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DOE Princeton Plasma Physics Laboratory

PPPL NEWS

The Princeton Plasma Physics Laboratory is a United States Department of Energy Facility

PPPL Director Goldston Garners Fusion Power Associates Leadership Award

In recognition of his influence on the course and content of the national fusion program and his effectiveness in communicating the value of fusion research to the U.S. Congress, Fusion Power Associates (FPA) gave PPPL Director Rob Goldston its Leadership Award for 2001. Goldston is one of two recipients this year. The other is Ron Parker, former director of the Massachusetts Institute of Technology Plasma Science and Fusion Center and former leader of the International Thermonuclear Experimental Reactor Co-center in Garching, Germany. The awards were presented during FPA's annual meeting, held this year September 25 and 26 in Washington, D.C.

The citation for Goldston states, "You have provided forceful and effective guidance to a wide spectrum of fusion scientific topics and have helped put fusion back on the U.S. national political agenda." In addition to lauding Goldston's influence on the course of the national fusion program, the FPA Board noted his "outstanding leadership of the Laboratory."

Said Goldston, "I am delighted to receive this award. I have worked broadly to develop a vision of fusion energy science which respects the range of scientific judgment in our community, and which moves forward both the science of plasmas and the development of fusion energy."

Distinguished Career

Goldston came to PPPL as a graduate student in 1972 after receiving his bachelor's degree, magna cum laude, from Harvard University. He served as a research assistant at the Laboratory for five years and earned his Ph.D. in astrophysics, Program in Plasma Physics, from Princeton University in 1977. Over the next 15 years, he advanced to progressively responsible positions on the PPPL research staff. Goldston was named professor of astrophysical sciences at Princeton University in 1992, a position he continues to hold, and Associate Director for Research at PPPL in 1995. In 1997, he became the Laboratory's fifth Director.

Rob Goldston

Goldston has had a distinguished career pursuing experimental and theoretical research on the high-temperature plasmas required for producing thermonuclear fusion. He is the author and coauthor of more than 200 scholarly articles, and is coauthor with Paul Rutherford of the textbook, *Introduction to Plasma Physics*.

FPA Awards are given annually for Leadership, Distinguished Career, and for Excellence in Fusion Engineering. Special Awards also are occasionally presented. Leadership awards have been presented annually since 1980 to individuals who have shown outstanding leadership qualities in accelerating the development of fusion. Other PPPL scientists to receive the FPA Leadership Award are Dale Meade (1999) and Harold Furth (1982).

Fusion Power Associates is a nonprofit, tax-exempt research and educational foundation that provides timely information on the status of fusion development and other applications of plasma science and fusion research. ●

PPPL Participates in the "Scientific Discovery through Advanced Computing" Program

PPPL has been awarded funding under the new "Scientific Discovery through Advanced Computing (SciDAC)" Program. Nationally, 51 projects will receive a total of $57 million this year from the DOE to advance fundamental research in several areas, including climate modeling, fusion energy sciences, chemical sciences, nuclear astrophysics, high-energy physics, and high-performance computing. The projects involve collaborations among 13 DOE laboratories and more than 50 colleges and universities.

SciDAC is an integrated program that will help create a new generation of scientific simulation codes. The codes will take full advantage of the extraordinary computing capabilities of terascale computers (computers capable of doing trillions of calculations per second) to address ever larger, more complex problems. The program also includes research on improved mathematical and computing systems software that will allow these codes to use modern parallel computers effectively and efficiently. Additionally, the program will develop "collaboratory" software to enable geographically separated scientists to effectively work together as a team, to control scientific instruments remotely, and to share data more readily.

"This innovative program will help us to find new energy sources for the future, understand the effect of energy production on our environment and learn more about the fundamental nature of energy and matter," said Secretary of Energy Spencer Abraham. "A major strength of many of the projects is a partnership between scientists at the Energy Department's national laboratories and universities."

PPPL researchers will participate in four SciDAC projects focused on the development and improvement of physics models and computer resources needed for integrated simulations of plasma confinement systems and data analysis. Plasmas are the hot, ionized gases that fuel the fusion process. Three of the projects will focus on fundamental phenomena including electromagnetic-wave-plasma interactions, plasma turbulence, and macroscopic stability of magnetically confined plasmas. The fourth project aims to develop a software "collaboratory" allowing workstation and supercomputer resources to be shared among fusion experiments for high-speed data analysis. The project will include tasks relating to security, high performance distributed computing, and networked collaborative visualization of scientific results. All totaled, PPPL will receive approximately $2 million for the four projects during the next three years. ●

The U.S. Department of Energy's (DOE's) National Laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security, and environmental quality missions. Interested in the latest achievements of the National Laboratories? Then visit the DOE Pulse at: http://www.ornl.gov/news/pulse/.

