

## PPPL Achieves 20 Year D-T Goal

### *Chronicle of a World Record*

By all outer appearances, Thursday, December 9, 1993 was a quiet day at PPPL. But behind the scenes, physicists, engineers, and technicians were working feverishly to prepare for the first high-power experiments, using an almost equal mixture of deuterium and tritium (D-T). Twenty years earlier, in December 1973, the goal of beginning high-power D-T experiments using about equal amounts of tritium and deuterium was presented to DOE (then called ERDA—Energy Research and Development Administration).

Looming large in everyone's mind was the big question—just when would we do those first deuterium-tritium experiments?

All day, the question hung in the air, with an announcement going out at 3 p.m. over the EVES system that the decision would be made at



*Laboratory staff members stand in the back of the MBG Auditorium watching the evening's events as they progressed.*

6 p.m. Many employees waited until 6 when the announcement came that this was to be the big night—one day earlier than anticipated.

Gradually, the MBG Auditorium filled with PPPL staff, along with

some spouses and children. Department of Energy officials, fusion researchers from other laboratories who have collaborated on the TFTR project or made past contributions, retired employees, and a myriad of media representatives were also present. All were there to keep watch for this historic moment.

Appropriately, the auditorium was festooned with bright balloons from the United Way campaign meetings held earlier in the day. In this celebratory atmosphere, everyone waited with great expectation, as Deputy Director Dale Meade gave a briefing on the evening's game plan and provided up-to-the-minute commentary as events unfolded.

As Meade explained, the plan was to begin with some low-power experiments that included about eight percent tritium and gradually increase the fusion power, cross-

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*Physicist's Steve Scott's family arrived with his dinner early in the evening and stayed to watch TFTR achieve more than three million watts of controlled fusion power. Left to right are: daughter Kimberly, wife Laurie, and daughters Rebecca and Katherine.*



## D-T Goal Achieved

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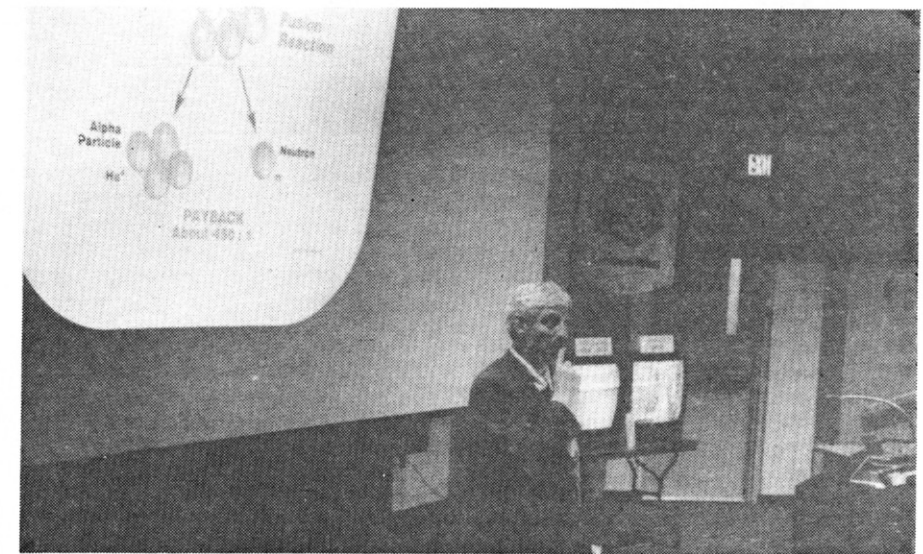
checking among four diagnostics that measure neutron properties. Between shots that included tritium, pure deuterium-deuterium (D-D) shots would be run to provide a contrast (a control) for the D-T experiments.

In the auditorium, one monitor provided live coverage of the TFTR control room, while another showed the countdown to plasma shots, and a third showed the actual evolution of the plasmas as shots were made. A fourth monitor, of the Fusion Power Light Diagnostic, showed the power of the plasma and the fifth was used for viewing the TFTR Test Cell.

### Unfolding Events

With an average twelve to fifteen minute gap between every shot, the evening moved slowly but steadily along towards the moment when the first high-power D-T experiment would be made. Between shots there was time to talk to some of those present.

