Labs Struggle to Promote Spin-Offs

Federal laboratories are increasingly viewed as promising sources of commercial technology, but getting it into the private sector is proving difficult

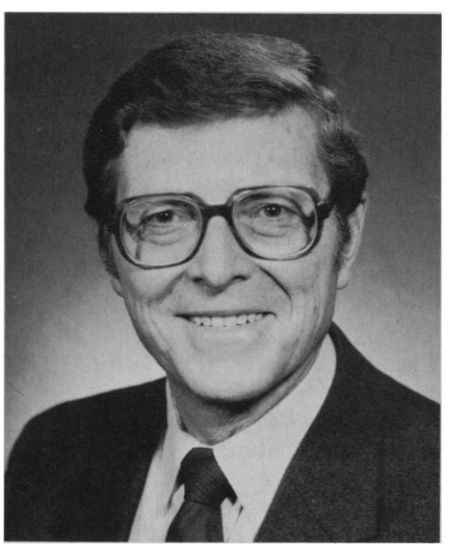
LAWRENCE Livermore National Laboratory, best known for its work on nuclear weapons and the Strategic Defense Initiative for the Department of Energy (DOE), may seem an unlikely partner to the U.S. steel industry. Last year, however, together with North Star Steel, Caterpillar Tractor, and Ladish, a custom steel forging company near Milwaukee, the laboratory began spending $1.8 million of DOE money to develop a new type of superplastic steel. The steel can be forged in extremely precise shapes, said Jack Geiger, vice president for technology at North Star Steel, thus eliminating much of the expensive machining now required to produce steel machinery parts.

Working hand in glove with private companies on proprietary research projects is a novel experience for most scientists in the federal laboratories. But if Congress has its way, such collaboration may be the wave of the future. The federally funded laboratories are being ordered to the front in the trade wars with Japan and Western Europe.

"The Department of Energy laboratories are a huge treasure and storehouse of knowledge and science," said Senator Pete Domenici (R–NM). "My dream is that they could be one of the lead institutions adding to America's ability to apply technology to the marketplace. But their record of traceable new products spun off is so small that one would almost think they're not charged with doing it."

Congress passed several laws during the past decade encouraging laboratories to promote commercial spin-offs from their research. Until recently, however, little changed, say most observers. But the current trade crisis has spawned a political campaign for "technology transfer"—finding commercial uses for technology developed inside government laboratories—and federal research administrators are busy clearing away bureaucratic obstacles and hoping that the promised spin-offs actually appear.

By any standard, the federal laboratory network is a huge part of the U.S. R&D establishment. According to James Wyckoff of the National Bureau of Standards, more than 400 federally funded labs spend about $20 billion each year on in-house R&D. The Defense Department, the Department of Energy, and NASA account for 84% of that total, with a variety of other agencies, including the departments of Health and Human Services, Commerce, and Agriculture making up the difference. Just over 100,000 scientists and engineers—one-sixth of the nation's active R&D professionals—work in these facilities, according to the Federal Laboratory Consortium, a government-funded group organized to promote cooperation between private industry and the federal labs.



Senator Domenici. *"There's no question there's an enclave mentality in the DOE labs."*

Reliable statistics on the extent of commercial spin-off from this research complex are impossible to compile, but most R&D experts consulted for this article agreed that little laboratory technology had found its way to the marketplace. "We're getting such a minuscule amount out of [the federal labs] that almost any improvement would be a big step in the right direction," said Lee Rivers, Washington representative for the Federal Laboratory Consortium.

"The public is being ripped off; it isn't getting its money's worth from federal research, because there aren't good mechanisms of technology transfer," said Roger Ditzel, director of the University of California Patent Office. Ditzel is responsible for the rights to technology from the Lawrence Livermore, Lawrence Berkeley, and Los Alamos National laboratories. His office examines 20 to 30 inventions a year from these three laboratories, sometimes negotiating agreements with companies that want to develop commercial products using the inventions.

