Fusion gains ground with new tokamaks

Groundbreaking ceremonies for the first "working" fusion reactor in the United States were timed almost identically with the announcement of the Culham, England, site for its cousin, the Joint European Torus (JET), last week. Both are tokamaks (a Russian acronym for toroidal magnetic chamber) shaped like thick doughnuts (SN: 11/27/76, p. 340). The U.S. version, called the Tokamak Fusion Test Reactor (TFTR), is expected to mark a transition from theoretical and laboratory work to tests and development of fusion power. If it operates as designed, TFTR will be the first such reactor to create "a significant amount of energy."

TFTR will operate in pulses, producing enough energy from each to boil a gallon of water; it will not generate electrical power. Each pulse will last several seconds, long enough to initiate the proper atmosphere, burn its fuel and liberate the energy of fusion, carried away and measured by neutrons. The reactor is designed for break-even energy production. That is, the fusion-energy output should equal or exceed the huge quantities of energy needed to heat the plasma and initiate the reaction. In contrast, JET will concentrate on complementary physics problems such as plasma contamination, control of current density, electron losses and low-collision rates, and uncertainties regarding how best to heat the plasma. TFTR is scheduled for completion in June 1981 at a total cost of about $228 million, JET in 1982 or 1983 at a cost of $180 million (which unlike the TFTR figure, does not include escalation and contingency allowances).

The major difference between the two reactors is fuel: TFTR will inject an intense deuterium beam onto a (radioactive) tritium target; JET is using hydrogen and deuterium. The large quantity of neutrons produced in TFTR as a result of using tritium will radioactively contaminate the reactor, requiring that all handling and maintenance be done remotely. This is indicative of a real operating fusion environment.

Another difference is the cross-section configuration of the plasma. JET is designed to use a D-shaped plasma, TFTR a circular one. According to Edward Frieman, associate director of Princeton University's Plasma Physics Laboratory, theory predicts that a D-shaped plasma will achieve a higher beta value—the ratio of plasma pressure to magnetic-field pressure. Since this is essentially a measure of the balance between the plasma's natural attempt to escape its magnetic confinement and the pressure of the magnetic field to contain it, the higher the beta value the better. Frieman says that since the D-shape advantage lacks laboratory proof, Princeton is taking a "more conservative" approach, using a circular cross-section. Either reactor can be altered, however, to run a plasma of the opposite configuration, he says.

In the other major aspects, namely radius, current, working temperature and ion density, both reactors will be essentially equivalent, Frieman says.

According to THE ENERGY DAILY, a Washington newsletter, two years of fierce and competitive haggling among the nine participating members of the European Community over where to situate JET has ended in a compromise. JET's first phase will take place in England, but the second phase, JET II, may still end up at the runner-up site, Garching, West Germany. □

Lung cancer: A status report

Lung cancer, the leading cancer killer of men and the second leading cancer killer of women in the United States, is one of the swiftest-acting and most lethal forms of malignancies. Eighty percent of its victims die within two years after diagnosis, and 50 percent of them within only six months. Nonetheless, some modest progress is being made toward conquering lung cancer, reported John D. Minna of the National Cancer Institute and of the Washington Veterans Administration Hospital last week at a National Institutes of Health science writers' seminar on lung diseases.

Successful treatment of lung cancer, Minna explained, first depends on diagnosing the disease before it has spread far in the lungs or into other parts of the body, and some inroads are being made in this area. Preliminary results from screening programs at Johns Hopkins University, the Mayo Clinic and the Memorial Sloan-Kettering Cancer Center show that annual chest X-ray exams coupled with tri-annual deep-cough sputum exams of high-risk persons (individuals age 45 or older who smoke at least a pack of cigarettes a day) can detect lung cancer very early.

In another area of advance, the lives of patients with one of the four kinds of lung cancer—small cell anaplastic carcinoma—are being extended considerably with chemotherapy, Minna continued. (Chemotherapy, rather than surgery or radiation, is usually used in the treatment of this especially rapidly spreading cancer.) Small cell anaplastic carcinoma patients at various U.S. medical centers are receiving a combination of eight different drugs. Formerly, they would have been expected to die within three months after diagnosis, but now they are living a year or even 18 months, and a small number are even remaining disease-free for several years.

Less progress is being made in extending the lives of patients with the other three kinds of lung cancer—epidermoid carcinoma, adenocarcinoma and large cell anaplastic tumors—Minna reports. Such patients are now receiving better preoperative evaluations than they used to in order to determine whether their lung cancer is localized and whether they should undergo surgery for it. Deaths during such surgery have been reduced (although patients still have a 10 percent chance of dying on the operating table). Better postoperative care is being provided than before. Patients with these kinds of lung cancer are also receiving drugs or drugs with radiotherapy that are helping them survive several months longer than previously.

Recent innovations in computer science and nuclear medicine may also soon help lung cancer patients, Minna anticipates. For instance, Bruce R. Line of NIH and his colleagues can now tag the air and blood in a person's lungs with short-lived radioactive tracers. Gamma rays emitted from the tracers are measured by a gamma camera, visualized by scintigraphic imaging equipment, then transmitted to a computer, which constructs pictures of 1,500 different air and blood spaces in the lung. (Present nuclear medicine methods cannot visualize the lungs on such a regional basis.) Such a technique, Minna believes, will eventually be used on lung cancer patients to determine whether their cancer is still localized and, if so, where, and thus what treatment to use.

Cell biology advances may also benefit lung cancer patients in the not-so-distant future, Minna predicts. For instance, Rosalyn S. Yalow, Nobel laureate at the Veterans Administration Hospital in the Bronx, N.Y., has discovered that adrenocorticotropic hormone (ACTH) is present in the bloodstream of lung cancer patients in abnormally large amounts. Studies sponsored by the VA are now getting underway to see whether a blood test for ACTH might be used to diagnose lung cancer in its earliest stages.

Minna and his co-workers can also now grow human small cell carcinoma cells in the test tube, thus providing a vehicle for the rapid testing of new drugs against this form of cancer. □

Last shuttle drop test

The space shuttle Enterprise made its last scheduled test landing on Oct. 26, descending from its 747 "carrier" to a bumpy touchdown on a 15,000-foot runway in California's Mojave Desert. The next shuttle to fly on its own will be the one taking off for earth-orbit in the spring of 1979. Last week's test was the first to use a runway for the landing and the second to be conducted without the turbulence-reducing "tailcone" that formerly covered the craft's main engine nozzles. (Removal of the cone approximately doubles the drag on the vehicle.) The next major activity for the shuttlecraft will be vibration tests at NASA's Marshall Space Flight Center in Alabama, set for next March. □