Kirpichnikov, 53, has experienced the rise and fall of Russia's scientific community firsthand. He graduated in 1969 from the prestigious Moscow Institute of Physics and Technology, specializing in molecular biophysics. From there he landed a research position at the Engelhardt Institute of Molecular Biology, where he pioneered techniques for making artificial proteins, racking up more than 200 publications. His research has been "highly appreciated and recognized by the scientific community," says Alfimov. Today, Kirpichnikov heads the institute's protein engineering group, where he still puts in regular appearances. "When I come to my laboratory, it's a kind of relaxation for me," he says.

Conducting research provides a respite from Russia's government offices, where Kirpichnikov has labored for the last 9 years. He spent 4 years as a division chief in the science ministry before becoming director in 1993 of the government's Department of Science, High Technologies, Education, and Culture—a position similar to that held by Neal Lane, President Clinton's science adviser. Known as an intelligent and soft-spoken administrator, Kirpichnikov forged a strong ally in former Science Minister Vladimir Bulgak, now a deputy to Prime Minister Evgeny Primakov. For 2 years Bulgak talked up plans for commercializing Russian research and closing some of the Russian Academy of Sciences' roughly 350 institutes, where much of the best research is done, but he failed to deliver on the promised reforms (*Science*, 14 November 1997, p. 1220).

Like Bulgak, Kirpichnikov says he hopes to "target funding for research priorities" and "increase the competitiveness of Russian scientists on the world market." He rattles off a list of areas that he says merit special attention: molecular biology, genetic engineering, physics, new materials, telecommunications, and information technology. "Not a single country in the world can carry out research in all disciplines," he says. Targeting research in this way, he acknowledges, would require restructuring the academy.

The question is whether Kirpichnikov can do any better than Bulgak in shaking up a research system deeply rooted in the Soviet era, when there was little competition for funding. Institutes still receive budgets determined primarily by the size of their staffs, and the science minister has no authority over how the academy spends its money. Kirpichnikov, for now, declines to reveal how his ministry might steer more money to labs in strategic areas. And when he does show his hand, he is sure to provoke a backlash from scientists clinging to tenuous careers. "The very mention of reforms irritates impoverished scientists," says Leo Borkin, founder of the St. Petersburg Association of Scientists and Scholars.

Kirpichnikov also faces a tough challenge in trying to stem the loss of Russian innovations overseas. The brain drain of the early 1990s may be over, but for "any scientist who remains here in Moscow, his intellectual property may drain to the West," Kirpichnikov says, referring to dozens of contracts inked between Russian researchers and firms such as Microsoft and Motorola, as well as inventions for which institutes lack funds to seek patents. "We don't have much experience with protection of intellectual property. This worries me a lot." The ministry is exploring ways to safeguard Russian inventions without harming the ability of scientists or institutes to cut deals with foreign firms, and they will seek ideas at next week's meeting in Moscow.

One recent thrust Kirpichnikov says he's planning to continue is a ministry program called Integration, which spent $32 million this year priming collaboration between researchers at the academy institutes, where the best science often takes place, and professors and students at universities. Loosely coordinated with a similar initiative run by the Education Ministry and Western foundations (*Science*, 29 May, p. 1336), Integration is expected to remain a priority next year, with an undetermined amount of new funds set aside for equipment for future joint academic-university labs, called Centers of Excellence. "This is a very acute issue," Kirpichnikov says. "Most equipment is out of date."

Reform-minded scientists welcome such moves, but they argue that the prospects for Russian science are now so dire that radical surgery is needed. "It's terrible," says Strakhov. "Instead of reading scientific literature and discussing problems, scientists must spend their time selling cigarettes or tending gardens. They're losing their professional level." The time has come, he says, to fire mediocre scientists and close lame institutes. "The government is avoiding confronting this inevitable question. They are afraid of the responsibility." With the gauntlet thrown down, Russian scientists are waiting to see if Kirpichnikov, unlike his predecessors, will pick it up. Over the next few months, those precious few hours Kirpichnikov spends in his lab are likely to seem more and more appealing. **–RICHARD STONE**