PPPL NEWS

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PPPL Recognizes Inventors

Photo by Gregg Wielage

In June, the Laboratory honored 22 inventors during the nineteenth annual Patent Awareness Program Recognition Dinner at Princeton University's Prospect House. The event recognized inventors who received patents, applied for patents, and disclosed inventions during Fiscal Year 2000. The honorees are from the Research, Engineering, and Technical staff of PPPL, as well as from other institutions that work in collaboration with the Lab. The inventors at the Patent Dinner are (above), from left, Tobin Munsat, Gail Eaton, John Desandro, Martha Redi, Nathaniel Fisch, Richard Majeski, Samuel Cohen, Charles Gentile, John Schmidt, Gennady Shvets, Robert Woolley, and John Parker. Honorees not pictured are Joseph Bartolick, Amnon Fruchtman, Boris Grek, Bob Herskowitz, Max Karasik, Alan Kennedy, Ken Lincoln, Richard D. Milroy, Yevgeny Raitses, and Stewart Zweben. ●

Neumeyer Named "Engineer of the Year"

PPPL engineer Charles Neumeyer (at left) received the "Engineer of the Year" award from the New Jersey Society of Professional Engineers (NJSPE) on June 2 at the organization's awards and installation banquet in Somerset.

The citation for Neumeyer stated, "In recognition of your outstanding achievements in engineering, your contributions to the development of fusion as a long-term energy source, and your notable service in enhancing the prestige of the engineering profession." Neumeyer is the lead project engineer for the National Spherical Torus Experiment (NSTX). As lead project engineer, he was responsible for integrating the many physics and engineering requirements and developing the overall engineering design of the NSTX. ●

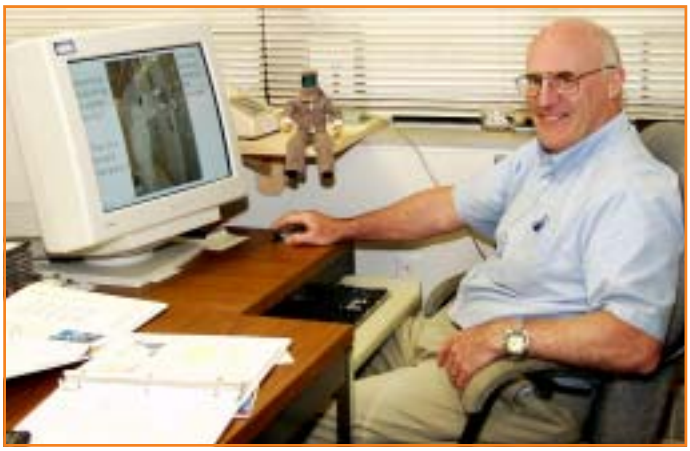
O'Neill Develops Arc Blast Safety Training

An electric arc, which often accompanies a failure in an electric power system, reaches temperatures four times as high as that of the sun's surface, and can cause fatal burns to a person as far away as 5 feet. At a 10-foot distance, it can inflict major burns. The amount of time necessary for an electric arc exposure to cause debilitating or fatal burns to an individual is less than one-tenth of a second. Contact is not necessary for electric arcing to be fatal.

An electric arc is the passage of current through the vapor of the arc terminal material. It is usually accompanied by an intense burst of radiant energy, a high pressure shock wave, and very high sound levels.

To protect electrical workers from the ravages of electrical arcs, PPPL engineer Dave O'Neill has developed an arc blast protection program that includes a course called Electric Utilization Training. In the eight-hour course — usually divided into two half-days — O'Neill presents his material through videotapes, lectures, power point presentations, and by exhibiting protective clothing and personal protective equipment.

The sessions illustrate to electrical workers and their supervisors just how dangerous an arc flash is. One of the videos, produced by the Institute of Electrical and Electronics Engineers (IEEE), captures an arc flash through high-speed photography, showing how rapidly radiated heat can burn or seriously injure a person. Mannequins are instrumented to measure incident energy, pressure, and sound level. Tests have revealed body surface temperatures in excess of 400 degrees farenheit, pressures in excess of 2,000 pounds per square foot at the chest, with sound levels in excess of 165 decibels at the ears.



