



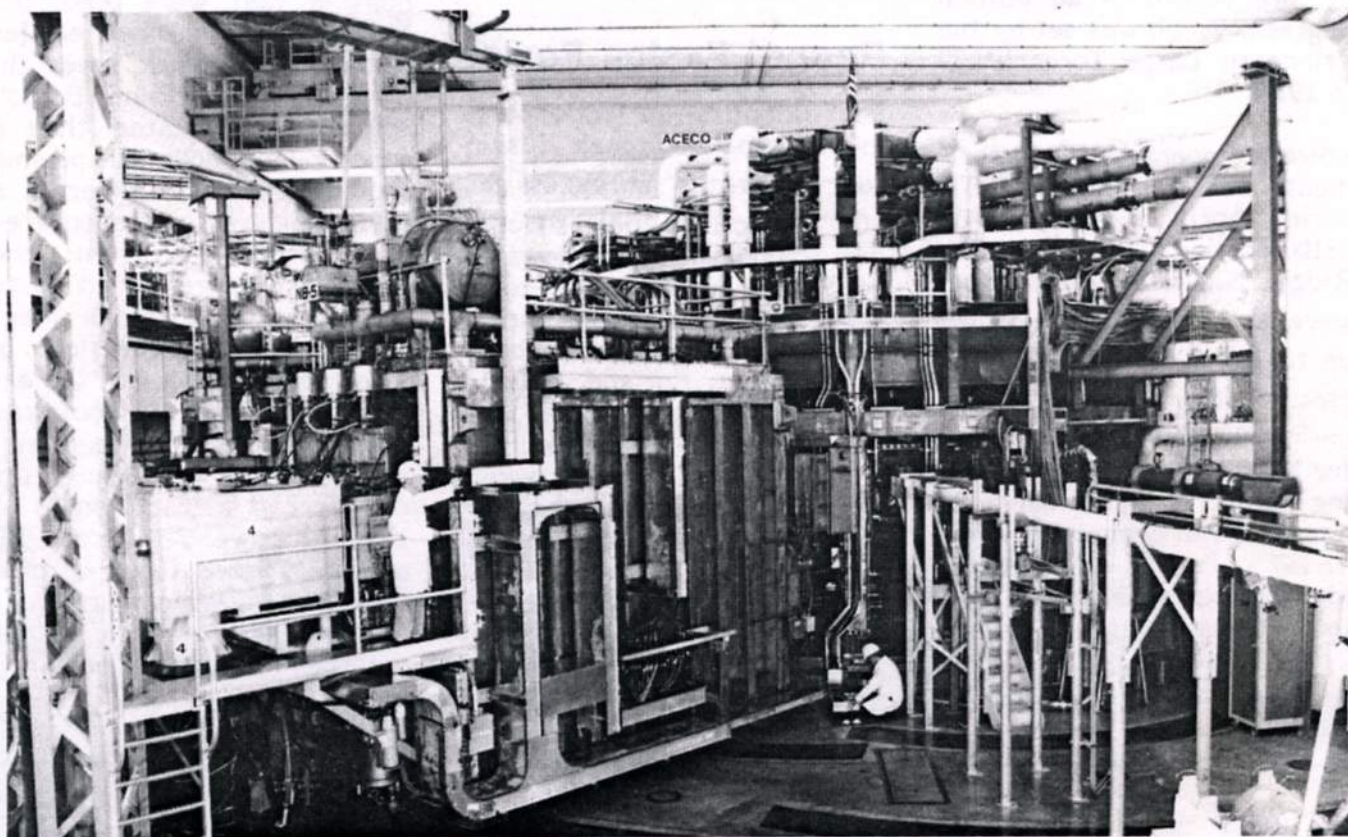
HOTLINE

PRINCETON PLASMA PHYSICS LABORATORY

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TFTR HITS 200 MILLION °C



Exceeds Original Objectives

During July, PPL physicists succeeded in producing plasma temperatures of 200 million degrees Celsius on TFTR. This is the highest temperature ever produced in a laboratory -- more than ten times the temperature at the center of the sun.

