly promoted HEDM research throughout the academic world. Under Dr. Drake's direction, the HEDM group continues to discover groundbreaking new concepts, including the only two all nitrogen compounds discovered in more than 100 years and new hydrocarbon fuels that will replace the 45-year old vintage rocket propellant, RP-1. Dr. Drake's own HEDM research is opening up an exciting new line of energetic compounds by pioneering the use of energetic low melting salts. These ionic compounds are salts (like table salt), but Dr. Drake has developed a class of these compounds that are liquids at room temperature and over the range of temperatures required for liquid rocket propellants. These compounds are stable and energetic and will advance the state of the art in rocket propellants. Furthermore, they are suitable as mono-propellants for satellite propulsion and will double satellite lifetimes. Dr. Drake has filed a patent on 27 compounds resulting from his line of research on energetic low melting salts, and the academic community is eagerly awaiting disclosure of this information. Because of Dr. Drake's innovative research, Air Force space-lift customers will have a choice of propellants that will greatly reduce the inhalation toxicity that is the bane of the current hydrazine family of propellants. (R. Channell, AFRL/PRSP, (661) 275-6442)



Dr. Greg Drake was chosen to receive the Exemplary Civilian Service Award

HARTSOCK AND JONES NAMED CO-WINNERS OF DECEMBER DIRECTORATE AWARD: Ms. Linda Hartsock and Ms. Temeca Jones were named co-winners of the Propulsion Directorate's Employee of the Month award for December 2002 in the Staff Support category. Ms. Hartsock was recognized for her outstanding efforts for PR's Business Services Branch (AFRL/PROB). Ms. Hartsock is an effective and efficient manager responsible for several interrelated programs, and her efforts are broadly focused to solve problems related to all of PR's business processes. As an example of her accomplishments, she was responsible for developing, authoring, and implementing a much needed directorate-wide process to document and track technical reports. This process has helped to reduce reporting delinquencies by 51%. In addition, she recognized DTIC/ASTARS interface problems, and developed solutions to prevent delinquent/erroneous records updates. As a result, delinquencies were reduced markedly from 53% to only 10%. Ms. Temeca Jones was recognized for her efforts for PR's Financial Management Division (AFRL/PRF), where she performed admirably on several key projects. At the direction of the AFRL Commander, she developed an informational briefing to describe changes in business practices for 2003. She also conducted a complete scrub of the FY02 civilian

pay database to determine the appropriateness of charging FY02 direct labor hours versus indirect labor hours. Furthermore, she was responsible for articulating the relationship between work units and JONS to the division and branch personnel who are responsible for inputs into the timecard system - some 150 PR staff members. On top of this, she created hundreds of JONS and cross checked existing JOCAS records to the ASTARS database. For their numerous accomplishments, both Ms. Hartsock and Ms. Jones are worthy of this recognition. (S. Steltz, AFRL/PROB, (937) 255-1889 and C. Turner, AFRL/PRF, (937) 255-3044)



Ms. Linda Hartsock (left) and Ms. Temeca Jones (right) were named co-winners of PR's December 2002 Employee of the Month award