Dave O'Neill

PPPL's Art Wise in protective clothing and gear as he inserts a starter bucket into a Motor Control Center at the Lab.

Lab policy, following the requirements of OSHA, requires staff to carry out any electrical work with cables or conductors de-energized, unless de-energizing creates a greater hazard than working hot or is infeasible due to equipment design or operational limitations. Activities at PPPL and elsewhere that could result in arc blast exposure include taking a voltage measurement, installing or removing a fuse, inserting a starter bucket into a motor control center, and racking a circuit breaker in or out of switchgear. Additional examples are hook-stick operation of medium voltage fuses, testing of a cable terminal before grounding, grounding before testing, and work in manholes near energized cables.

"Workers need to take precautionary measures," O'Neill emphasized. "And anyone who works on or near exposed energized conductors must wear flame-resistant clothing and personal protective equipment."

Flame-resistant clothing — shirt, pants, coat, raincoat, and coveralls — is often made of cotton that has been specially treated or Nomex. The most critical function of this clothing is to withstand an arc flash without igniting (when used within its rating). Many of the arc-flash-related injuries and fatalities are caused by the ignition of clothing. Personal protective equipment includes a face shield made of polycarbonate (lexan) that is treated to give it an arc-resistant rating. An arc flash can melt a non-arc-resistant face shield. A hard hat, safety glasses, volt-

age-rated gloves with leather protectors, hearing protection, fire-resistant flash suit jacket and pants, and a fire-resistant hood are additional arc protection gear that may be required depending on the task.

Since O'Neill began teaching the course last year, 96 PPPL employees and 28 non-PPPL workers and supervisors such as Department of Energy, subcontract, and other employees, have completed it here at the Lab. O'Neill has also trained 124 managers, supervisors, and workers at Brookhaven National Laboratory and 50 managers and supervisors at Argonne National Laboratory. IEEE is adopting the course as its own official training. In addition, all members of the staff from the Department of Energy's (DOE's) Princeton Area Office have completed the course, including Allen Wrigley.

"This training introduces electrical workers to electric arc flash hazard, motivates them to protect themselves from this hazard, and teaches them precautionary techniques and [what] clothing [is] needed to protect themselves," said Allen Wrigley. "I found the course highly interesting, and full of useful information. Because of Dave's mix of media types in presentation, the course seems to go very quickly, and generates a lot of enthusiasm, based upon the response and participation during question opportunities."

There have been no arc blast injuries at PPPL. O'Neill's goal is to keep that record. "We need to understand the bigger picture so we don't become a casualty." The prevalence of the arc flash hazard was amply demonstrated in that four arc blast accidents, injuring six workers, occurred within 50 miles of PPPL during the six-month period that the course was being taught.

He became aware of the dangers of arc blasts after viewing the IEEE video mentioned above. A seminal IEEE paper on the subject, "The Other Electrical Hazard: Electric Arc Blast Burns," written by Ralph Lee in 1982, was the first to quantify the relation between an arc blast and skin tissue damage. In the 1990s, a plethora of IEEE papers were written that became the basis for new OSHA regulations and for NFPA70E, a national consensus standard that stipulates safe work practices to protect the worker from this hazard. Before developing the course, he researched the topic, talking to several authors of original papers. "I wanted to convince electrical workers that this is a serious problem. I felt I had to develop a course and get the word out," said O'Neill, who has about 40 years of experience in the electrical power field.

He said accident data about arc blasts is difficult to obtain because flash and electrical burns are not distinguished from one another in most reports. In an electrical burn, a current goes through a person's body, burning him or her from inside. In an arc blast burn, no contact is necessary and the person is burned from the exterior.

