DOE to Consider FFTF for Tritium, Medical Isotope Production

The Department of Energy (DOE) will decide in 1998 whether to conduct a National Environmental Policy Act (NEPA) review of the impacts of restarting and operating the Fast Flux Test Facility (FFTF) at the Hanford site in Richland, WA, for tritium and medical isotope production. A NEPA review would be the first step necessary to restarting FFTF. If the DOE decides to return the 400-MW liquid-sodium-cooled reactor to service, its primary mission will be to produce tritium as an interim source to replenish that in the U.S.'s stockpile of nuclear weapons. The DOE estimates that FFTF will provide about 1.5 kg per year of tritium, a radioactive isotope that decays with a half-life of 12.3 years.

FFTF's secondary mission would be to produce isotopes for diagnostic and therapeutic medical applications. It is this secondary mission that interests the Nuclear Medicine Research Council (NMRC; Richland, WA). "We believe that FFTF could be a significant source of isotopes," says Marc Garland, president of NMRC. NMRC, a group of scientists, engineers, government officials, physicians, cancer survivors and others, was created 3 years ago to promote nuclear medicine and other beneficial applications of radioisotopes, especially cell-directed radiation therapy for cancer.

FFTF is owned and operated by the DOE at the Hanford site. Contributing to the FFTF medical isotope project is Pacific Northwest National Laboratory (PNNL), which performs research and development at Hanford and is operated for the DOE by Battelle Memorial Institute. FFTF, the highest powered research reactor in the U.S., began operation in 1982. Its primary mission was to test fuel assemblies, control rods and other core components for the government's liquid metal ("breeder") reactor development program. FFTF, however, is not a breeder reactor. It also performed isotope production tests and produced about 39 different isotopes, ranging from tracer quantities to thousand of curies. Although the U.S. breeder reactor program was discontinued in the early 1980s, FFTF operated as a multimission reactor until late 1992. At that time the reactor was placed on standby and prepared for deactivation The fuel was removed and stored nearby.

"It's, in our view, a situation where 10 years from now this nation could be in a terrible crisis for medical isotopes," said Thomas Tenforde, senior chief scientist and site manager of the Hanford Isotopes Program, "having to rely perhaps on European sources for isotopes that we should have available in the U.S." According to Tenforde, FFTF would not compete directly for existing isotope business. "What we are proposing to do is to produce the isotopes that are most difficult for those other reactors to produce."

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FFTF Characteristics

FFTF has many design characteristics that are beneficial for isotope production. Its liquid sodium coolant does not "moderate" (i.e., slow down) or absorb neutrons the way the water coolant in light-water-power reactors does, so FFTF has the very high neutron energy needed to make some isotopes. The neutron energy spectrum can be locally moderated to the energy needed to maximize production of a specific isotope. "In the same irradiation cycle," says Tenforde, "you have the potential to make isotopes that require high-energy neutrons and at the same time make the isotopes that are peaked for production at low energy."

FFTF is the only sodium-cooled, fast reactor in the U.S. It has a power of 400 MW, with a peak flux of 7.2×10^{15} n/cm^2 sec. Other isotope-production reactors in the U.S. have less power and flux to work with. The Advanced Test Reactor at Idaho National Engineering and Environmental Laboratory has a power of 250 MW and a peak flux of 1.8×10^{15} n/cm^2 sec. The High Flux Isotope Reactor at Oak Ridge National Laboratory has a power of 85 MW and a peak flux of 4.4×10^{15} n/cm^2 sec. FFTF's neutron energy spectrum peaks at 1 MeV, while the spectra of neutrons in thermal reactors, such as the commercial light-water reactors in the U.S., peak at 1–1000 eV.

The other characteristic that makes FFTF especially suited to isotope production is its large target volume. High neutron flux combined with large target volume means that FFTF is capable of producing isotopes in greater quantities and with higher specific activity than isotopes from most other U.S. reactors. Tenforde described specific activity as the ratio of radioactive atoms to nonradioactive atoms in the isotope sample. "When you're doing radiolabeling of monoclonal antibodies or peptides for injection into patients for targeted radiotherapy of cancer, it's critical that the isotope that's being attached to the antibody carrier have a very high specific activity. The high specific activity is very sought after and very difficult to achieve with low-power reactors."

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of the Administrative Procedure Act.

In response to this decision, the Justice Department has filed a motion to vacate the ruling on the grounds that the passage of the PET provision in the Food and Drug Administration Modernization Act of 1997 (S. 830) renders the case moot. If the ruling is vacated, the following effects may be felt by the nuclear medicine community.

Because the decision by the appeals court validates the actions of PET facilities not complying with the FDA's policy statements and final rules from 1995 to 1997, removal of the appeals court decision makes those actions illegal and subject to potential liability lawsuits or action by the FDA. Observers consider this result unlikely.

Since the decision also indirectly protects the nuclear medicine community from facing internal change to the 1984 nuclear pharmacy guideline by the FDA without appropriate notice and comment, the result might be to lose the guiding document for FDA jurisdiction over radiopharmaceutical compounding.

ACNP/SNM, along with the APhA and Syncor, has filed opposition to the government's motion. Alvin J. Lorman of Mintz, Levin, Cohn, Ferris, Glovsky, and Popeo, PC, will continue to represent the group.

—David Nichols is the director of the ACNP/SNM government relations office.

FFTF

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Future of FFTF

Restarting FFTF as an interim source is being considered by the DOE to supplement its longer-term dual-track strategy for producing tritium. As part of a dual-track strategy, the DOE is evaluating proposals to make tritium either by building a new accelerator at the Savannah River site in Aiken, SC, or by leasing or buying a commercial power reactor to provide irradiation services and electricity production.

The DOE announced on January 15, 1997, that it was maintaining FFTF in standby mode until it decided whether the reactor could play a role in the Department's tritium production strategy. In hot standby, Hanford is making sure that there is no degradation of key FFTF systems. The reactor is currently defueled, but the liquid sodium is still flowing through the cooling system, and essential systems, staffing and support services are being maintained.

Under the plan being evaluated by the DOE, three core positions would be made available for the production of medical isotopes. "What we've been doing is calculating the amount of 30 different isotopes that we could make using just those three assemblies of the high-flux region of the reactor," said Tenforde. "I was surprised. The production rates, even of isotopes that have relatively small cross-sections, is sufficiently high that it would certainly justify including a medical isotope mission along with a tritium mission."

Part of the technical situation being considered by the DOE is the fact that the ideal cycle for producing tritium is a fairly long 100 days, which is much too long for some short-lived medical isotopes of interest. PNNL and its engineering collaborators are working on a design for a rapid retrieval system that would allow operators to insert and remove short-lived medical isotope target assemblies with the reactor at full power. Under the plan being evaluated, FFTF could be restarted by mid-2002.

The FFTF Standby Project Office (SPO) finished an evaluation of the technical and economic feasibility of future FFTF operations and delivered it to the DOE's Office of Nuclear Energy, Science, and Technology in December 1997. According to the SPO, this report includes a technical information document covering environmental issues associated with restarting FFTF, a technical database and tritium production analysis, a life-cycle cost estimate and mode for FFTF restart and operation, a systems engineering document assessing critical interfaces and a feasibility report on medical isotope production. The NMRC and many of the professionals at Hanford believe strongly that FFTF can make an important contribution to medicine and medical research. They are working to convince the DOE of the value of such a contribution.

The DOE plans to select one of the dual-track options in December 1998 as the primary, long-term source of tritium, with the second option to be maintained as a backup.

—Allen Zeyher