NRC Targets University Reactors

They may be ordered not to use weapons-grade fuel; researchers claim conversion could be financially and scientifically costly

This spring, more than 20 American universities may be asked to help reduce the traffic in bomb-grade uranium by converting to low-grade fuel in their research reactors. The Nuclear Regulatory Commission (NRC) wants the universities to lead the way now in order to bring U.S. reactors in line with a policy it is trying to impress on foreigners. Although the government may pick up the tab, which the universities say will be around $15 million, researchers argue that the fuel switch could cause financial, political, and scientific difficulties.

Universities use only 10 percent of the bomb-grade fuel produced each year for research purposes. The rest is shipped to research centers abroad (50 percent) and to federal laboratories (40 percent) run by the Department of Energy (DOE). DOE has no plans to convert its reactors, however. The NRC's action would thus affect only the smallest portion of the traffic in high-enriched uranium (known as HEU).*

Until now, the universities have dodged the plea for changing fuels, saying it is technically too hard to satisfy. But there is another, nontechnical reason for inertia, an objection that is strongly felt but not always clearly expressed. "You have to understand campus politics," says one college official. Switching fuel will draw attention to the finances of nuclear physics departments, some of which fear they could lose a reactor if this change shows up as a big expense.

The new policy could embarrass universities in another way, by dragging them into relicensing hearings at NRC, the federal arbiter of atomic power issues. For example, the University of California at Los Angeles (UCLA) has been struggling for several years against a local campaign to block the relicensing of its reactor. The NRC staff says it plans to write a "generic" rule on fuel conversion so as to avoid case-by-case public hearings. But university officials wonder whether the NRC can really guarantee this kind of protection.

Foreign researchers also cite the technical excuse for not switching fuels, saying they dare not embark on anything until they know it works. Recently, however, scientists at the Argonne National Laboratory in Illinois have designed and tested low-enriched fuels that appear to be good substitutes for the high-grade cores that have become popular since the mid-1960's. (Before then, universities and foreigners were not given bomb-grade fuel.) Workers at Argonne say they are getting excellent cooperation from abroad and some foreign governments are ready to certify the safety of the new fuels. Thus the technical barriers are falling.

As this happens, the NRC is finding that it must change its own attitude. In 1982 the NRC voted to "encourage" a switch from HEU to low-enriched uranium (LEU) in domestic reactors. As a result of the success at Argonne, this policy is going to be hardened from encouraging to ordering fuel conversion. The NRC staffer in charge, Charles Kelber, says the staff has been asked to come up with a proposal by the end of March. As he sees it, the question is whether to insist that the switch to LEU be made immediately, or to allow a delay until after fuel in storage has been exhausted. There is a big difference in cost, for the first option would mean throwing out millions of dollars worth of existing HEU fuel plates.

> The policy is going to be hardened from encouraging to ordering fuel conversion.

The campaign to reduce the traffic in bomb-grade uranium has a long history punctuated by two recent events. One was the passage in 1978 of the Nuclear Non-Proliferation Act, which tightened controls on international nuclear commerce in an effort to slow the spread of bomb-building capability. The second event was Israel's destruction of a research reactor in Iraq in 1981, carried out, Israel claimed, to prevent Iraq from acquiring technology which it would use clandestinely to build nuclear weapons. The bombing was carried out after Iraq refused to accept LEU from France and insisted on having HEU. Although the charge was never proved, Israel's attack left the impression that there were gaps in the uranium control system—specifically, at research reactors.

The International Atomic Energy Agency tried to reassure the world that this was not so and stepped up its uranium safeguards program. Research to find a substitute for HEU continued, with the NRC endorsing a policy on fuel conversion in 1982 and beginning work on a specific rule in 1983. Finally in December 1983, the NRC heard a report from the universities and other licensed users of bomb-grade fuel on the feasibility of fuel switching.

Donald Harris, director of the reactor at the Rensselaer Polytechnic Institute in New York, headed a group hired by the NRC to report on the impacts of a new rule. NRC staff members realized they were asking an interested party to give a disinterested paper, but wrote, "The staff knows of no other practical way to develop the knowledge . . . and feels that, with the independent basis generated by DOE . . . there is sufficient basis to render a dispassionate synthesis of the information." The conclusions of Harris' group were discouraging. A general order to switch to LEU would cost on average $500,000 to $600,000 per reactor, endanger the future of some university programs, waste fuel elements, possibly retard U.S. researchers in relation to their peers abroad, do little to reduce HEU traffic, and, in a few cases, lower the quality of experimental work that could be performed.

Shortly afterward, on 28 January, the NRC heard from citizen groups who believe the universities should not be let off the hook. The speakers were Paul Leventhal, president of the Nuclear Control Institute, former bomb designer Theodore Taylor, and Daniel Hirsch, president of the Committee to Bridge the Gap, the California-based group that has objected to the relicensing of UCLA's reactor.

Taylor said there is "no excuse whatsoever" for HEU to be used on campus. "HEU should be prohibited except under conditions that I would say are extraordinary [national defense work]. The prohibition should come first and the exception should come later. No research facility should have a quantity of HEU sufficient for building a weapon

*The term HEU usually refers to fuel containing 93 percent of the fissionable isotope, uranium-235, while low-enriched fuel (LEU) contains only 20 percent. It is possible, but more difficult to make an atomic bomb with LEU, and the weapon "would have to be delivered in a truck," one physicist says.

under any circumstances for any purpose." It is possible to make a bomb with less than a kilogram of HEU, depending on the "talents and experience" of the designer, he added.