Among the audience were Melvin Gottlieb and Harold Furth,



*Throughout the evening, Deputy Director Dale Meade talked to the audience describing what was happening in the TFTR Control Room, explaining the experimental sequence of events, and interpreting the results of each plasma shot. To his left are two of the five TV monitors set up in the auditorium to provide live coverage of the events. Groups of monitors were also set up in the LOB Lobby, the C-Site Cafeteria, and the gallery above the TFTR Control Room.*

the second and third directors of the Laboratory. Said Gottlieb, "This is something we've been waiting for almost 20 years. We were delayed by funding reductions and changes in environmental and safety restrictions. But we've finally made it."

"The dedication and enthusiasm of the staff has been incredible,"

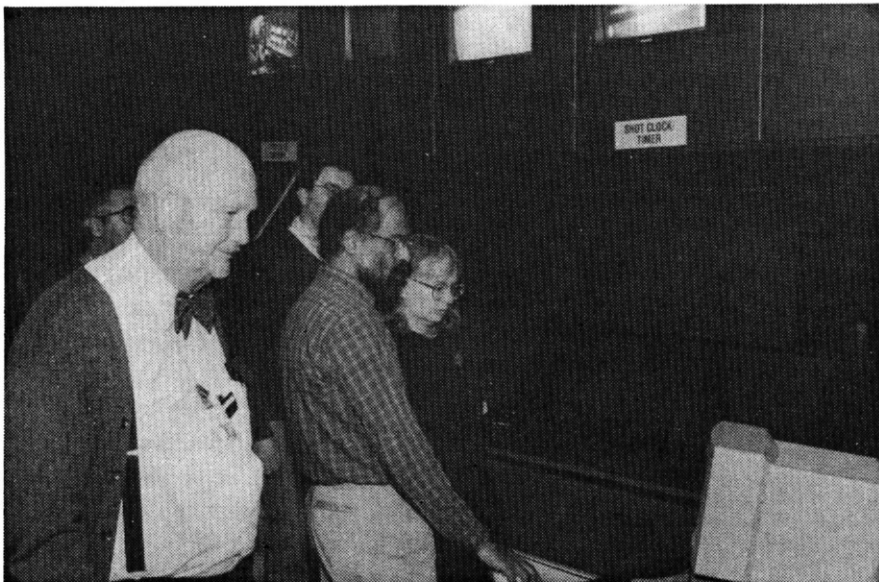
Gottlieb added. "We used to run the machine two shifts a day, six days a week, because everyone was so eager to have something happen."

Noticing that the clock read 10:15, Gottlieb added, "Now the question is whether they can get that high-power shot off before I fall asleep. I'm not used to these late hours."

Remembered Don Grove, "It's wonderful to be here for the culmination of what we began almost exactly 11 years ago with the first D-D shot, which occurred at 3 a.m. on Christmas Eve. Even that first dinky little plasma wasn't bad by some standards."

"We'd put in a tremendous effort to get ready to start up TFTR. It's a huge machine, with many complex electronics," noted Grove. "This group [the present TFTR staff] is much more sophisticated than we were. There's a complete script of what to do next, and they're actually following it!"

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**Staff members look down into the TFTR Control Room and view events on the TV monitors as they unfold.**

## Success!

By 10:45, just as the audience was becoming fatigued, the moment came for the first high-power shot, and everyone came to attention. However, a small glitch kept the shot from reaching its potential and, as tension mounted, a second try had to be made.

Finally, at 11:08 p.m., the first successful high-power shot was made, and as the data came up on the screen at 11:11, those in the TFTR control room and in the auditorium broke into rounds of great applause and cheers.

TFTR had set a world record of more than three million watts of controlled fusion power. This was the world's first magnetic fusion experiment utilizing a plasma made up of approximately equal parts of deuterium and tritium in a tokamak—the mix expected to be used in commercial reactors. The next day, this fusion energy record was to be almost doubled—with a shot producing about six megawatts of fusion power.

As they drove through the PPPL gate coming to work on December 10, staff members were greeted with the exuberant news of this great accomplishment in the form of a *News Alert* which included the following comments.

Said Laboratory Director Ron Davidson, "The TFTR team is to be congratulated for this superb accomplishment. We now look forward to the rest of the D-T experimental campaign with great pride and anticipation."

"These results are products of years of hard work by an extraordinarily dedicated and creative staff," added TFTR Project Manager Rich Hawryluk.

