HOTLINE

PRINCETON PLASMA PHYSICS LABORATORY

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TFTR Neutral Beam Passes Test

A successful test of the cryopumping system for the TFTR neutral beams was accomplished on June 10 and 11. Liquid nitrogen and helium were used to lower temperatures in the vacuum chamber to -450^{o} Fahrenheit.

According to Rolf Brocker, who was in charge of vacuum enclosure assembly, the test "verifies and duplicates the results Berkeley (Lawrence Berkeley National Laboratory) obtained in the operation of the prototype neutral beam. We got the results we expected, which proves that the whole thing works. The painstaking, tender loving care that has gone into the building of the TFTR neutral beam has paid off."

The beam cryopumping system consists of two arrays of cryocondensation panels installed along two sides of the vacuum enclosure. Liquid nitrogen and helium are pumped through the panels, cooling the interior of the vacuum enclosure. Stray particles 'stick' to supercold baffles in the panel array, allowing the neutral beam to pass unhindered from the source into the TFTR plasma.

Brocker said work on the beams is continuing on schedule. Beamline Number 1 (the subject of the test) will be moved to the TFTR site approximately in September of this year as the first component for the three source test setup.

Current Drive Experiments Successful On PLT

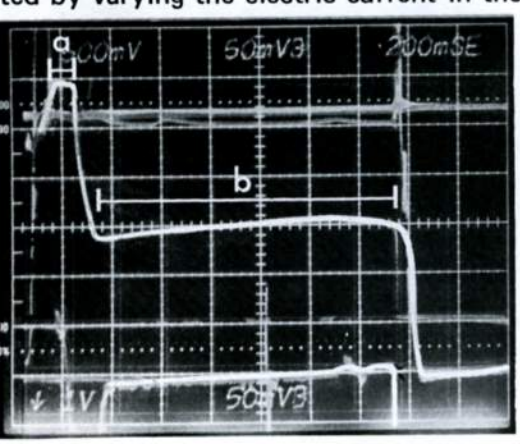
In the most successful current drive experiments to date, lower hybrid waves were used on PLT to drive a 200-kA plasma current for one second. In the series of experiments on Saturday, July 25th, 100 kW of lower-hybrid-wave power at a frequency of 800 MHz was injected into the plasma using an array of six waveguides. Central electron densities were about 5 x 10^{12}, and electron temperature was in the range of 1 keV.

The entire machine pulse lasted about 1.3 seconds. Ohmic current was used for the first 0.3 second; wave-generated current was used for the remainder.

According to physicist Bill Hooke, the significance of these experiments lies in the length of time the current was generated and in the efficiencies that were achieved. It was predicted that a current of only a few tenths ampere per watt of radio-frequency power input could be achieved for driving bulk electrons, but these experiments reached a significant 2 amperes per watt of input by driving tail electrons, those energetic electrons that are moving faster than the bulk electrons. The experiments were carried out on low-density plasmas. The next big step will be to achieve comparable results at higher densities, and for even longer times.

Lower hybrid waves generate a current in the plasma when all of the waves are propagated into the vacuum vessel in the same direction. The waves selectively accelerate those electrons already moving in the direction of propagation. With proper phasing of the waves, a current is generated.

In previous experiments, the plasma current was generated by varying the electric current in the



This photograph of an oscilloscope reading shows the plasma current strength over time during a machine pulse. Ohmic current was applied during period A. When it was terminated, the plasma current dropped rapidly. During period B, lower hybrid waves were injected and the plasma current was maintained. Each square represents a time period of 0.2 second. The bottom line on the graph represents the loop voltage, which stayed near 0 or even below, indicating that the plasma current was attributable entirely to lower hybrid waves.

ohmic heating coils. The plasma acts as the secondary coil of an air-core transformer, and a current is generated. The need to rapidly change the current in the coils, however, limits the length of a machine pulse. Using radio-frequency waves rather than ohmic coils to generate the plasma current eliminates this need and could lead to steady-state operation of tokamaks, an important development in fusion reactor technology.

Benefit Changes

The University Benefits Committee has approved two improvements in the university's medical plans.

The monthly $50 limit on major medical reimbursement for treatment of mental or nervous disorders has been changed to a yearly reimbursement limit of $600. The change is intended to assist those needing more intensive therapy over a short time.

