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TFTR Hints at New Results

by Diane Carroll

Like all of us, TFTR is showing new signs of life after the breakup of the summer's heat wave. And with the advent of cooler weather, TFTR is providing some "hot" new results.

The sultry weather this summer affected more than our temperatures, tempers, and air conditioning bills. TFTR has had its problems staying cool, too. The water that keeps the MG sets and the neutral beams at operable temperatures was unable to lose enough heat on its trip through the cooling towers at D-Site. Normally, the water will reach a temperature of 81°F in less than a minute. But with the air temperature at 90° or more, coupled with high humidity, it was like trying to cool off in the Amazon jungle. Water System technicians, Tech Shop plumbers, and Geoff Gettelfinger worked hard to make modifications to improve this situation. But for several days the TFTR experimental pulses were run as infrequently as one every half-hour as compared to the normal pace of one every 10 minutes. So for physicists eager to collect data during the three weeks between maintenance periods, the long, hot summer was also a frustrating one.

The extraordinarily high demand for electric power throughout the Northeastern United States also conspired to slow the pace of experiments. On three separate days, PPPL was asked to "shed load," electric company jargon for turning off the power. The Laboratory receives a very favorable electric rate in exchange for agreeing to shut down TFTR when PSE&G is experiencing extremely high demand.

In spite of these delays, some excellent results were observed on a number of shots. The TFTR neutral-beam system has been working very well. Neutral-beam-heating power of 26 MW has been routinely delivered to the plasma, resulting in world-record neutron fluxes that are 50% higher than TFTR's previous record. The

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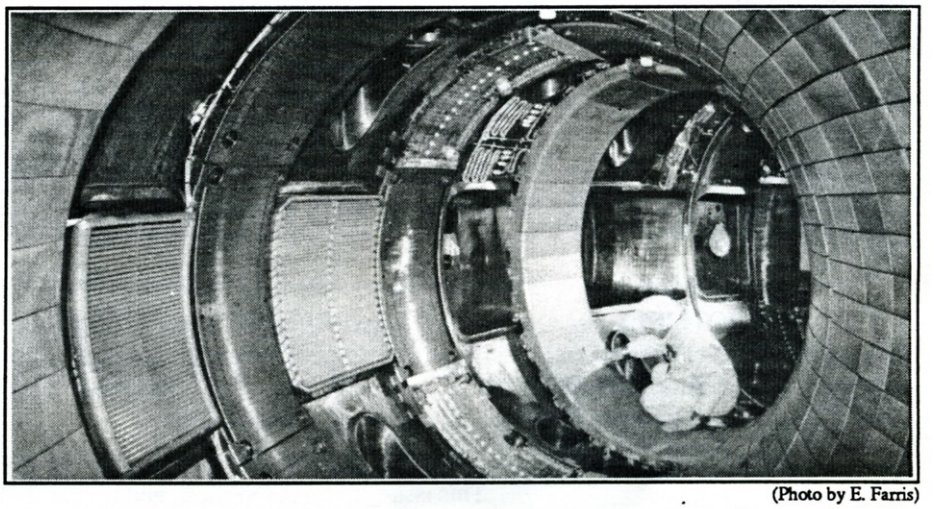
RF Limiter Troubles at Bay

by Diane Carroll

An initial difficulty during the present TFTR run has been the heat loading on the two radio-frequency (RF) limiters. Each limiter is a ring of 24 carbon tiles encircling the inside of the vacuum vessel in the poloidal direction. The limiters are designed to protect the RF antennas from contact with the plasma. Early in the run, physicists found that the limiters were getting hot, up to 1200°C, and they feared that if overloaded, the limiters would break, enter the plasma area and prevent the formation of any new plasmas. A lengthy vessel opening might be required to repair the damage.

After a great deal of analysis of the results of several diagnostics, physicists concluded that the excessive heat loading was occurring close to the bumper limiter and was caused by the plasma striking the RF limiters in an unanticipated location. The limiters were designed for perfectly circular plasmas, but in real life the plasma is slightly vertically elongated.

