DOE Pushes Case for New Defense Reactors

It says they are needed to ensure adequate tritium production. Critics challenge the assumptions, while engineering companies push to build two new facilities

THIS WEEK the Department of Energy (DOE) is expected to announce its choice of a site for one, and perhaps two, new reactors to produce tritium for nuclear warheads. The announcement is sure to set off a broad debate in the coming months about the need for tritium supplies, the appropriate production technology, and the merits of using this project to demonstrate advanced reactor designs that electric utilities might eventually adopt.

The construction of a new production reactor, according to the department, is an "urgent" need. DOE says it must be completed within the next decade to ensure that the nation has a reliable supply of tritium, which is used in nuclear warheads to boost their explosive yield. Stocks of the isotope are required not only for new warheads but also for periodic refills of tritium reservoirs in existing warheads because the isotope decays at a rate of 5.5% a year.

Tritium presently can be produced at the P, K, and L reactors at DOE's Savannah River, South Carolina, weapons materials complex. The plants also have been used to produce weapons-grade plutonium. If operated at full power, 2500 megawatts, just one of the 32-year-old reactors could fill the government's current tritium orders. But safety questions raised by the National Academy of Sciences* have forced the department to operate the reactors at half power.

At issue is whether the emergency core cooling systems in these plants, even after upgrading, will be adequate to cope with a catastrophic event such as an earthquake. There are also doubts about the how long the stainless steel reactor tanks will last. A similar reactor at Savannah River, the C reactor, was shut down in 1986 because of cracks that developed at weld joints.

These concerns are behind DOE's drive to build at least one new production reactor, an undertaking that will cost at least several billion dollars and some say as much as $10 billion. The department's Energy Research Advisory Board (ERAB), a group of scientists, engineers, and industrialists that reviews DOE programs, backed building a new reactor earlier this month,† stating that it "is convinced that it is urgent for DOE . . . to acquire new production capacity."

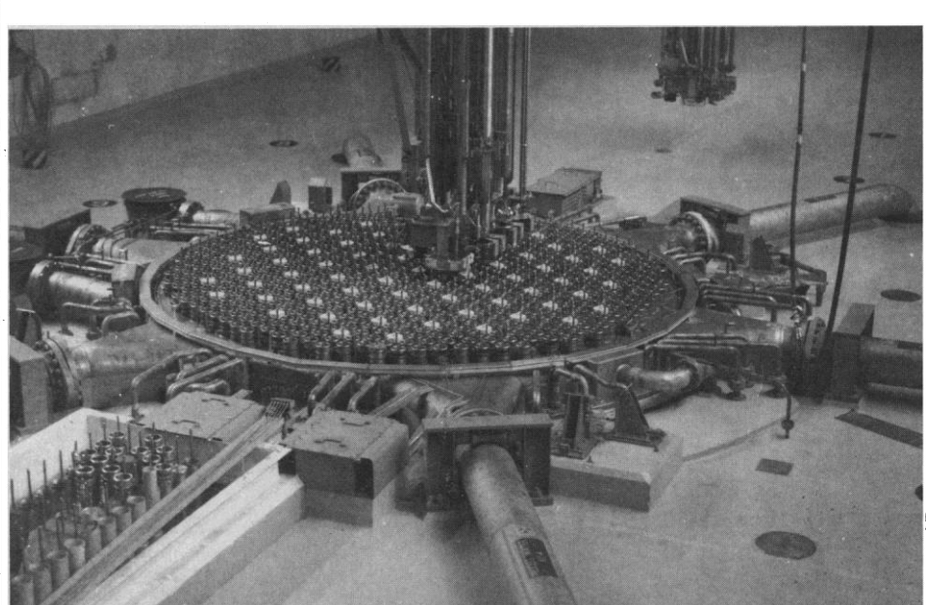
In its fiscal year 1990 budget request, which goes to Congress next January, DOE is expected to ask for construction funds for at least one new reactor. Nuclear engineering and equipment manufacturers have been lobbying for this for some time, and would like the government to build a second unit. The scope and pace of the project, however, is not likely to be decided until the next president takes office. Congress then may alter that plan.

Thus far no strong opposition has emerged to building a new production reactor. Some critics are, however, questioning the assumptions that underlie DOE's case for the facility. For example, David Albright, senior staff scientist with the Federation of American Scientists, questions whether the United States might not fill its tritium needs with a smaller reactor than that contemplated by DOE. "I think the tritium production requirements have been hyped quite a bit," he says, noting that "we were told for years we were desperate for plutonium, only to find out that we had far more than we could use."