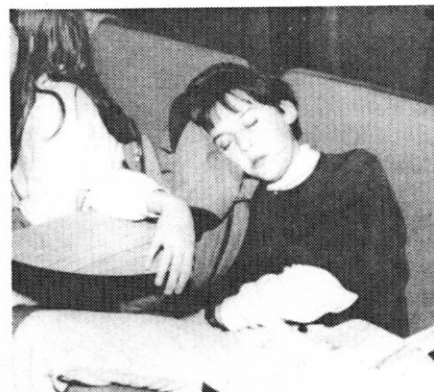
In the DOE press release announcing the achievement of three MW of fusion energy, Secretary of Energy Hazel O'Leary said, "This



*Many retired employees returned to watch as the TFTR set a world record of more than three million watts of controlled fusion power. Shown here are left to right: Don J. Grove, former TFTR Project Manager and former Deputy Director for Technical Operations; Marshall N. Rosenbluth, theorist; Melvin B. Gottlieb, PPPL Director, 1961 to 1981; and Harold P. Furth, PPPL Director, 1981 to 1991.*

world record is a great step in the development of fusion energy. It highlights the enormous progress being made in the field. This is the most significant achievement in fusion energy in the past two decades. I commend the Princeton staff for the years of hard work and dedication."

Manager of the DOE's Princeton Area Office Milton Johnson observed, "The U.S. Congress and the American taxpayers have demonstrated their support for—and their fascination with—the development of fusion energy



*Fatigue set in as the audience waited patiently for the first high-power deuterium-tritium experiment. Katherine Scott took a brief nap as she waited for the big event.*



*Tension mounted in the TFTR Control Room as the experiments progressed toward the high-power D-T plasma shot.*  
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***Rounds of applause and cheers broke out in the TFTR Control Room when it became evident the high-power D-T experiment was successful and that record amounts of fusion power were achieved. Smiles of jubilation and happiness were everywhere.***

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for years. This important milestone shows their faith well placed, and we welcome the opportunity to show that their investment will pay off in the future."

In a letter to PPPL, anticipating the D-T experiments, New Jersey Governor Jim Florio wrote, "As Governor of New Jersey, I extend best wishes and congratulations to the staff of the Princeton Plasma Physics Laboratory as you begin the deuterium-tritium experiments on the Tokamak Fusion Test Reactor. I have followed the accomplishments of PPPL with great interest, and I expect these experiments to put the crowning touch on the decade-long series of successes from the TFTR Project. With your concern for safety today and a safe, abundant energy source for the future, you bring credit to the State of New Jersey."

Concluded Secretary O'Leary in the DOE press release, "This research exemplifies three elements of the Department's mission; to achieve diverse energy sources, a productive and competitive economy, and improved environmental quality. Fusion offers the promise of a safe, environmentally acceptable, inexhaustible source of energy in the next century."

Letters also poured into the Lab from other fusion laboratories as well as from many other dignitaries.

*(A display of congratulatory messages can be found on the LOB third floor balcony that connects the two wings of the building.)*

## News Spreads Like Wildfire

The media leapt into action, giving unprecedented media attention to events at the Laboratory.\*

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A press conference held at noon on Friday, December 10, drew media representatives from ABC, CBS, NBC, and CNBC (cable). Local stations which sent camera crews include: WPVI, Channel 6, and WTXF, Channel 29, for the Philadelphia-Trenton area, and three New York stations—WABC, Channel 7; WWOR, Channel 9; and WPIX, Channel 11.

A video news release (VNR) explaining the significance of the TFTR world record and showing the exuberant reaction of scientists in the TFTR control room was picked up by TV stations across the country and around the world. In addition, national and international newspapers highlighted the story as well.

The result of this unprecedented coverage was that almost 57 million viewers saw coverage of PPPL's accomplishment in the United States alone.

### Shapiro Congratulates Lab

During the first high-powershots, Princeton University President Harold Shapiro was in Sweden for the Nobel awards, including PPPL Physics Laureate Russell Hulse. On the following Wednesday, during a gathering of staff members in the auditorium, Shapiro said, "I'm



**TFTR Project Head Richard Hawryluk addresses television, radio, and press reporters at a noon press conference held Friday, December 10, following Thursday evening's historic events.**

extremely grateful and very impressed with your accomplishments."

He added, "I heard the results of the first D-T experiments in the most marvelous way." He then recounted how he had gone to pick up a paper at a Stockholm rail station newsstand when he saw emblazoned on the Manchester Guardian (from Great Britain) the headline announcing PPPL's fusion breakthrough. At breakfast, the conversations of the Nobel Laureates were buzzing with the news.