Fear of litigation makes arc flash accident information very difficult to obtain. Consequently, much of the information about electrical arc injuries is anecdotal. One non-PPPL electrical worker was told by his supervisor that he was not allowed to discuss a recent electrical accident that occurred at the worker's facility. But the danger is real. O'Neill recounted incidents in Trenton and Newark. In one, the clothing of two electricians burst into flames as a result of an arc blast and could not be quickly extinguished, causing severe burns to both. In the other, an electrical panel exploded, severly burning two electricians, one of whom spent several months in a coma at a burn center. "An arc blast is a nasty hazard. People need to know it is there, and protect themselves by taking precautionary measures, wearing flame-resistant clothing, and using personal protective equipment," said O'Neill. ●

PPPL Hosts DOE Electrical Safety Meeting

PPPL recently hosted the 2001 Department of Energy (DOE) Electrical Safety Meeting, which drew about 160 attendees representing 25 DOE sites, 10 field offices, DOE Headquarters, and 20 commercial companies. The safety meeting covered many topics, including electric arc hazard, protective clothing selection guidelines, the role of current limiting fuses in limiting arc energy, ASTM [American Society for Testing and Materials] electric arc testing standards, and underground cable detection.

At left, from left, are meeting coordinator Larry Perkins, DOE sponsor Pat Tran, and PPPL host Dave O'Neill. ●

Connecting with Colleagues Across the World

Technology Makes Long-distance Communications Easy

Imagine a meeting that brings together people from various locations around the U.S. — no, the world — without any participant traveling. No hotels; no flights, trains, car rentals, or gas mileage; no per diems. And no loss of work time due to being on the road.

It's possible through a videoconference tool employed by PPPL's Media Services. A videoconference is a meeting in which participants at two or more locations are able to communicate through audio and visual links. Participants may view and listen to one another as they are speaking and presenting material. Here's how it works: a microphone and camera are used to capture the sound and video of a speaker, then the Integrated Services Digital Network (ISDN) or the internet transmits that signal to another location (s). The "far end" must have equipment similar to the Lab's, which enables both sites to communicate. ISDN is a digital service designed to carry voice, data, and video across the public-switched network.

The PPPL Media Services group prepares for a videoconference. From left are John Wertenbaker, Carl Scimeca, Bob Reed, and Larry Nixon.

Site participants communicate either through a point-to-point conference like those conducted in a telephone call or through a bridge such as the Energy Science Network Bridge in California, which allows multiple sites to participate in a conference. This type of conference is known as a multi-point conference. Each site participating has its own videoconference system and uses the bridge to connect to another. A coordinator from each site tends to the links. At PPPL, Computer Operations and Multimedia Services Head Carl Scimeca and his group are responsible for videoconference arrangements.

"Videoconferences save a tremendous amount of money and time that would be spent traveling to meetings," said Scimeca. There are four videoconference systems in place at PPPL. In addition, the Lab's Melvin B. Gottlieb Auditorium and DOE Conference Room are wired for videoconferences.

Videoconference systems have connected folks at PPPL with people in England, Australia, Japan, all over the U.S., and South Africa. It is by far the most popular service requested by staff for hooking them up with other researchers or for training, said Scimeca. In the year 2000, Media Services set up 105 videoconferences. Project staff, physicists, hazardous materials staff, theorists, graduate students, and collaborators are among the requestors. "Our facilities are quite booked. We have standing weekly and bi-weekly videoconferences," said Scimeca.

For instance, on Monday mornings, personnel from PPPL and the Department of Energy's (DOE's) Princeton Area Office in New Jersey "meet" with staff from the DOE's Office of Fusion Energy Sciences in Maryland to discuss projects, hardware, and budgets, among other subjects. On Monday afternoons, PPPL staff collaborating on the C-Mod experiments at the Massachusetts Institute of Technology (MIT) participate in a videoconference with their colleagues in Massachusetts. Scimeca also set up a videoconference for all staff when Energy Secretary Spencer Abraham announced the DOE budget rollout in April.

Media Services provides videoconference services for PPPL and collaborations at General Atomics, Oak Ridge National Laboratory, the University of Texas, the University of Washington, DOE, the Lawrence Livermore National Laboratory, and the Lawrence Berkeley National Laboratory, among others.

In addition, staff support requests from Princeton University and have accommodated employment interviews, as well as lectures. In one instance, a Princeton professor came to PPPL to present a lecture in French

about coastal water management to government officials in South Africa.

Besides providing support for videoconferences, Media Services offers streaming media via Realplayer® software, PPPL telephone bridges, tape duplication, video recording, and satellite broadcasting. The Realplayer® allows people to view presentations from other locations. A camera captures the picture, feeds the signal to a computer which encodes the signal, and ships it to a server (computer). Users then connect to an assigned web address to view the broadcast. There is a 20-second delay, and users need Realplayer® software. Satellite broadcasting is available in the Lab's Auditorium, enabling staff to attend training programs on topics ranging from hazardous materials to diversity. This system uses a satellite dish to pick up a signal, tune into a channel that offers a particular program, and broadcast it on a screen.

