

DOE and universities oppose reducing U^{235} in campus reactors

Three months before the Olympics began in Los Angeles last summer, UCLA announced that its 100-kW Argonaut research reactor would be shut down during the games to avoid any acts of vandalism or terrorism directed against it. The reason for UCLA's concern: The reactor core contains 3.56 kg of uranium enriched to 93% of uranium-235, which is the enrichment level for weapons. In August, UCLA officials decided to close down the reactor permanently, not because it was a target for terrorists but because of worries about meeting the requirements of the Nuclear Regulatory Commission.

The decision was based on the implications of a proposed rule change the NRC published in the Federal Register on 6 July, requiring those research reactors at university campuses and corporate centers that use highly enriched fuel to convert to low-enriched fuel containing less than 20% uranium-235. High costs and long delays involved in converting the fuel and relicensing the reactor are too much to handle, UCLA administrators figured, especially with the nuclear science department already having trouble recruiting graduate students. On campus since 1960, the reactor was shut down once before for changes. What's more, UCLA has experienced four years of hearings and paperwork for a license renewal, over objections from anti-nuclear groups and environmentalists, at a cost to the university of \$500 000 in legal fees.

Costly conversion. So far, none of the other research, testing and training reactors with highly enriched uranium have followed UCLA's action. Throughout the US, high-enriched uranium is used to fuel 69 nonpower research reactors, with the Department of Energy operating 36, which account for about 90% of weapons-grade fuel. DOE estimated in 1978, during Congressional hearings on the Nuclear Nonproliferation Act, that it would take two years and some \$10 million to convert all research reactors from high-enriched to low-enriched uranium. Since then, DOE has spent about \$24 million on its Reduced Enrichment Research and Test Reactor Program and reckons another \$24 million more will be needed to develop new

UCLA reactor for research and training is shut down rather than converting it to use low-enriched uranium fuel.



fuel elements with low-enriched uranium in aluminide, oxide and silicide plates or zirconium-hydride rods. The new elements are under development in France, West Germany and the US, mainly at Argonne National Laboratory. The 2000-kW Ford Reactor at the University of Michigan has already been converted to a uranium-aluminide fuel with 20% enrichment as part of a DOE-funded demonstration of what can be done for campus reactors. Still, the cost of converting all the high-enriched plate-type university reactors and four of 25 rod-type university reactors with enrichments of 70% is variously estimated by the National Association of State Universities and Land Grant Colleges as totaling \$8 million to \$35 million.

At hearings before two House energy subcommittees on 25 September, A. Francis DiMeglio, director of the University of Rhode Island reactor and chairman of a national organization of research reactors, said the estimated cost of conversion did not include expenditures for relicensing; but, even so, "while something like \$76 million may not seem a large amount of money to members of Congress in terms of non-power reactors, it is sufficient to keep dozens of them running many years."

NRC and State Department officials claim the new rule is necessary for two reasons: to reduce the risk that weapons-grade uranium could be stolen

from storage or in shipment at university facilities and turned into a nuclear explosive by some foreign government or terrorist group, and to set an example to foreign countries to convert their small nonpower reactors to low-enriched uranium fuel. The end result in both cases would be to reduce the worldwide threat of nuclear weapons proliferation.

Currently there are 137 research and test reactors using high-enriched uranium in 34 countries in the Western bloc. In the US, high-enriched U^{235} is used to fuel 36 DOE research reactors, three at other government agencies, 25 at universities and five at commercial firms. Only the NRC-licensed reactors at universities, companies and the National Bureau of Standards would be affected by the new NRC rule because reactors located at national laboratories and government facilities are not licensed by the agency and presumably have stricter security precautions. The NRC Advisory Committee on Reactor Safety has suggested that the conversion to low-enriched uranium be made "in a gradual and orderly manner as funds and fuels become available" and that operators have the option of converting or retaining high-enriched fuel and meeting security requirements. While two university reactors, at MIT and the University of Missouri, would not be exempt from the rule, they may be granted a delay in implementation

because the design of their fuel cores and heat-transfer systems does not permit conversion with fuel elements now available.

The US is responsible in part for the situation. Under the Atomic Energy Act of 1954 the government encouraged universities to build research reactors to train scientists, engineers and technicians. In the early 1960s the US exported low-enriched uranium for research reactors abroad as part of the "Atoms for Peace" program. As greater power levels and neutron fluxes were needed to perform new experiments, the quantity of U^{235} was stepped up, either by using fuels of high uranium density or by increasing uranium enrichment. The Nuclear Proliferation Act of 1978 was intended to reduce high-enrichment inventories both at home and abroad as a principal way of decreasing the risk of weapons-grade uranium from falling into the hands of agitators and adversaries.