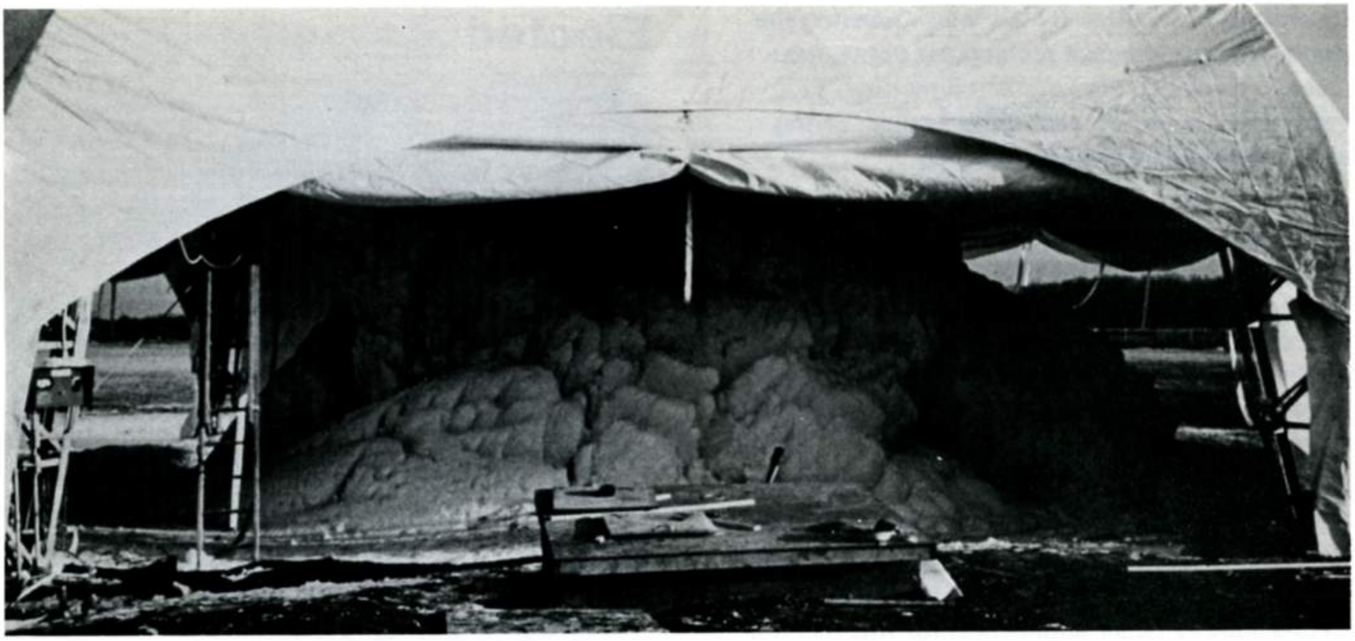
The definition of eligible dependents for Blue Cross/Blue Shield 750 series has also been changed. Spouses and unmarried children (either through the end of the benefit month in which they marry, or through the end of the calendar year in which they turn 23) qualify as eligible dependents. Unmarried children are no longer required to be dependent on their parents for support to be eligible for coverage.

Questions on either of these changes should be directed to Eleanor Schmitt, ext. 2035.

Environmental Dome

A 22-m diameter dome at B-Site is proof that nuclear fusion is not the sole energy option being pursued at the Forrestal campus. The dome is part of an experimental solar-powered air-conditioning system, conceived by Dr. Ted Taylor of Princeton University's Center for Energy and Environmental Studies. The project is managed by Prof. Robert Socolow, consulting engineer Don Kirkpatrick and graduate student Marco Masoero.

The cooling system is a reincarnation of the old ice house, which stored winter ice for summer cooling. A PVC-lined pond, 18-m in diameter and 3-m deep, stores ice produced by a commercial snow-making machine. The snow maker sprays small (0.1-m diameter) water drops, which quickly freeze and settle into the pond. In sub-freezing



The dome with its flaps open, revealing the large pile of snow.