The US DOE made the announcement Thursday, August 7. Secretary of Energy John S. Herrington commented that "This marks a major milestone in progress toward the development of fusion energy. The

temperature achieved is in the range required for a fusion reactor. These promising results bring us closer to the goal of fusion energy."

The levels of plasma temperature and heat confinement achieved in TFTR experiments during July exceeded the objectives specified for TFTR when the project was authorized in March 1976. The recent experiments required the use of only about one-half the neutral-beam heating-power (30 million watts) that will ultimately become available.

Progress Towards Break-Even

The objectives of the TFTR project include the demonstration of "scientific break-even," where the power produced by fusion reactions equals the power required to keep the fuel hot. In order to reach break-even, two separate conditions must be met: both the plasma temperature and the quality of heat insulation must exceed threshold values. The quality of heat insulation is measured by the Lawson parameter $n\tau$ -- the product of plasma particle

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density, n per cubic centimeter, and the heat-confinement time, τ in seconds. The 200 million degree temperature level was achieved in TFTR along with a Lawson parameter $n\tau$ equalling 10^{13} cm^{-3} sec -- more than ten times the $n\tau$ -value associated with the previous high-temperature record of 80 million degrees, which was set by the Princeton Large Torus (PLT) in 1980.

Lower-temperature experiments carried out in TFTR during April of this year, in collaboration with the Oak Ridge National Laboratory, were able to reach $n\tau$ -values up to 1.5×10^{14} cm^{-3} sec -- close to the goal of 3×10^{14} cm^{-3} sec that will be desired for a practical power-producing reactor. Performance of a break-even demonstration in TFTR calls for the present high-temperature plasma regime to be extended to $n\tau$ -values of 2-3 times 10^{13} cm^{-3} sec, which is believed to be a

realistic near-term goal. Plans now call for an initial demonstration of the feasibility of break-even during 1987 using plasmas of deuterium ions. Preparations are underway to introduce tritium into TFTR and carry out a fully realistic break-even demonstration in 1989.

Record Fusion Power

Last month's TFTR experiments produced peak fusion reaction rates in excess of 10^{16} reactions per second, corresponding to 10 kilowatts of fusion power. The total fusion energy released during a half-second pulse was about 3 kilojoules. For the existing TFTR plasma parameters, introduction of a deuterium-tritium fuel mixture would produce a fusion yield in excess of one-million joules, satisfying the minimum TFTR project objective specified in 1976: "production of one to ten megajoules of thermonuclear energy (per pulse) in a

deuterium-tritium tokamak."

"Bootstrap" Current

The combination of ultra-high temperature and high plasma pressure that characterizes the new TFTR regime has permitted experimental study of some important new phenomena that were predicted theoretically during earlier phases of tokamak research. In 1971, Soviet and British scientists calculated that a reactor-level tokamak plasma should be able to generate a sufficiently strong spontaneous electrical current, the "bootstrap current", so as to maintain the tokamak magnetic-field configuration in steady state. Proof of the existence of such a bootstrap current would be of major significance in enhancing the commercial attractiveness of tokamak power reactors. PPL scientists have reported preliminary measurements supporting the existence of the predicted bootstrap phenomenon.

Edward A. Frieman Heading SIO

Former PPL Deputy Director Edward A. Frieman has been selected as the new director of the Scripps Institution of Oceanography (SIO), located in La Jolla, California. The appointment took effect July 1.

SIO is the oceanographic graduate school and research center for the University of California-San Diego (UCSD). It is recognized as one of the world's foremost centers for providing marine science graduate training in research and public service.

Frieman was hired as a PPL research associate in January 1952. He was promoted to



head of the Theory Division in 1953, and concurrently served

as a professor of astrophysical sciences at Princeton University. He was appointed Associate Director in 1964, and Deputy Director in 1978.

Frieman left PPL in 1979 to take over as Director of the Office of Energy Research for the Department of Energy in Washington, D.C.

Frieman joined Science Applications International Corporation, a high-tech research and development firm, as vice president in 1981. During the same year, he served as adjunct professor of physics at UCSD. He held both positions through June of this year.