Department records indicate, Albright says, that the combined output of the P and K reactors at half power is sufficient to meet the tritium needs of existing warheads. Furthermore, Troy E. Wade, DOE's acting assistant secretary for defense programs, confirms that it might be feasible to produce tritium using the Fast Flux Test Facility, a liquid metal cooled reactor located at DOE's Idaho National Engineering Laboratory.

Lawrence T. Papay, who chaired ERAB's production reactor assessment panel, told *Science* that his group did not question DOE's projections for future tritium use. "We were given some classified information as to what the tritium requirements would be," said the senior vice president of Southern California Edison Co., "but our job was not to investigate that."

Gearing up to do just that are a number of House and Senate members, including Senator Edward M. Kennedy (D–MA), a member of the Senate Armed Services Committee, and Representative Albert G. Bustamante (D–TX), a member of the House Armed Services Committee. Both are expected to ask DOE to show why it cannot get by with a new reactor that is half the size of one of the 2500 megawatt units at Savannah River.



Department of Energy

Reactor head. *A maintenance crane is centered over the top of the L reactor to access fuel rods and control rods. The reactor head is covered with a plenum during operation.*

**Safety Issues at the Defense Production Reactors: A Report to the U.S. Department of Energy* (National Academy Press, Washington DC, 1987).

†*Assessment of Candidate Reactor Technologies for the New Production Reactor* (Energy Research Advisory Board, U.S. Department of Energy, Washington, DC, July 1988).

DOE also is likely to be pressed to detail its long-term plans for the P, K, and L reactors. Even though these reactors are aging, officials say the units may be usable for several more decades. Roger D. Rollins, chief of the reactor branch at Savannah River, believes that DOE can address the problems cited by the National Academy of Sciences in 1987. He says there is a high probability that the reactors could be returned to about 80% of their former operating capacity and perhaps operate for several more decades.

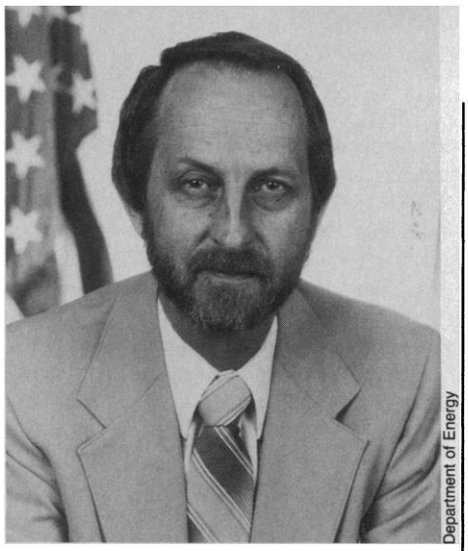
Wade supports Rollins' assessment, stating that "there are no known paths to failure at this moment." Nevertheless, he says it does not make sense to delay building a new reactor. "It is just not prudent for the nation's nuclear deterrence to have to rely on machines that are that old."

Most arms control and environmental groups do not contest the wisdom of that statement. The Natural Resources Defense Council, for example, acknowledges that a replacement reactor would be superior to the existing plants. Still, this group and others may oppose construction of a reactor unless they can wring some concessions out of DOE, namely to:

- Refrain from producing any more plutonium in any of its production reactors and agree to run tritium-producing reactors at the lowest levels possible for fulfilling defense requirements.
- Subject the new reactor to Nuclear Regulatory Commission (NRC) licensing for health, engineering, and safety requirements for commercial power reactors.
- Conduct a comprehensive environmental impact statement that examines all the alternative technologies and sites and documents future tritium needs.
- Set a firm schedule and commit to a funding plan for decontaminating weapons production sites.

DOE clearly is opposed to some of these demands. The department, for example, says that "the primary mission" of the new production reactor is to produce tritium. But it will not rule out making plutonium. As for what would be done with P, K, and L reactors, Wade says, "We have no schedule for phaseout." The old Savannah River plants, he says, could be kept on standby unless two new reactors are built.

DOE also is dead set against having the NRC license the production reactor. The department has pledged that the reactor will be built to "comparable" standards. On 12 July, however, former NRC Commissioner John F. Ahearne, who now chairs DOE's internal Advisory Committee on Nuclear Facility Safety, told Secretary John Herrington that the department's promise was inadequate. The advisory group called on the department to spell out what standards it will comply with.



Department of Energy

Troy E. Wade. *Defense programs chief says DOE can make a case for a new weapons reactor.*

One bargaining chip that could dampen opposition to a new production reactor is the Special Isotope Separation (SIS) Project. This $10-billion plutonium processing plant, which many environmental groups have sought to kill on the grounds that it is not needed, is in an early stage of construction at DOE's Idaho National Engineering Laboratory. The facility, which is slated to start operating in 1995, would extract weapons quality plutonium from government reactor-grade plutonium.