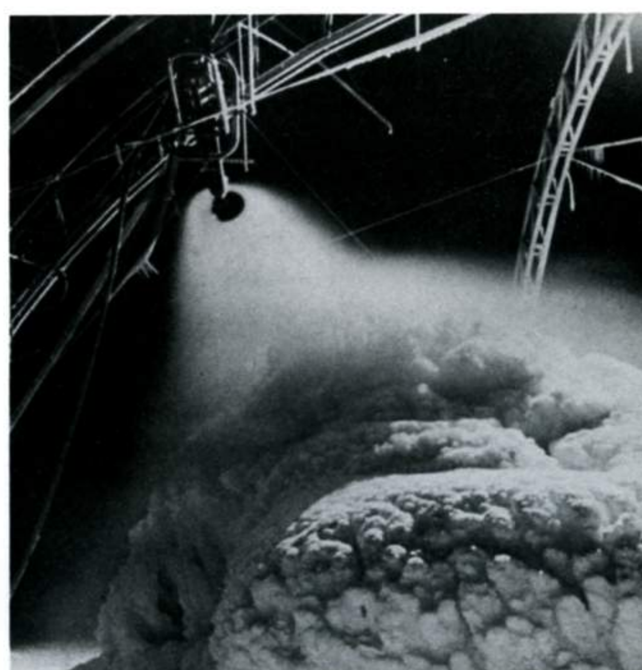
weather, flaps on the dome are opened to aid air circulation.

At the close of the snow-making season, the flaps are closed to block warm winds, and an insulated blanket is placed over the ice. During the air-conditioning season, melt water from the reservoir is pumped into a building, where it absorbs heat through an air-cooling heat exchanger and flows back into the pond. The remaining ice cools the warmed water back to 32° F. Each ton of ice provides 288,000 BTU's of cooling.

Efficiency is the main advantage of this system. The seasonally-averaged coefficient of performance (or COP: the ratio of heat removed to electricity consumed) of a conventional air conditioner is usually less than 3. During the relatively warm 1980-81 winter, the ice pond had a COP of about 9; seasonal COP's greater than 20 are theoretically achievable. As an additional bonus, major energy use is shifted away from the summer peak load period, reducing expenses for utilities and users.

Ice ponds, however, have higher capital costs than conventional chillers. Since ice-making depends on cold winter weather, the technique is most practical in climates that have a "balance" of winter cold and summer heat. Additionally, large reservoirs are required to achieve acceptably low melting rates, suggesting ice pond use for office buildings and clustered houses; fixed costs for isolated homes presently appear to be excessive. Some of these problems may be alleviated by properly incorporating the system into new construction.

An office building under construction at Forrestal Center will utilize the first full-scale ice pond system. The 36-m x 49-m x 6-m deep reservoir will store up to 5,000 tons of ice, with a cooling



A nighttime shot of the snowmaker in operation. The dome, not present in the photo, is supported by the curved members.

capacity of 1.4 billion BTU's/year. Covering the pond will be a low-cost rectangular dome, insulated to minimize environmental melting. This system will approach cost-effectiveness, saving about $12,000 of electricity a year.

In urban areas, land could be saved by placing the snow maker on a roof (where adequate air flow exists), and allowing the snow to fall down a shaft to a basement reservoir. Ice for entire cities might be stored in lakes or flooded quarries, with the cooling water transported long distances through large pipes. Storage ponds that big will need little or no insulation.

Ice ponds may eventually provide a majority of space cooling, which accounts for 4% of present U.S. energy requirements. Industrial and commercial refrigeration and process cooling could provide a considerably larger application for this technology. Users will benefit from reduced costs; utilities will benefit from reduction of expensive peak loads; and both groups will benefit from reduced dependence on fossil fuels.

Bicycle Racks

In order to encourage and facilitate the use of bicycles, storage racks have been provided at key locations around Forrestal Campus. Everyone is requested to use the racks, due to a variety of problems that result from random parking of bicycles around the laboratory.

Sheryl Cargill and Anne Golden (foreground, left to right) are co-chairmen of the 1981 PPL Blairstown Potpourri ticket committee. John Anastasio and Jim Turley (background, left to right) are members of the committee, as are Joe Cecchi and Robert Applebaugh (not pictured).

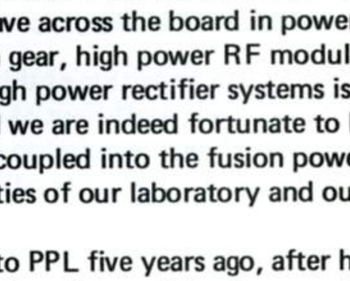
Elected

Russ Winje of the PPL Advanced Projects Design and Analysis Division (APDAD) was recently elected a senior member of the Institute of Electrical and Electronic Engineers, the major professional organization for electrical and electronic engineers.