Coil Shop Firsts

Designing and fabricating coils for various PPL machines doesn't qualify as unusual work for the Coil Shop. But the unique method the group employed in winding new coils within the PBX-M vacuum vessel has opened new avenues for revitalizing existing experimental devices.

This is the first time continuous coil winding has been performed in place within a closed, confined area. The success of the procedure provides a cost-effective alternative to dismantling an experimental device to modify its characteristics. The capability now exists to make alterations from within the vacuum vessel, drastically reducing the cost of such changes. In some cases, the savings might be significant enough to extend the life of an older machine.

PPL's Coil Shop staff wound five of the PBX-M coils in

place within the machine's vacuum vessel. These coils include four eight-turn diverter field (DF) windings and one 16-turn winding used as the device's "pusher coil." The pusher coil creates the indentation in PBX-M's kidney-bean-shaped plasma.

Normally, the copper conductor used for winding coils is held under tension as it feeds onto the winding mandrel. The coil is then removed from the mandrel, baked in the Coil Shop's large oven, leak checked, and installed in its coil case. However, winding coils in place on PBX required a different procedure, since no additional load whatsoever could be placed on the vacuum vessel. In addition, all winding apparatus had to enter and leave the vacuum vessel through a 14"x14" port.

Coil Branch engineers met this challenge by devising a method of "pushing" unworked copper conductor onto a man-

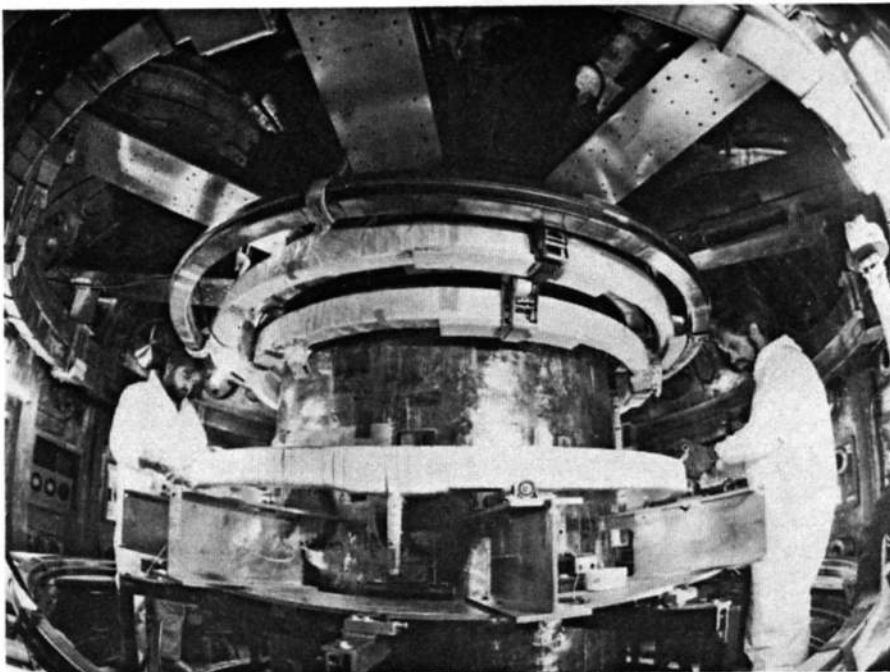
drel attached to a coil-winding table within the machine. The winding table rotated as the malleable copper was press-formed onto the mandrel via a hydraulic clamping system. The mandrel and coil were then insulation wrapped as one unit, permanently incorporating the mandrel into the coil bundle for added coil support.

Engineer Jim Chrzanowski pointed out that "everything was a series of firsts for us. Normally, we have more reliance on tension when we're winding a coil. With this project, everything was a challenge, but it was those challenges that made it interesting."