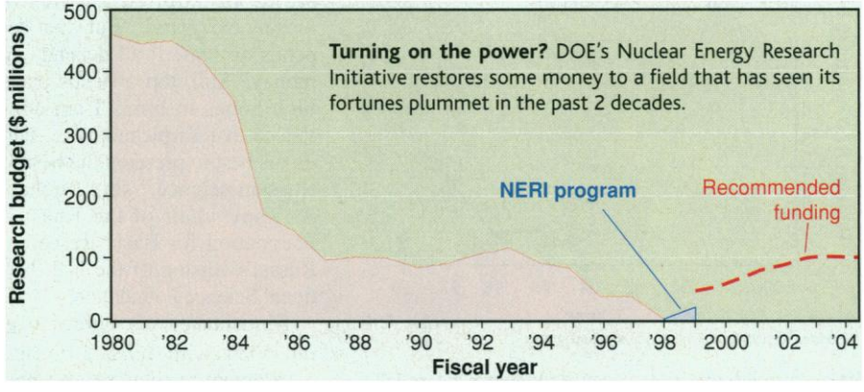
NUCLEAR POWER

New DOE Research Program To Boost Sagging Industry

A $19 million competitive grants program aims at developing new technologies and reinvigorating the nuclear science community

When nuclear engineers from academia and industry gathered last month in Washington, D.C., for an annual conclave, they heard an old refrain: The prospects for building a nuclear power plant in the United States anytime in the foreseeable future are bleak. Panelists noted that no new U.S. plants have been ordered since 1978, and many others have been shuttered because of cost and safety concerns. And there was consensus that an increasingly competitive power market may soon snuff out more of the nation's 109 aging plants. But, amid the gloomy predictions, researchers heard one note of optimism: Officials at the U.S. Department of Energy (DOE) had breathed fresh life into the government's moribund nuclear research program with the creation of a Nuclear Energy Research Initiative (NERI).

Supporters say the $19 million initiative is a desperately needed first step toward funding studies that may not pay off for decades. DOE undersecretary Ernest Moniz hopes the program, which has six focus areas (see box),



Turning on the power? DOE's Nuclear Energy Research Initiative restores some money to a field that has seen its fortunes plummet in the past 2 decades.

SOURCE: DOE

will eventually lead to technologies that prevent nuclear weapons proliferation and form the basis for cheaper, safer reactors that generate less waste. NERI proponents also argue that the funding is essential to preserve the nation's nuclear science community, which has seen its numbers and funding dwindle in recent years. "There's no question that NERI is a big shot in the arm—we've been virtually without funding for years," says Barclay Jones, a nuclear engineer at the University of Illinois, Urbana-Champaign. Indeed, cash-starved researchers have responded enthusiastically: This week, DOE officials began sorting through more than 500 preliminary proposals seeking slices of the NERI pie.

Critics, however, charge that NERI represents a handout to a mature industry that can afford its own research. "These corporate welfare programs waste taxpayer dollars on a crumbling industry," says Auke Piersma of Public Citizen's Critical Mass Energy Project, a Washington, D.C.–based advocacy group.

The impetus for NERI was an imbalance in DOE's research portfolio that followed the 1985 cancellation of the $7 billion Clinch River Breeder Reactor in Tennessee and other nuclear projects (see graph). That trend culminated last year in the zeroing out of DOE's primary nuclear research budget, while the department's solar energy research program received $79 million and $362 million was allocated for oil, gas, and coal studies. In a November 1997 report (neri.ne.doe.gov/info.html), the President's Committee of Advisors on Science and Technology (PCAST) warned that those spending decisions threatened to rule out a U.S. atomic resurgence at a time when concerns about global warming could revive interest in nuclear energy. Because nuclear plants produce virtually no carbon dioxide, they offer an attractive alternative to some policy-makers searching for ways to limit carbon emissions over the next century.

Such concerns led PCAST to conclude that "fission belongs in the R&D portfolio." The panel recommended that Congress revive DOE's nuclear program, starting at $50 million in 1999 and reaching an annual steady state of $100 million by 2003. The Clinton Administration, however, requested just $24 million, and Congress coughed up $19 million. The appropriation, say congressional aides, reflected the ambivalence of some economically conservative lawmakers who saw the program as an unnecessary handout. But support from Senator Peter Domenici (R–NM) and Representative Joseph Knollenberg (R–MI) eventually helped secure enough funds to get the program rolling.