During the same assembly of PPPL staff, Laboratory Director Ron

Davidson highlighted the contributions of several key players in bringing TFTR to this point. To Harold Furth, whom he called father and architect of TFTR, he said, "Harold, those three megawatts were for you. We should institute a new unit of fusion power called 'the Furth.'"

He also acknowledged the important contributions of Paul Reardon, who was the construction manager for TFTR, and to Dale Meade he said, "We greatly appreciate your outstanding contributions to steering the TFTR ship over so many years." He also thanked Head of Engineering Mike Williams for "bringing the incredible talents and resources of engineering to bear on TFTR."

He expressed appreciation to Associate Director for Environment, Safety, and Health/Quality Assurance John DeLooper for the extra efforts made to assure that this work is carried out safely. He also acknowledged the significant efforts of George Coward, head of the TFTR D-T Project, for preparations for the Operational Readiness Reviews and for assuring compliance with Department of Energy regulations.

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**Reporters talked to PPPL and DOE Princeton Area Office staff members immediately following the Friday press conference.**



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He recognized the efforts of Jim Anderson, who is on assignment from Los Alamos National Laboratory, for his outstanding contributions to TFTR as a leading expert in tritium handling. He also thanked Jim Strachan, Head of the D-T Fusion Power Task Force for his excellent leadership in developing the D-T experimental sequences.

He expressed his appreciation to Milton Johnson, Manager of the DOE's Princeton Area Office (PAO), for the spirit of teamwork he has encouraged between the Laboratory and the DOE.

He praised the public relations efforts of Tony DeMeo, Rush Holt, and their staffs for supporting "this incredible media event, which went far beyond our wildest dreams."

Finally Davidson thanked Rich Hawryluk for his extraordinary leadership of the TFTR project during the past several years and during this historic sequence of experiments.

During the same assembly Hawryluk gave a talk describing the process and accomplishments of the first high-power D-T experiments for Laboratory employees.

### Thanks to the Entire Staff

As a special holiday gift of acknowledgement, everyone at the Lab received in the mail a photo of their working group along with a message from PPPL Director Ron Davidson and Deputy Director Dale Meade.

The message read: "Holiday Greetings. 1993 has been an extraordinary year for the Princeton Plasma Physics Laboratory, and we want to take this opportunity to thank you for contributing so generously of your talent and time to the success of the Laboratory's programs. The historic high-power deuterium-tritium experiments on TFTR, the

exciting profile-control results on the PBX-M tokamak, and the very favorable reviews and design developments on TPX are only three examples of the outstanding accomplishments resulting from your dedicated efforts and teamwork.

The high quality of the staff is evident throughout the entire Laboratory. We are very appreciative of your superb efforts. Enclosed is a photograph of those you work with at the Laboratory in recognition of what you and your associates have accomplished this past year. We extend our warmest wishes to you and your loved ones for a happy holiday season and an exciting New Year."

Also included in the package was a page reproducing congratulatory letters from Hazel O'Leary, Secretary of Energy; N. Anne Davies, DOE Associate Director for Fusion Energy, Office of Energy Research; New Jersey Governor Jim Florio; and New Jersey Senator Frank Lautenberg, as well as from JET (Joint European Torus), the Japan Atomic Energy Research Institute, International Thermonuclear Experimental Reactor, and General Atomics. These were just a small fraction of the letters received. ♦



*Princeton University President Harold T. Shapiro addressed a gathering of Laboratory staff after he returned from Sweden where he attended the Nobel Prize Ceremony including PPPL Physics Laureate Russell Hulse. He told everyone, "I'm extremely grateful and very impressed with your accomplishments."*

**\*Videotapes containing the VNR and a compilation of television news broadcasts for December 10 to 13 covering the high-power D-T experiments are available for \$5.00. Call Pat Buggs, extension 2750, to purchase a tape.**