In order to provide as much room within the vacuum vessel as possible, the new coils were wound within the vessel before other new hardware was installed. Additional space on the machine platform was obtained by removing a neutral beam ion source, which was located on the platform near the winding station. Much of that precious workspace was quickly absorbed by a wooden platform built to allow personnel to safely walk around inside the vessel. Using only one 14"x14" port to admit people and another for machinery and materials required for the alteration created further difficulties. A steady stream of incoming conductor quickly restricted workspace at the machine's diameter. In comparison to the spaciousness of the I-K Building, the Coil Shop staff found working within PBX-M a tight fit.

Each mandrel was designed and fabricated at the I-K Coil

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Once completed, each of the five coil bundles were hand-wrapped with fiberglass insulation within the PBX-M vacuum vessel.

Shop to fit a specific PBX-M coil. The mandrel frames were wrapped with B-stage fiberglass insulation (a semi-cured, polyester-filled glass tape), and heat cured. Each mandrel was then precisely cut into segments and transported to PBX-M.

The segments were passed into the vacuum vessel to be spliced and epoxied back together. Grooves and feed-through holes were cut into each mandrel to allow epoxy to flow through them. G-10 plates and screws at the splice joints provided further support. Treating the mandrel assembly with air-cured epoxy and attaching it to the winding table completed the reassembly operation.

The actual winding procedure began with several four-foot diameter spools, each holding 65 feet of 3/4" square copper conductor with a 1/4" cooling channel. All coolant holes were flushed with a degreasing agent and continuity checked. Lengths of conductor were joined together using a portable induction brazing unit. Each joint thus created was helium leak checked, and subjected to a hydraulic stretch test of 11,000 pounds.

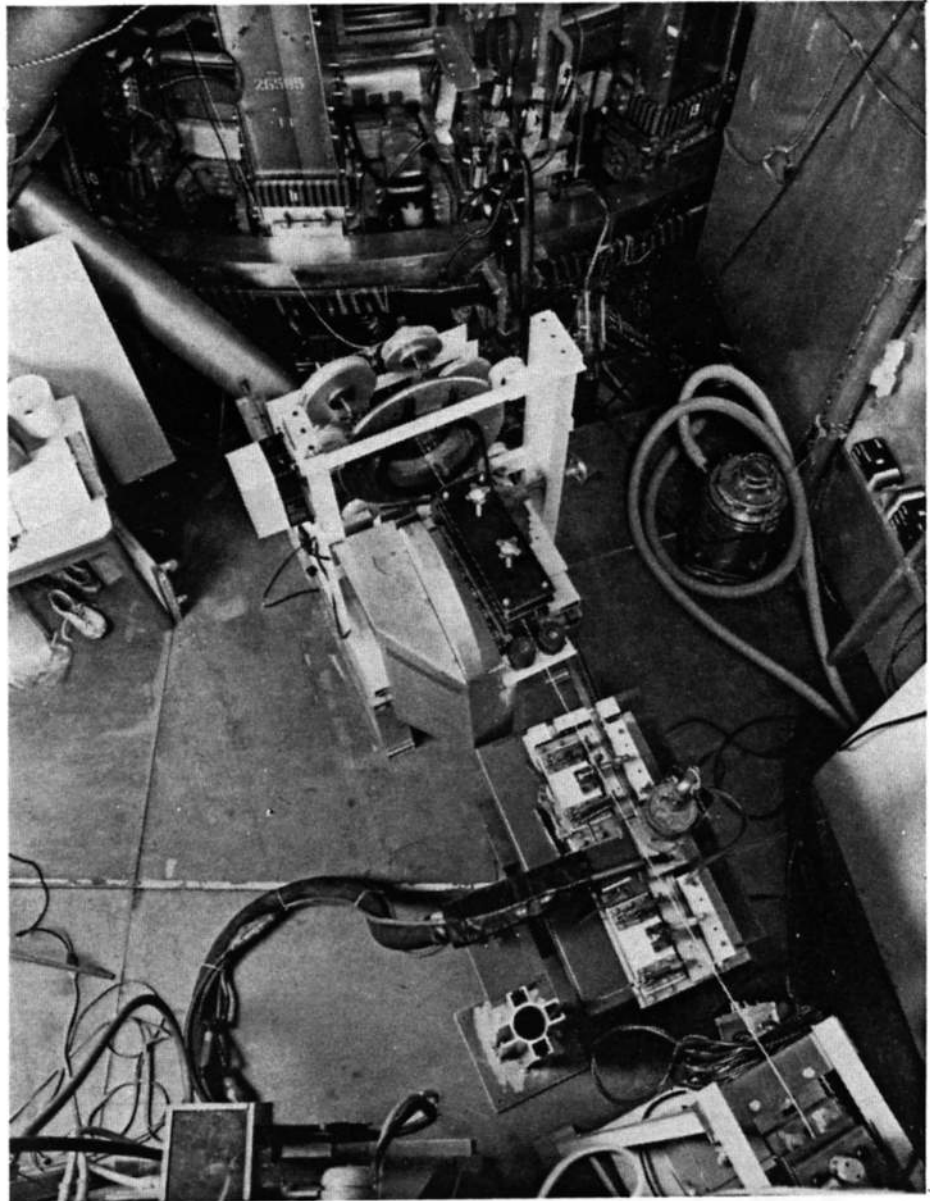
An automatic feed system, which straightened and continuously fed the conductor through the vacuum vessel port to the winding table, was located on the PBX-M machine platform. Approximately 16 feet of conductor separated the winding table from the feed system.