In a letter commending Russ on his appointment, Associate Director Paul Reardon said "The experience you have across the board in power transmission, switch gear, high power RF modulator systems and high power rectifier systems is relatively unique, and we are indeed fortunate to have you so effectively coupled into the fusion power development activities of our laboratory and our country."

Russ came to PPL five years ago, after having worked for Fermilab and the Argonne National Laboratory. He is currently involved in work on the TFTR neutral beam power supply.

Thank You



To all of "vous" who helped to make my Birthday special: "Thanks!" —Moi

Fire Safety

Flame itself is not the only killer in a fire. Fire needs oxygen to start, and consumes oxygen as it burns. The normal oxygen content of the air we breathe is about 21 percent. During a fire, that level drops rapidly. If it falls below 17 percent, clear thinking and muscle control are impaired; your attempts to escape become irrational. When the oxygen level drops below six percent, breathing stops. If the brain is deprived of oxygen for four to six minutes, brain death occurs.

The heat a fire generates can also be deadly. The human body can tolerate temperatures between 150° and 250° Fahrenheit for only moments. In a serious fire, superheated air with temperatures in excess of 1000° F rises to the ceiling, then fills the entire room.

In addition, most fires generate a number of gases which can have drastic effects on the body. These include:

- Carbon Monoxide -- a tasteless, odorless, colorless gas that hampers oxygen flow to the brain
- Carbon Dioxide -- over-stimulates the breathing rate, increasing the intake of other toxic gases
- Hydrogen Sulfide -- affects the nervous system, causing dizziness and respiratory system pain
- Nitrogen Dioxide -- an extremely toxic gas which numbs the throat and causes asphyxiation by displacement of air

Fire's major threat, however, is smoke. Smoke may contain some or all of these toxic gases, and may interfere with vision or obscure light. Smoke particles irritate the respiratory system, causing coughing and sneezing. The impairment of breathing, seeing and thinking clearly often lead to panic -- which can easily lead to death in a fire.

In a smoky fire, crawl close to the floor where the air is cooler and less smoky. GET DOWN ON YOUR HANDS AND KNEES AND GET OUT!

The best protection available against the hazards of smoky fires is a smoke detector. Everyone in the family should be familiar with the sound of the detector, and a family meeting place outside the home should be established. Practice evacuation procedures regularly, until the procedures become habit.

There are several things to remember if you have a smoke detector:

- Sleep with bedroom doors closed; smoke detectors have a high decibel level that will penetrate into the room.
- Be sure everyone realizes the smoke detector siren means GET OUT NOW! Test this by activating the alarm while family members are sleeping and observing the results.
- Never waste time getting dressed or gathering valuables during a fire. They are replaceable; your life is not.
- Feel every door before you open it. If the door feels hot, or smoke is seeping past its bottom or sides, DON'T OPEN IT! Leave the room by an alternate exit.
- Use windows for escape and rescue.
- If there's smoke, crawl near the floor.
- If your clothing catches on fire, STOP, DROP AND ROLL to put it out.
- Once you are out of the house, go immediately to your meeting place.
- Call the fire department. Make sure you give your complete address, and say whether you think someone may be trapped in the fire.
- Once out of the house, STAY OUT! NEVER return inside a burning structure, and don't let anyone else back into the building.

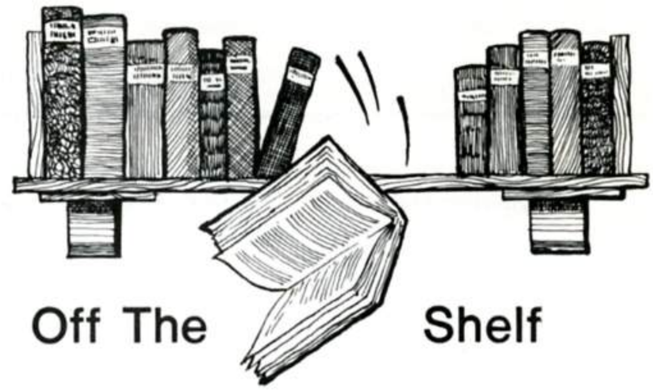
New Hires

Jane Holmquist joined the PPL staff as assistant librarian on July 1. Jane, who holds a M.L.S. from Rutgers University, received a B.A. in biology from Gustavus Adolphos College in Minnesota. She also earned a M.S. in biology from the University of Waterloo in Ontario.