In response to questions raised by Senator Mark Hatfield (R–OR) and other members of Congress (*Science*, 1 May 1987, p. 515), DOE has disclosed that it has no near-term need for additional stocks of plutonium. "SIS is really on very weak ground," says an aide to Representative Bustamante. Not only is there surplus plutonium now, but a new missile treaty could allow DOE to salvage plutonium from an estimated 5000 warheads, which could make the new separation plant unnecessary.

A new arms control treaty could also focus attention on the possibility of negotiating an agreement to limit or halt production of fissile material, including tritium. Milton M. Hoenig, scientific director for the Nuclear Control Institute, predicts that materials production capacity could become a centerpiece of arms talks within a few years. The United States has rejected Soviet proposals to control production of fissile materials so far, but for arms control to be meaningful, says Michèle Flournay, senior research analyst at the Arms Control Association, "you have to start controlling at some point the production of fissile fuels."

The concerns and uncertainties have not deterred three groups of American companies who are engaged in an intense competition to win the contract to build one or more replacement reactors. "I don't think there is any question that it is an important project in the nuclear industry," says James DeFrancis, director of energy programs for Enserch Corp., parent of Ebasco Services, a nuclear engineering company.

The last firm order to build a commercial reactor in the United States was placed in 1974. Of the 11 power reactors still under construction, most are about 75% complete. Engineering companies and equipment vendors now are largely focused on servicing the existing reactor fleet.

The few new reactor projects that U.S. companies have going are overseas. General Electric and Westinghouse are working on separate advanced light-water reactors with Hitachi and Mitsubishi, respectively. And Combustion Engineering has contracts to build two power reactors in South Korea. Although the level of economic activity is adequate to allow the American nuclear industry to survive, companies have clearly been yearning for a new construction project in the United States.

This is reflected by the comments of members of ERAB, which in preparing a report for Energy Secretary Herrington on the merits of various reactor options, invited companies to make presentations on their respective designs. Several members told *Science* that following these presentations they were pressed by company representatives to consider specific reactor technologies.

Perhaps the most aggressive is General Atomics and its partner, Combustion Engineering. General Atomics Vice Chairman Linden Blue wants DOE to use a high-temperature gas-cooled reactor to produce tritium. Blue sees this as a chance to demonstrate a second-generation helium-cooled reactor that could be adapted by elected utilities to generate electricity.

General Atomics claims that its reactor design is inherently safer than heavy-water or light-water alternatives. ERAB agreed that the gas-cooled reactor is particularly promising and ranked it second overall behind the heavy-water reactor.

There is a strong chance that DOE will stick with what it knows best and build an advanced heavy-water reactor at Savannah River, a strategy that could minimize costs and delays. ERAB supports this approach. "If there is a need for full tritium production as early as possible," the panel advised, "then . . . the heavy-water reactor appears to have the best chance of quickly providing the needed capacity because of the existing facilities, personnel, and experience at Savannah River."

Should the reactor decision go this way,

Ebasco Services and Babcock & Wilcox would be pitted against Westinghouse and Bechtel for the contract, since both groups are prepared to build heavy-water reactors. General Atomics and Combustion Engineering would be out in the cold, unless DOE recommends building a second reactor. This idea has been pushed by Senator James McClure (R–ID), ranking Republican on the Senate Energy and Natural Resources Committee.

Not surprisingly, McClure would like to see this plant built in Idaho. But an aide to McClure says the issue goes beyond parochial interests. McClure says more than one type of plant should be built to insure against unforeseen disruptions. In the past, the United States has relied on Savannah River for virtually all of its tritium supplies. In its report to Herrington, ERAB made the same arguments as McClure. Two different reactor designs operating at different sites would guard against a complete loss of production capacity caused by natural disasters, accidents, or equipment failures, the group said.

Some contractors, such as General Atomics, are using the report's language to push their case for building a second weapons reactor to prove out a new civilian reactor design. In addition to proposing to build a heavy-water reactor, Westinghouse has advanced the idea of a "special water reactor." This is a variant of a small, second-generation commercial unit that would incorporate passive cooling features.

Not everyone in the electric utility industry, however, is thrilled at the idea of using DOE's weapons complex as a testing ground for new utility reactors. Although the first generation of civilian plants evolved from military reactors, Thomas L. Mack, vice president of Bechtel Group, Inc., says a strong linkage should be avoided. "It is a question of perception—having the civilian power industry tied to nuclear weapons production," he says.