The conductor was wrapped by an automatic taping machine. This unit applied five layers of insulation simulataneously. The insulation con-

sisted of three layers of Mylar tape, and two layers of dry glass for added mechanical and electrical strength. Once completed, each coil bundle was hand-wrapped with fiberglass insulation within the vacuum vessel. Staff from PPL's Vacuum Shop then installed the stainless steel "cans" surrounding each coil, welding them into place within PBX-M. In the fall, the coils will be impregnated with air-cured epoxy to give each coil its mechanical and added

electrical strength to complete the assembly process.

The winding process began in early March, and was completed in late April. Jim Chrzanowski commended the entire Coil Shop staff working on the project for their dedication during the two-shift operation. Speaking on behalf of the PBX-M project, Dan Kungl added his praise for "a job well done from both a quality and schedule viewpoint."



Copper conductor is seen being automatically straightened, wrapped with insulation, and fed through a PBX-M port to be wound into coils within the machine's vacuum vessel.

Industrial Hygienist



Rebecca Mitchell

The Occupational Medicine and Safety Office staff increased in June when Rebecca Mitchell became the laboratory's new industrial hygienist.

Rebecca, who also holds a bachelor's degree in nursing, earned her master's degree in environmental and industrial health from the University of Michigan in 1982. During five years in the nuclear industry,

she has had a lot of experience in program development. Prior to joining the laboratory staff on June 23, she was respiration protection supervisor at the General Public Utility's Oyster Creek nuclear plant. At Pennsylvania Power and Light's Susquehanna nuclear plant, she developed and ran both the internal dosimetry and respiratory protection programs at the facility.

She was attracted to PPL by "the general academic and research atmosphere," as well as by the "broader base of responsibilities" handled by the laboratory's industrial hygienist. "Industrial hygiene's focus is to protect the employee from workplace hazards," Rebecca explained. "When they hear that description, most people think first of chemical hazards. I have responsibilities for managing chemical hazards, and I'm the person to call when people need Material Safety Data Sheets. But I'll also be doing air sampling, and analyses of the ventilation, noise and vibration levels, illumination levels, and ergonomic problems of work areas."

Rebecca expects to be surveying many areas of the laboratory, gathering data from employees as well as from the physical environment. But she also sees herself as a consultant, providing advice on the selection of protective clothing to attain a specific level of protection, for example.

Employees can contact Rebecca at the Occupational Medicine and Safety Office on C-Site, ext. 3584.



Harrison Street



According to a report in the Greater Princeton Transportation Management Association's spring newsletter, the Harrison Street bridge reconstruction is proceeding on schedule. However, design delays still threaten to derail the project.

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State officials said detailed studies of the bridge foundations found that potential environmental problems and other impediments are not as serious as expected. They concluded that the entire structure, including the bridge piers, can be rebuilt without major increases in cost or construction time.