She has been working in Princeton University's geology library, as well as in Firestone Library's microfilm division, for the past two years.

Jane is responsible for answering reference questions and conducting literature searches using the DOE/RECON and other data bases. Her duties also include abstracting journals and technical reports.

Jane replaces Tom Conkling, who has become the librarian at the University of Pennsylvania's engineering library.



Off The Shelf

With this issue, the HOTLINE introduces a new column called OFF THE SHELF. Written by PPL Head Librarian Betty Graydon, the column will feature new publications of general interest that are currently available in the library.

NEW JERSEY'S GOT IT–
An all inclusive list of events being held throughout the state. Provides information on hunting, fishing, summer theatre, the Garden State Arts Center, flea markets, antiques and much, much more. Published quarterly by the New Jersey Division of Travel and Tourism, Trenton, New Jersey.

RAND McNALLY ROAD ATLAS–
Plan your trips by consulting the newest edition of this very popular atlas. The volume includes maps of the United States, Canada, and Mexico, 250 city maps and both a mileage and driving time map. New York: Rand McNally Co., 1980.

NEW INTERNATIONAL ATLAS–
Latest edition of this classic volume of international maps. Greatly expanded in scope, this atlas now includes place names in local language as well as in English, a glossary, abbreviations of geographical terms, a world information table, and a section on metropolitan area maps. New York: Rand McNally and Co., 1980.

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

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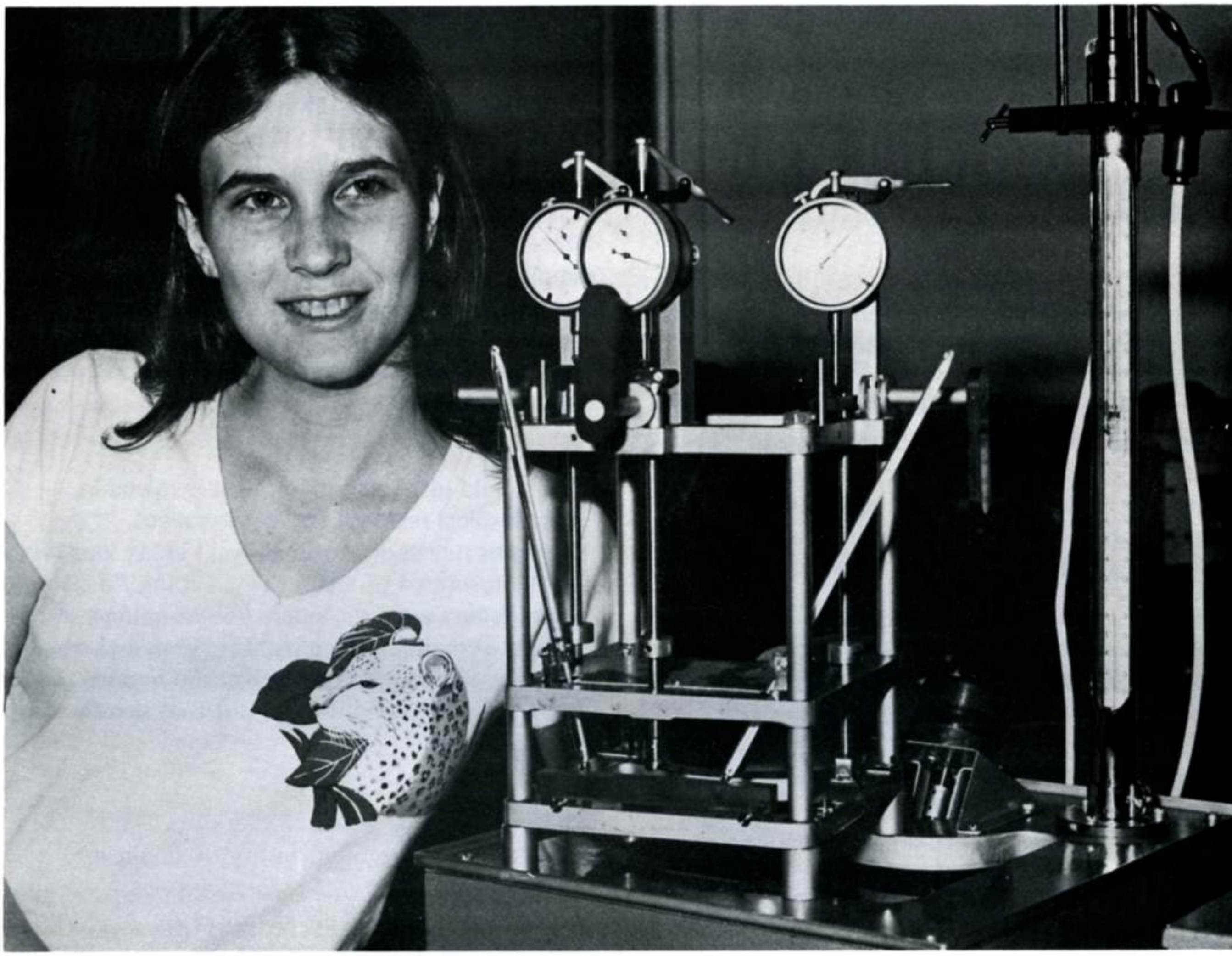