The new initiative comes with one string attached, however. Lawmakers and the White House insisted that DOE conduct a peer-reviewed competition open to both DOE scientists and their colleagues in academia and industry. In the past, DOE nuclear program officers had doled out money to selected researchers, often at the department's own extensive network of laboratories, with minimal external review. "We need strong, competitive proposals to revitalize the nuclear option," Moniz told more than 100 researchers who gathered in Washington in April to help design the initiative. NERI, he said, would focus on "finding the best ideas, irrespective of where they originate."

DOE'S NUCLEAR ENERGY RESEARCH INITIATIVE

The program seeks to fund "innovative" technologies for the next decade and "revolutionary" technologies over the next 30 years. It will focus on:

- Proliferation-resistant reactor and fuel technologies, including methods to hinder reprocessing reactor fuel into weapons-grade materials.
- New reactor designs with higher efficiency, lower cost, and improved safety.
- Compact, easily deployable reactors for developing nations or specialized applications, such as making medical isotopes.
- New technologies for onsite and surface storage of nuclear waste.
- Better understanding and performance of advanced nuclear fuels, such as "ultrahigh burnup" fuels that generate less waste.
- Fundamental nuclear science in areas such as materials and chemical sciences, automation engineering, and reactor physics.

The new approach appears to be paying off, says NERI manager John Herczeg, noting that his office received 524 preproposals earlier this month. They presented "a whole raft of ideas that we might never have dreamt of here in DOE," he says, from self-repairing ceramics for coating nuclear fuel pellets to innovative control systems. "There's a tremendous pent-up demand and untapped creativity out there," says nuclear engineer William Kastenberg of the University of California, Berkeley.

That popularity may complicate the peer-review process, however, as many potential reviewers are also applicants. To solve the problem, DOE is planning to pile the work onto fewer reviewers. And in a novel twist, reviewers who are not government employees will get a small monetary reward for their labor: $1200 to evaluate nine proposals.

Herczeg expects to receive some 300 proposals by the 29 January deadline, with requests ranging from $100,000 to $1 million a year for 3 years. The DOE announcement encourages collaborations among sectors, and would-be applicants say they recognize the advantages of working together. "What seems to be emerging is that labs are scrambling to find university partners," says nuclear engineer Gilbert Emmert of the University of Wisconsin, Madison, who reports that colleagues in his department were approached by several DOE labs. Similarly, Kastenberg says he's been courted "by at least four different labs. ... They know partnering enhances their chance of getting money." He eventually hooked up with all four on two proposals, including one that included three DOE labs, two universities, and a company.

For their part, many universities are hoping that NERI funds will help slow—and eventually reverse—the decline of nuclear science departments. Nationally, undergraduate enrollment in nuclear engineering and related programs has declined by an "alarming" 10% per year in the 1990s, according to the PCAST report, while the number of graduate programs in the field has fallen by 30%, to 35, since 1975. "Formerly strong university groups are becoming subcritical in size," the PCAST report concludes.

How far NERI can go in rebuilding academic programs will be up to Congress, which will set annual funding levels for the program. Moniz said recently that DOE plans to ask for a boost in its 2000 budget request, to be submitted to Congress in January. And researchers hope that the outpouring of proposals this year will convince lawmakers to pump up the program.

NERI's advocates are also braced for another round of attacks by opponents, both antinuclear campaigners and economic conservatives. During this year's budget battles, for instance, Public Citizen suggested that NERI stood for "Nuclear Expenditures to Replace the Insolvency." The group accused the program of focusing on "increasing industry profits by reducing the cost of fuel, bandaging aging reactors, and planning future reactor designs."

But Herczeg says that criticism is off the mark. It's unlikely industry will see any short-term benefits from NERI spending, he says. "This has to be long-term R&D that may not pay off for a minimum of 10 years and preferably 20 years," he says. "We don't want any technology that is off the shelf. If [a project] doesn't produce new knowledge, we're not interested." –DAVID MALAKOFF