County and local governments, Princeton University officials, and area residents have submitted suggestions concerning the structure and aesthetics of the new bridge. These comments are being processed by state and federal highway officials, who are attempting to incorporate some of those suggestions in the bridge's conceptual plan. If local and state officials fail to reach a consensus on the plan, however, bridge construction could be delayed.

If an agreement is reached soon, final design work on the bridge could begin this summer, and the new bridge could be open to traffic by late fall 1988.



The purpose of the C-Site Security booth is to provide controlled access to C- and D-Sites. In addition to being an employee entrance, the Security booth also serves as a visitor check-in point.

Since visitors are no longer required to report to the LOB receptionist's desk for visitor's badges, ALL visitors MUST stop at the Security booth to obtain the required badges before proceeding.

Employees bringing guests into the campus (including spouses, friends, and so on) MUST ALSO STOP at the booth to obtain the required badges. Visitors found on site without a visitor's badge will be told to obtain one from the Security booth officer.

All employees should use the right-hand entrance lane at the Security booth when entering C-Site. The left-hand lane is reserved for visitors and vendors. However, employees bringing visitors onto the campus should use the left-hand lane and be sure to obtain visitor badges for their guests.

Motorists approaching the Security booth entrance should be sure to reduce their speed. The curve in the road makes for dangerous driving conditions when speed limits are exceeded. The recommended speed limit for this area is 15 miles per hour.

Questions concerning these procedures or other Security matters should be directed to the Department of Public Safety, ext. 2894.

HazMat Disposal

The following procedures are to be used for disposing of hazardous materials lab-wide:

- Departments using hazardous materials must have Material Safety Data Sheets (MSDS) on hand for all hazardous material stored or used in a PPL work area.
- All hazardous materials requestors will complete a three-part Hazardous Waste ID Card, available at the C- or B-Site stock-

rooms. After filling in all the necessary information on the Hazardous Waste ID Card, the top copy should be sent to Materiel Control with all applicable MSDS sheets. The second copy should be sent to Occupational Medicine and Safety (OM&S); the third (card) copy should be attached to the material to be disposed of.

- Upon receipt of any Hazardous Waste ID Cards with MSDS information, Materiel Control will pick up the material as promptly as possible -- usually within 10 working days. OM&S industrial hygienist Rebecca Mitchell (ext. 3584) should be advised of any materials requiring immediate action due to imminent danger. She will arrange for prompt removal of the material.
 - If the requestor does not have the MSDS sheets, or does not know the identity of the material, he should contact the industrial hygienist. She, in turn, will obtain the needed information -- either by checking OM&S files, by contacting the manufacturer, or by arranging for an analysis. Once this information is available, Materiel Control will promptly pick up the material.
 - If requestors find it necessary to remove the material from a work site prior to scheduled pickup by Materiel Control or prior to the availability of MSDS data, they will be allowed to move the material themselves to a "quarantine" area set up by Materiel Control. Each
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requestor must make prior arrangements with the Hazardous Materials Section of Materiel Control (Scott Larson, ext. 3387) for receipt and storage of the material.

- In all cases, the requestor is responsible for having the material in a container suitable for transportation to Materiel Control and to ensure that items in the work area are stored properly prior to removal for disposal.

In order to assure expeditious handling and follow-up of disposal actions, Materiel Control will present a status report of pending actions at the laboratory's monthly safety meetings.

Any questions or problems relating to the disposal of hazardous materials should be referred to Scott Larson in the Hazardous Materials Section of Materiel Control, ext. 3387.



Bowling Wrapup

The Princeton University Mixed League's May 14 roll-off between the Gutter Dusters and the Pony Express was a contest of champions. Each team won half of the league's bowling season, but the Gutter Dusters grabbed the final victory by defeating the Pony Express in the roll-off.

Ending their season on a winning note were Gutter Dusters Dotty Kerr, Sarah Thomas, Barbara VanNostrand, Brian VanLiew, Mike Quigley, and

Safety Training

The following Occupational Medicine and Safety training courses are scheduled for August:

<u>Course</u>	<u>Responsible Instructor</u>	<u>Date</u>
Respirator Protection	Rebecca Mitchell Ext. 3584	August 19 9 a.m.