Metals Spark Student's Interest

The next time you watch a welder raise his mask on a break, don't be suprised to see a woman's face. It might be Kristine Richter, a metallurgical engineering student who is working at PPL for the summer.

Kristine, a 21-year-old from Warren, N.J., is entering her senior year at Lafayette College in Easton, PA. Her major is metallurgical engineering, an interest that, oddly enough, she became aware of during a discussion at band camp.

"A friend of mine first mentioned it to me," Kris explained. "She said it was much easier to switch out of the program than to switch into it, so I thought I should try some of the courses."

She did, and found herself engrossed by a demonstration given by Dr. McGready, presently the director of engineering at Lafayette. "He was like the Wizard of Oz, pulling pieces of metal out of his bag. He explained that his job was to determine why metals fail (in auto accident cases, for example) and to testify as an expert witness in court. I was fascinated by that; it seemed much like detective work."

Kris says she took the "roundabout" way towards her career choice. "First I studied civil engineering, and worked as a surveyor for a while. Then I took chemical engineering for a semester, but it's a very broad field. I narrowed my study to metallurgy because I'd always been curious about what things are made out of. My father (an engineer himself) and I have a lot in common, and often discuss our work."

Metallurgists get involved in a number of areas, according to Kris. Her preference, however, involves analyzing metals' structures with a microscope to determine their properties. This knowledge is then applied to other metals to create new alloys. Metallurgists are often instrumental in the design phase of machinery, suggesting old metals or designing new alloys to meet specific applications.

Kristine applied to the summer program at the suggestion of her uncle, Harold Richter (a technical specialist in the electronics section). "This is a colorful place," she asserts. "I've had a variety of jobs during the two summers I've worked here. Last summer I worked as a computer programmer for Dr. John Coonrod, and I really enjoyed working on the simulation of the tokamak. I was also here for two weeks in January, doing computer work in addition to doing the layout necessary for the fabrication of metal parts. This summer I began working in the Tech Shop, and ran the drill press and other machinery."

She's being exposed to several aspects of metallurgy. Kris spent a week with Hector Morales, who showed her the fine points of welding. "Hector's a good teacher," Kris feels. "I learned a lot from him; he kept me working all the time, but it was very interesting."

Kris says she hasn't run into any discrimination on the job. "I haven't had any trouble," she reports. "My co-workers are eager to share their knowledge and expertise with me. They treat me like one of the gang!"

Kris is now working in Dr. Graham Brown's Metals Testing lab, mounting and polishing metal samples for analysis and testing various materials. She enjoys being switched from job to job by supervisor Joe Csenteri, considering the experience beneficial. She'll remain at PPL through the end of August.

Kris would ultimately like to get involved in metallurgical research and development. "I'd like to be developing new alloys; I enjoy working on the forefront of technology. I think I'd also enjoy failure analysis, where you examine a small sample of metal, tracing its history back to how it was cast and formed to discover the reasons for imperfections it might have. But that takes a lot of experience."

She's gaining that experience at PPL. "At school, there's not enough opportunity to go out into the field and learn something. When you learn on site, you take things into consideration you might not have thought of in school—like the fact that metal stretches considerably upon forming."

She might even make her career here. "I'd consider working here," she quickly asserts. "The atmosphere is friendly, the people are nice—I really like it here!"

Suggestions for future PPL PEOPLE features are always welcome. Send your ideas to HOTLINE, Module 2, Room 160 or call ext. 2754.