Media Services staff also loan out equipment to personnel for presentations, including Liquid Crystal Display (LCD) projectors, VCRs, laptop computers, and show stations. In addition, the group video records weekly colloquia, Science-on-Saturday lectures held in the Auditorium, and other special presentations as requested. "Our team makes sure everything is working ahead of time, which involves troubleshooting and contingency plans," said Scimeca. ●

FIRE Design Reviewed

In June, an external review committee commended the pre-conceptual engineering design of the Fusion Ignition Research Experiment (FIRE) magnets, structure, vacuum vessel, and plasma facing components. Following the review, which was held at PPPL, the committee recommended that additional resources be made available to conclude pre-conceptual design expeditiously. The FIRE team is preparing a plan to address several critical design and research and development issues identified during the meeting.

The committee included Chair Charles Bushnell, Jim Irby of the Massachusetts Institute of Technology (MIT), Saurin Majumdar of Argonne National Laboratory, Peter Mioduszewski of Oak Ridge National Laboratory, Ron Parker of MIT, Aldo Pizzuto of Frascati, and Fred Puhn of General Atomics. The charge for the review, presentations made to the review committee, and the Committee's recommendations are available on the web at http://fire.pppl.gov/eng_extreview2001.html.

Above, Brad Nelson of Oak Ridge National Laboratory, discusses the stress calculations for the FIRE vacuum vessel. ●

DOE Honors Young for Achievements

In recognition of his collaborative efforts and contributions in developing fusion diagnostics systems, PPPL physicist Ken Young (at right) recently was awarded the U.S. Department of Energy (DOE) Distinguished Associate Award. John Willis, Director of the Research Division at the DOE's Office of Fusion Energy Sciences, presented the award to Young in April during Young's retirement dinner. The award cites Young for his role as "the leader of diagnostics development for the Tokamak Fusion Test Reactor (TFTR), his subsequent contributions to the breakthrough measurements which are the TFTR legacy, and his very real efforts in behalf of collaborative fusion physics research, both within the U.S. and abroad. His dedicated efforts have had a major impact on the diagnostics systems that bind theory and experiment together in advancing fusion."

During Young's more than three-decade-long career at PPPL as a fusion researcher and plasma diagnostics specialist, he was involved in moving forward the whole concept of how diagnostics are used on machines. He developed diagnostics and performed measurements and experiments on a number of fusion devices at PPPL. From 1982 to 1994, he was the Division Head for TFTR and before his retirement served as Diagnostics Head of the Lab's International Off-site Research Division. ●

Trenton Students Discover Energy and Build Solar-powered Machines at PPPL's Plasma Academy

In a quest for knowledge about energy and solar power, 16 high school students from the Trenton area came to PPPL this summer to build solar-powered devices and shoot toy rockets. These hands-on activities were part of Plasma Academy (officially called Energy, Space, and the Environment Institute), which ran August 6-16.

Topics covered were solar energy; clouds, weather, and storms; and the Sun, stars, planets, and plasmas. The institute was part of a Mercer County Community College Upward Bound program. The participating students were from Granville Academy, Mercer Junior-Senior High School, McCorristan High School, and Trenton Central High School.

Show How Energy is Transformed

"This is the first time we offered an academy like this for high school students. Designing and constructing useful solar-powered devices such as model cars, water heaters, and ovens, as well as shooting toy rockets and aircraft, are tasks that show the students how energy is transformed in different ways and where energy comes from," said PPPL Science Education Program Lead Scientist Andrew Post-Zwicker. Post-Zwicker designed and led Plasma Academy. Watchung Hills Regional High School physics teacher Sophia Gershman assisted Post-Zwicker with the workshop.

Plasma Academy participant Patrick Alvarado tests his solar-powered model car on the patio area of PPPL's Commons. Alvarado is a student at Trenton Central High School.

The academy also included field trips to a coal-fired plant in Trenton, the Hayden Planetarium in New York, and the Peddie School Observatory in Hightstown. ●

Above left, Trenton Central High School student Meghan Campbell (left) and Granville Academy student Quam Onigbanjo build a model garage that uses solar energy to power the ventilation. Above right, Patrick Alvarado (middle) and Marcus McCray (right) build a solar-powered model vehicle under the guidance of workshop leader Andrew Post-Zwicker (left).