Employees must obtain permission from their immediate supervisor to attend these classes. Supervisors must call the responsible instructor to enroll their employees.

Dick Yager. Bowling for the Pony Express were Debby Simmonds, Nancy Strine, Ken Strine, Keith Sapp, and Al Martin.

Anyone interested in signing up for the League's 1986-87 season should contact Sarah Thomas at ext. 3711 or Elmer Fredd at ext. 2120.

CONGRATULATIONS -- to former PPL employees Mary Dyson and Gary Estepp, who were married in Las Vegas on June 14. Both left the laboratory and moved to Albuquerque, New Mexico in 1985.

TRANSITIONS

The HOTLINE offers its congratulations to the following employees, who recently became proud parents:

Geter Hicks of Procurement and his wife, Leslie, whose daughter, Allana, was born May 9;

Doug Loesser of the Mechanical Engineering Branch and his wife, Lisa, whose son, Scott, was born June 11.

Petty Cash ID's

Effective immediately, employees picking up reimbursements from the Petty Cash office must present a valid PPL ID badge to receive their money. The Petty Cash office is open daily from 9 to 10 a.m., and from 2 to 3 p.m.

For any questions about this requirement, please contact Flo Short at ext. 3503.

Commuter Exchange

If you're looking for a ride, why not try the classifieds?

The Greater Princeton Transportation Management Association (TMA) launched "Commuter Exchange," a want-ad program designed to link potential car or vanpoolers, this month. Commuters traveling to and from the greater Princeton area who are interested in ridesharing can now call the TMA at 609-452-1491 to place a free advertisement. The ads are published under the "Commuter Exchange" heading in the classified section of US 1, a monthly Princeton-based publication delivered to most area employers.

Each ad lists pick-up and drop-off points, work hours,
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and the phone number of a contact person. Optional information, such as how many days a week you wish to ride-share, whether you're a rider or a driver, and preferences for smokers or non-smokers, may also be included.

TMA is a member-supported service organization whose goal is to reduce traffic congestion and improve mobility in the central New Jersey region. For more information about TMA or its activities, please call 609-452-1419.

Obituary

William G. Kirkham, 63, a technician with the Electronic and Electrical Engineering Department, died on June 9. He had been a laboratory employee since 1962.

Mr. Kirkham is survived by his wife Marion, his son William, and two daughters, Kathleen and Maureen.



United Way

AT WORK

"There's Nothing to DO!"

How many times have you heard that comment from your teenage children once school lets out for the summer. With *their* time on *your* hands, it helps to have some ideas for activities. Big Brothers/Big Sisters of America, a United Way-supported agency, offers these suggestions for entertaining children or the entire family:

- Take advantage of athletic or family education classes or activities. Now is the perfect time to take up water sports, or to tour your area by bicycle.

- Do shop projects, such as carpentry. Build a bird-house, for example, place it in your yard, and take photos of your feathered visitors.
- Find neighborhood money-earning projects, such as mowing lawns or babysitting. Better yet, get involved in a project that will beautify your neighborhood, such as collecting discarded bottles and cans for recycling.
- Visit the library and do some reading.
- Wash and/or repair the car.
- Hit the road! Visit a historical site, or an amusement park.
- Get involved in volunteer work. Lend a hand to the homebound elderly, become a candy striper at your local hospital, or read to the blind.