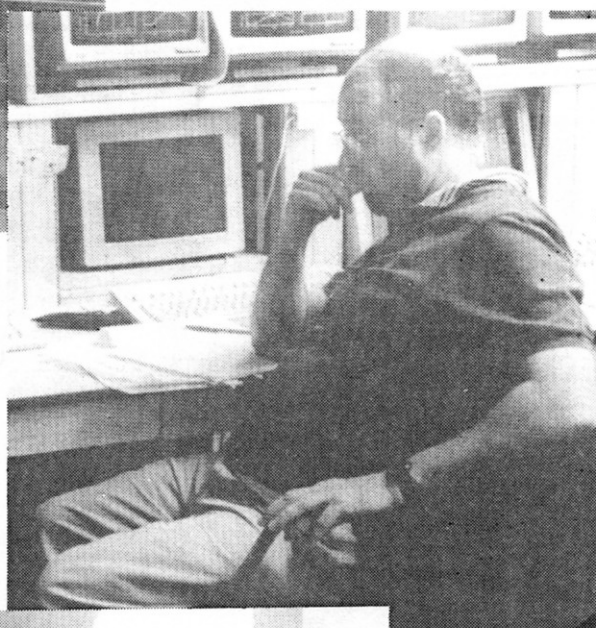
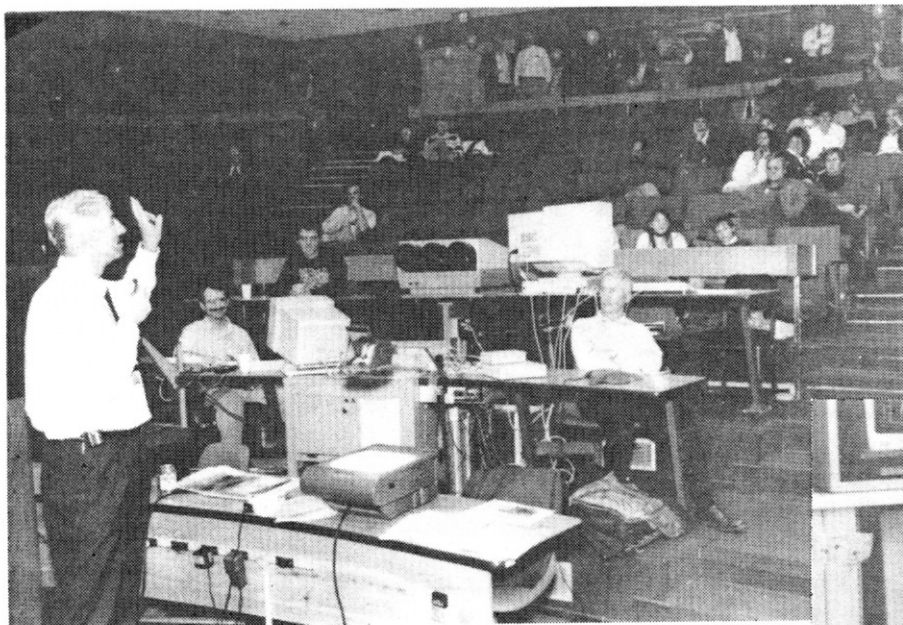


*Deputy Director Dale Meade shakes hands with former PPPL Director Harold Furth as Director Ron Davidson highlighted and acknowledged the important contributions of several key players throughout TFTR's history.*



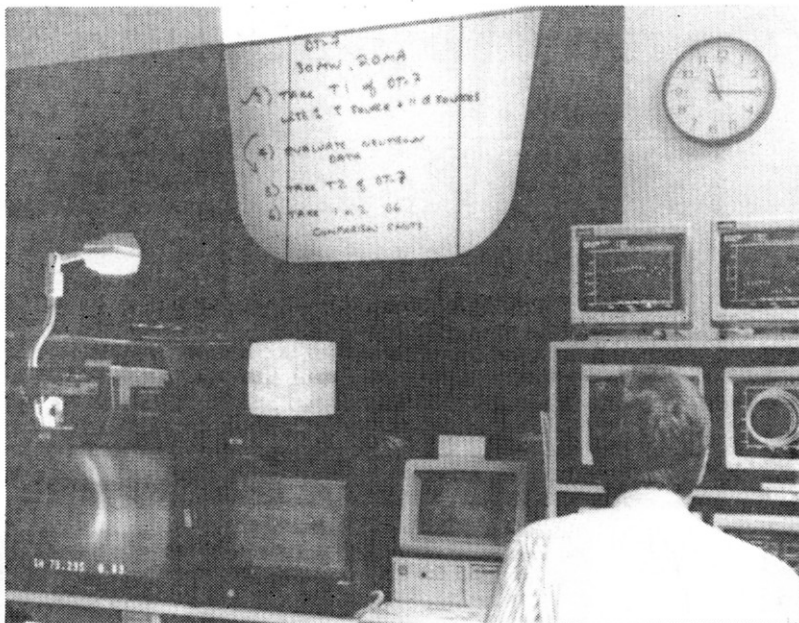
# High-Power D-T Experiments Achieved

*December 9, 1993—D-T Experiments*










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***December 10, 1993—News Conference***







## HOTLINE

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