According to Taylor, 12 U.S. research reactors are authorized to store more than 4 or 5 kilograms of HEU, ranging in the highest instance to a limit of 45 kilograms. He doubted that campus burglar alarms give enough protection, since a black marketeer or terrorist might be willing to pay $100,000 to obtain a credible bomb threat. A blackmailer need only send authorities a small amount of HEU to make his threat credible. In view of this risk, Taylor said, "there is no crucial research at university reactors of which I am aware that would require weapons-grade uranium."

Leventhal reminded the commission of the importance of setting an example for users of HEU outside the United States, mentioning that the issue of "even handedness" came up last November at an international meeting on HEU held in Japan. The United States exported 23,590 kilograms of HEU to 43 nations through 1982, he said, representing an impressive potential bomb capacity.

Hirsch attacked the Harris report on several fronts, saying that its cost estimates were two times too high, that fuel conversion could take place in a matter of weeks rather than years, and that the change would not restrict research. The total cost of the conversion, Hirsch calculated, should be between $5 and $7 million, not $15 million. (Kelber agrees that the universities may have overstated their needs, adding he might do the same if he were as desperate for funds.)

It appears that the agency's staff will recommend a broad, rather than a narrow, order for conversion. Two or three special cases are likely to be exempted for a time: the reactors at Massachusetts Institute of Technology (MIT), the University of Missouri at Columbia, and the National Bureau of Standards. Directors of these reactors argue that their very high emittance machines cannot be converted to LEU at this time without great expense and considerable loss in experimental value. The Bureau of Standards says that its problem is that even if LEU fuels are developed, they will have a higher noise-to-signal ratio in the neutron spectra of interest, degrading the quality of information that can be obtained. MIT and Missouri seek a delay simply because there is no suitable fuel available at present for their reactors.

The Bureau of Standards is likely to be let off the hook altogether, partly on the rationale that it has better security than a university could afford. MIT and Missouri will probably be allowed to wait until further research on LEU fuels has been finished, perhaps until the end of the decade. But the others probably will be given some deadline for conversion, contingent on federal aid. DOE's research reactors, which are self-regulated, may not have to make any changes.—**ELIOT MARSHALL**

No Fraud Found in Swiss Study

An international commission has found "no compelling evidence" that Karl Illmensee, a researcher at the University of Geneva, fabricated data in a series of experiments he conducted in 1982. The commission was established after three of Illmensee's co-workers had questioned the veracity of some of his reported results (*Science*, 3 June 1983, p. 1023). Illmensee remains on the faculty of the university.

The work under investigation involved transplanting nuclei from cancer cells into fertilized mouse eggs whose own nuclei had been removed. Illmensee had previously gained considerable attention for similar experiments performed in collaboration with Peter Hoppe of the Jackson Laboratory, in which mouse embryo cells were transplanted into enucleated eggs from which normal mice developed. It was the first time such nuclear transplantation had been achieved successfully in mammals.

In a statement drafted in October 1982, Illmensee's co-workers challenged experiments that he carried out in July. Their chief charges were that fewer embryos were available than were reported by Illmensee, and that microsurgery equipment was apparently not used during a weekend when Illmensee claimed to have done a series of nuclear transfers. They also said they did not remember seeing Illmensee in the lab in April, when he said he did an earlier set of experiments. (The experiments have not been published, but the results were presented at a scientific meeting in September.)

Their statement was given to the Dean of the Faculty of Sciences at the University of Geneva in February 1983, but the university did not give a copy to Illmensee or take official action on it until June. It then appointed a commission consisting of three Geneva faculty members, plus Pierre Chambon of the University of Strasbourg, Richard Gardner of Oxford University, and Anne McLaren of the University of London.

The commission took evidence from Illmensee and his accusers and examined all the records. Illmensee offered explanations for the charges, and the commission concluded that the allegations were "inadequately supported and cannot therefore be taken as convincing evidence that Professor Illmensee had fabricated this series of nuclear transfer experiments."

The commission pointed out that the July experiments gave poorer results than those conducted in the three preceding months and "It is therefore unlikely . . . that the July experiments only were fabricated." But fabrication of the entire 4-month series would have been a formidable task, thus "Some members of the Commission felt that a major deliberate fabrication of this type . . . was implausible and inconsistent with the large number of random minor errors detected in the protocols." However, "Other members of the Commission took the view that a close examination of the experimental protocols did not enable them to find any compelling evidence supporting or refuting conclusively the hypothesis that some or all the experiments were fabricated."

The commission did agree, however, that Illmensee's records "contained numerous corrections, errors and discrepancies" that "throw grave doubts on the scientific validity of the conclusions." It urged that the experiments be repeated "as a collaborative project with full scientific rigor."

Although the earlier work with Hoppe was not contested by Illmensee's co-workers, the commission looked into it and found "no reason to doubt the authenticity of these experiments." A committee set up by the Jackson Laboratory reached a similar conclusion last year. The commission noted, however, that the results have not been replicated and urged Illmensee and Hoppe to repeat the experiments.—**COLIN NORMAN**