Tour Guides



The chill winds of the New Year blew almost 1,000 tourists through PPL's doors during the first three months of 1986. March roared in with 20 tours and 474 visitors to pace the period. We'd like to thank the tour guides who shepherded our sightseers through the facility:

January

Charlie Ancher
Norton Bretz
Diane Carroll
Sam Cohen
Ernst deHaas
Robert Fleming
George Gammel
Alan Janos
George Martin
Ernst Nieschmidt
Dave O'Neill
Greg Rewoldt
Stan Schweitzer

Hal Wexler
Irving Zatz

February

John Bradish
Norton Bretz
Dave Ciotti
George Gammel
James Kamperschroer
Mark Kijek
Don Monticello
George Martin
Ernst Nieschmidt
Irving Zatz

March

Halsey Allen
Robert Budny
Glenn Bateman
Dave Ciotti
George Cutsogearge
Ernst deHaas
Joseph Fennimore
George Gammel
Charles Gentile
Jerry Gilbert
Ralph Izzo
Bob Kaita
Randy Knize
Don Knutson

Naren Kokatnur
Mark Kijek
Ed Lawson
George Levitsky
David Meyerhofer
George Martin
Bob McCann
Ernst Nieschmidt
Robert Pinsker
Greg Rewoldt
Joseph Stencil
Stan Schweitzer
Marilee Thompson
Russel Winje
Irving Zatz



Keep Your Digestion Working

The digestive system performs the amazing job of breaking down food into the nutrients your body needs. As you grow older, however, this system may not work as well. The National Institute on Aging offers these suggestions for keeping your digestive system working at its best:

- Eat a well-balanced diet that includes a variety of fresh fruits and vegetables, whole grain breads, cereals, and other grain products such as pasta.
- Eat slowly and, if possible, try to relax for 30 minutes after each meal.
- Exercise regularly.
- If you drink alcohol, do so in moderation.
- Avoid large amounts of caffeine.
- Use caution when taking over-the-counter drugs, and always follow your doctor's orders exactly when taking prescription medicines.

Your digestive system is bound to get upset now and then. Most of the time the problem will take care of itself, but these symptoms warrant a trip to the doctor:

- Stomach pains that are severe, last a long time, recur often, or come with shaking, chills, and cold, clammy skin.
- Recurrent vomiting, or blood in the vomit.
- A sudden change in bowel habits, recurring diarrhea, or sudden constipation.
- Bloody or coal-black stools.
- Jaundice or dark, tea-colored urine.
- Pain or difficulty swallowing food.
- Unexplained weight loss.

OSHA Reminders

The following safety reminders are drawn from a list of common Occupational Safety and Health Administration (OSHA) violations:

- Flammable or combustible liquids shall be stored in tanks or closed containers. Such liquids shall be drawn from or transferred into vessels, containers, or portable tanks within a building ONLY through a closed piping system; from safety cans; by means of a device drawing liquid through its top; or from a container or portable tank by gravity feed through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks is prohibited.
- The in-plant handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tankcars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association Pamphlet P-1-1965. For further information regarding storage and handling of compressed gas, contact PPL's Occupational Medicine and Safety Office.

The PPL HOTLINE is issued by the Princeton University Plasma Physics Laboratory, a research facility supported by the United States Department of Energy. Correspondence should be directed to PPL Information Services, Module 2, C-Site, James Forrestal Campus, ext. 2754.



Since moving to the 1-0 Building, the Personnel Office meets with a few "neighbors" each Wednesday for a weekly cookout. Pictured enjoying the fruits of their labors are (left to right) Sally Young, Madeline McMullen, Steve Iverson, Barry Cohen, Bill Johnson, Noreen Cruser, Sheryll Poris, and Bobbie Cruser.

Art Exhibit

"William King: Sculpture" is the current exhibit on display at the Squibb Gallery.

Several of King's humorous sculptures have been included in the exhibit. The pieces are done in a variety of sizes, textures, and materials.

The Squibb Gallery is located in the world headquarters of the Squibb Corporation on Route 206, three miles south of Princeton. Gallery hours are 9 a.m. to 5 p.m. Monday through Friday, and from 1 to 5 p.m. on weekends. Thursday gallery hours are extended to 9 p.m.

Milton Machalek explains the finer points of the TFTR program to 70 Woodrow Wilson Master Teachers who toured PPL July 29. Sponsored by the Woodrow Wilson National Fellowship Foundation, 100 high school math and science teachers were selected for the honor after a national competition. Master Teachers spend four weeks in residence at Princeton University, where they participate in classes taught by faculty from across the country.