At the 25 September hearings before the House Committee on Science and Technology, arguments were presented against the NRC rule. "I believe the evidence is compelling," said Edwin L. Zebroski of the Electric Power Research Institute, "that a number of research reactors are likely to cease operation and cease to be available for training, research, testing or the production of radioisotopes for research and medicine" if the rule is imposed. "Our society—and with it our regulatory, legislative and judicial establishment—is in considerable disarray on how to define or specify 'how safe is safe enough'... The proposed rule on conversion is an apparent attempt to reach an objective the NRC uses in the phrase 'preferably zero risk.'"

No known threat. Safety and security measures, including increased physical barriers to access, alarms, guards and television monitoring systems, have been upgraded in the past few years, said Zebroski. Indeed, NRC staff testified that there has never been an attempted theft of fuel at a research reactor facility in the nearly three decades that they have been running and that no known threat exists.

For DOE, James S. Kane, deputy director of energy research, observed that if as much unirradiated fuel as possible were to be stored at secure DOE facilities, "theft or diversion ceases to be an issue. We have never considered the diversion of irradiated fuel to be an issue. The difficulties in surreptitiously handling a highly radioactive element, plus the technical and financial resources needed to separate the uranium in sufficient amount for a nuclear device, make such threats, if any, extremely remote. Our main disagreement with the proposed rules centers on the treatment of reac-

tors that have essentially a lifetime supply of fuel. It is worth noting that the US government is not seeking the conversion to low-enriched uranium of foreign reactors with lifetime cores. With the exception of the four 1-MW TRIGA reactors at Texas A&M, Washington State, Oregon State and the University of Wisconsin, which use a different type of fuel with 70% enrichment, our research reactors are low powered with in-core inventories of less than 5 kg of U^{235} . The total amount of high-enriched uranium currently in storage at all of these reactors is less than 15 kg." So, to gather enough U^{235} for a workable weapon would require the theft of all the fuel in storage either simultaneously or in rapid succession. "That is extremely improbable," said Kane.

'Negligible benefit.' Kane went on to observe that DOE holds university reactors to be "very important" in training nuclear physicists and chemists, as well as reactor engineers and technicians. "If conversion of all US university reactors is mandated," he said, "some are almost certain to be shut down. For negligible benefit, we will have lost a valuable nuclear training and research capability."

Congress enacts peace research institute

A National Academy of Peace is an old idea whose time has come at last. Ironically, though, a variation on the idea came in an amendment buried in the last big spending bill of the 98th Congress, the Omnibus Defense Authorization Act of fiscal 1985. Under it, the nation's military programs will get \$297 billion for the year, while the new Federal agency will receive \$16 million for peace research and training over the next two years, with \$4 million provided during fiscal 1985.

The concept of a government institution dedicated to the study of resolving conflicts through peaceful means dates back to 1793, when Benjamin Rush, a prominent physician and signer of the Declaration of Independence, proposed a US Peace Office. Just about the only backer of Rush's idea was Benjamin Banneker, a black mathematician. In the 20th century, Senator Matthew Neeley of West Virginia introduced a bill in 1935 for a Federal department that would advance nonviolent alternatives to hostilities among nations and peoples—in contrast to the activities practiced by the existing War Department. Since World War II, nearly 150 bills have come before Congress from prominent members of both major political parties to create some form of peace department or academy.

Of those reactors that comply with the low-enrichment order, argued Robert S. Carter, chief of the Reactor Radiation Division at the National Bureau of Standards, their beam intensities would be decreased by 10%–15% and undesirable radiation would increase by a similar amount. Reducing the enrichment from 93% to 20% implies, whatever the fuel type, adding 10 kg or more of U^{235} to the reactor core. While studies of core physics show this is feasible, there is marginal loss of fast neutrons and substantial loss of thermal neutron flux, according to Carter. Accordingly, performance of some campus and commercial reactors would decrease.

For his part, DiMeglio told members of Congress that the expense of converting university reactors, presumably to be funded by DOE, "will have no discernible education benefit." DOE now provides about \$200 000 per year for the use of university reactors. The \$8 million to \$15 million to implement the new rule could be spent more productively to upgrade obsolescent university laboratories, he observed, "which would have a major effect on improving the quality of science and engineering in this country." —IG

Until now, those proposals have met quiet deaths on Capitol Hill. Many politicians and academics thought of the idea as pie-in-the-sky. Some feared that any peace agency would be a haven for pacifists or crackpots and that it would send a signal of weakness to foreign adversaries. Other opponents claimed the US already had three peace academies—West Point, Annapolis, and the Air Force Academy.

Wishful thinking. Many of the same arguments continue to be made. The most recent bill, introduced in 1983 by Senator Spark Matsunaga of Hawaii and 51 Senate colleagues, was opposed by the Reagan administration on the grounds that it would increase the already massive budget deficits and that its job is being done by the State Department and Arms Control and Disarmament Agency. David Stockman, director of the Office of Management and Budget, informed Congress last year that ACDA already serves "as the primary source of governmental assistance to studies in the area of international peace and understanding." A small band of senators led by Dan Quayle of Indiana and Jeremiah B. Denton of Alabama, called the proposal "flawed in concept, lacking in definition, entailing large expenditures for few benefits, duplicative of activities