Funding problems and politics could moot the idea of building a second plant. DOE defense program budgets already are being squeezed by soaring costs for environmental cleanup and modernization of weapons facilities across the country. The department says it could cost $110 billion to complete the job (*Science*, 8 July, p. 155). This burden alone may cause Congress to balk at building a second reactor.

From a supply standpoint, ERAB confirms that one new reactor of sufficient size could meet the country's tritium needs. If a second one is built, concedes Wade of DOE, it probably will be "spread out over a long period of time to minimize the economic impact."

There is also some concern about DOE's ability to manage construction of one new reactor, much less two. Members of the ERAB review panel that *Science* spoke with note that the government has not built a reactor for some time. Even if Congress streamlines the regulatory process, moving ahead with a new reactor program, they observe, will require strong management.

These matters and saber rattling by activists, however, do not faze DOE's Wade. He says he is looking forward to next year's battle in Congress. "We are going to have critics," he concedes, "but we think we will be able to lay on the table projections that will support our case."

As for what will emerge from the wrangling, he predicts it will be a product of give and take among the defense establishment, Congress, and interest groups. Says Wade, "Somewhere in the middle is your answer."

■ MARK CRAWFORD

Sagdeev to Step Down

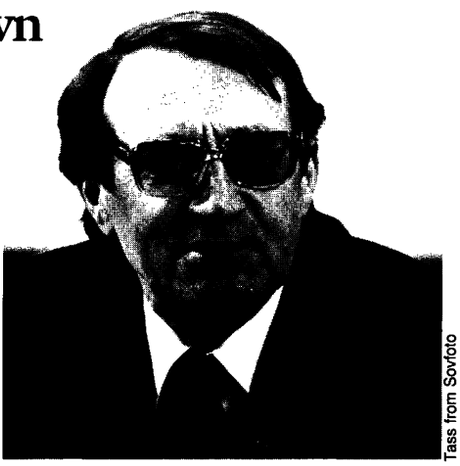
Roald Z. Sagdeev, director of Moscow's Institute for Space Research (IKI in Russian) and one of the most politically influential scientists in the Soviet Union, has announced that he will resign from his post at the end of September.

His resignation was made public at an international scientific meeting recently held at IKI to celebrate the 7 July and 12 July launches of the twin Phobos spacecraft to Mars. Among his associates, however, his decision has been an open secret for more than 3 months.

Whatever Sagdeev's reasons for stepping down—he did not explain them—it seems clear that the choice was his and not something forced from above. Quite the opposite: the success of IKI's planetary program appears to have given him enormous credibility in the Kremlin. He currently serves as an adviser to General Secretary Mikhail Gorbachev on the U.S. Strategic Defense Initiative—he is a plasma physicist by training—and he was elected last year to the Supreme Soviet.

IKI itself operates under the aegis of the Soviet Academy of Sciences, where it has responsibility for the Soviet Union's unmanned space research in general and its planetary exploration program in particular. Probably the closest counterpart in the United States is the National Aeronautics and Space Administration's Jet Propulsion Laboratory. Since assuming the directorship of IKI in 1973, Sagdeev has presided over a series of increasingly ambitious missions to Venus in the 1970s and the early 1980s; a much publicized flyby of Halley's comet in 1986; and now the Phobos launches, which inaugurate a decade of Soviet exploration of Mars.

Meanwhile, Sagdeev has opened up IKI's missions for an unprecedented degree of participation by Western scientists, not to mention scrutiny by Western journalists. He has been a vocal advocate of U.S.–Soviet cooperation on a robotic sample return mission to Mars, and perhaps even on a joint manned expedition to that planet.



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Roald Sagdeev. *Headed planetary program.*

According to American scientists who attended the IKI meeting, and who know Sagdeev well, his resignation may have been motivated partly by the fact that his outside activities are making it increasingly difficult for him to actually manage IKI; and partly by his own stinging criticisms of the "bureaucratic dinosaurs" that are stifling Soviet scientific research. In a recent article originally published in the Soviet newspaper *Izvestiya*, and then reprinted in a modified form in the U.S. National Academy of Sciences' journal *Issues in Science and Technology*, he called for major reform of the Soviet science establishment—including a requirement that the directors of research institutes be limited to two 5-year terms.

In any case, Sagdeev's future career is at least as nebulous right now as his motives for resigning. (At age 55 he is hardly a candidate for retirement.) Sagdeev himself has said only that he would like to remain as chief scientific adviser on the Soviets' next Mars mission in 1994. Also uncertain is Sagdeev's successor at IKI. In keeping with recent reforms, the new director will be elected by the institute's scientists. One name being prominently mentioned is Alec Galeev, head of IKI's space plasma physics division and a long time protégé of Sagdeev's.

■ M. MITCHELL WALDROP