Mike Ulrickson, Ray Ritter and other members of the Engineering Analysis Division, along with Sandia Laboratory in Albuquerque and the Southern Research Institute in Alabama, did extensive studies of the limiter material to more accurately evaluate how much heat it can take. They determined that the carbon-carbon composite can operate at 2100°C. This allows full-power plasmas at a major radius of 2.5 meters, and somewhat less power for the largest plasmas at a major radius of 2.62 meters. Right now, the limiter is monitored with an infrared camera, and operations are somewhat restricted to to avoid stressing it. "We have been very pleased with the performance of the carbon-carbon composite," Ulrickson said.



(Photo by E. Farris)

Engineer George Barnes is shown inside the TFTR vacuum vessel working on the radio-frequency limiter.

TFTR

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Lawson parameter ($n\tau T$) is "the highest we've ever achieved," said Rich Hawryluk, TFTR Tokamak Operations Head. A major goal of this run, increasing the plasma current from the previous high for supershots of 1.0 MA, has been achieved. The supershots are now run at plasma currents of 1.4 to 1.6 MA.

The results are preliminary, and no one is quoting numbers yet, but these indications are a tantalizing hint of progress to come. The next step, accordingly to Hawryluk, is to determine the key ingredient or ingredients of the best shots, and then make them reliable and reproducible. "There seems to be some cumulative effect on conditioning of the machine that enables us to get better supershots," he said. The more plasmas physicists and engineers make, the more conditioned the walls get, and well conditioned walls are essential to good supershots.

Over the next weeks, physicists and engineers will be working to raise the neutral-beam heating power beyond 26 MW, add radio-frequency power up to 2 MW, and to "find techniques to make our best shots more frequently and better yet," said Hawryluk.

"We really are starting to break new ground," he continued. "One question we all have is how much further can we go? Overall we are aiming for a factor of about 1.5 improvement which would give a Q_{DT} (equivalent) of 0.5 — halfway to the goal of $Q \sim 1$. This would should give us some very exciting results for the International Atomic Energy Agency meeting (the Plasma Physics Olympics) in October. ✪

PPPL ORC Employee Opinion Survey Response

EDP Course Offerings Coming Soon

Employee Development Program (EDP) course schedules for the Fall/Winter semester will be mailed to all PPPL employees next week. More than 20 courses will be offered for this academic period. According to Charles Staloff and Bill Johnson, Co-Chairpersons of the EDP, arrangements are being finalized regarding instructors, classrooms, and class schedules.

Courses new to EDP include a math class that will bridge algebra to an introduction to calculus, a multi-disciplined class designed to strengthen office and related administrative skills, a class in Advanced Twin (an electronic spreadsheet), and an introductory course in the programming language "C."

The EDP will offer a course of study leading to either State certification as an Engineer-In-Training or to the professional engineering license. "This is a very different type of program, and perhaps the most ambitious thing we have tried to accomplish," explained Staloff. "We believe it will have a positive impact on the Laboratory."

As in past EDP terms, most classes will be offered during work hours or will split work time and lunch time with the employee. Normally, there is no cost to the employee; tuition, books, and instructor's fees are paid for by the Laboratory. "The study courses for either the Engineer-In Training or the professional license will be exceptions, as collectively their tuition costs exceed the intent of this Program," Johnson explained. "We are exploring other means to offset the tuition costs for those who complete these courses," he added.

The committees that recommend the courses to be offered are open to suggestions about courses that may be needed at the Laboratory. Employees with recommendations should contact Norm Fromm, Chairperson of the Subcommittee on General Education, or George Renda, Chairperson on the Subcommittee on Technical Education. ✪

Cafeteria Special

On Friday, September 9, the C-Site Cafeteria will feature a good old fashioned fish fry and clam bake. Included on the menu are:

Baked Clams
Fried Fish and Shrimp
French Fries
Cole Slaw

Free PPPL Reports

Free to good homes, old PPPL Reports dating back to 1979. Due to housekeeping requirements, Marilyn Hondorp, Room B375, C-Site must part with excess file copies of old reports. Until September 16, or while the supply lasts, all interested employees may retrieve reports of their choice. No rain checks will be issued! ✪

We Need You!

Remember, the American Red Cross Penn-Jersey Blood Services' Bloodmobile will be at PPPL Thursday, September 8. Blood reserves are low. Let's help make sure blood is there if we need it. Sign up today to give!

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