Partnerships between labs and industry often sound better in theory than they work out in practice. Four years after White House Science Adviser George Keyworth called on the national laboratories to "develop leapfrog technologies in steelmaking," Lawrence Livermore's research into superplastic steel production is the only R&D work currently funded by the "Steel Initiative." According to one DOE official familiar with the program, joint projects that represent common ground between the laboratories' "research culture" and industry's "production culture" have been hard to find.

Most of the research carried out in government labs, such as classified work on military technology or very basic science, is commercially irrelevant. Alex Zucker, acting director of Oak Ridge National Laboratory, estimated that from 10 to 30% of the research in DOE's nonweapons laboratories—and a smaller percentage in weapons labs such as Lawrence Livermore—involved technology that could be commercially useful. But according to advocates of laboratory-industry collaboration, even when the labs do develop technology that may have commercial uses, it often languishes on the shelf because government regulations and the research culture of the lab discourage private companies from developing it further.

The main obstacle, say corporate executives and spin-off advocates, has been government reluctance to sign contracts that give a single company exclusive rights to a particular technology, and therefore a marketplace advantage. Without this incentive, they say, no firm will invest the large sums of money that are necessary to turn laboratory technology into a commercial product.

In Lawrence Livermore's cooperative research with the steel industry, for example, only the three private companies participating in the project—none of which directly compete with each other—will have immediate royalty-free access to the technology if the research yields practical results, giving them a leg up on their American and foreign rivals. "If there'd been a competitor in it, we

wouldn't be here," said one corporate executive involved in the project.

Traditionally, the government felt that "if the public pays for anything, then it ought to be free to anyone," said Ditzel. Any information or patent rights the government made available to one company had to be provided to everyone else on the same terms. But because few companies saw much value in investing in laboratory technology on these terms, they preferred to pursue their own separate R&D programs. "One thing on which industry is unanimous is that what's available to everybody is worthless," said Zucker.

To get over this hurdle, Congress passed a series of laws from 1980 to 1986 pressuring federal agencies to give each laboratory the authority to license technology to individual firms. As an added incentive to promote spin-offs, the laws allow inventors and laboratories to keep a substantial percentage of any royalties paid on these licenses.

Many agencies have been slow to put the laws into effect. None of the military services, which together control the largest federal laboratory system, have approved final regulations explaining how the law will be implemented, although a few cooperative research agreements have been arranged. The Department of Energy, meanwhile, has refused to give the contractors that operate many of its laboratories a blanket authorization to negotiate licenses for their unclassified technology. Instead, the laboratories must ask DOE headquarters to waive its prior rights to the inventions, a process that often takes more than a year.

The lack of a coherent framework for granting licenses is not the only impediment to transferring technology out of the national labs. Laboratory directors remain concerned about the possibility of releasing classified technology, getting caught in the middle of competitive battles between private firms, and compromising the laboratory's central mission.

"It represents caution on both sides," said Joe La Grone, manager of DOE's Oak Ridge operations. "The thing that makes technology transfer go slowly is making sure we don't open the gate and let tremendous resources flow out and allow advantage to one or a very few people."

Negotiating terms for licenses that will promote commercial developments "is very much of an art," said Ditzel. "You've got to know what you're doing. It takes a lot of years to know what to look for." A lack of government patent lawyers with experience

Oak Ridge Leads the Way

Oak Ridge, Tennessee

Despite the obstacles in moving technology out of the federal labs and into the private sector, the Department of Energy's Oak Ridge National Laboratory (ORNL), operated by Martin Marietta Energy Systems, has become something of a showpiece for technology transfer during the past 3 years. Martin Marietta made local economic development and the promotion of spin-offs a centerpiece of its successful proposal when it bid on the contract to operate DOE's Oak Ridge facilities in 1983, and has taken pains to deliver on its promises.

"We wanted to become the community's favorite bidder," said Bill Carpenter, the Oak Ridge corporation's ebullient vice president for technology application. Carpenter is responsible for promoting commercialization of technology at three DOE facilities at Oak Ridge: ORNL, a nuclear weapons production facility called Y-12, and a uranium enrichment plant. ORNL's operating budget this year is $456 million, Y-12's is $509 million, and the enrichment plant's is $102 million. Together, the Oak Ridge facilities employ 15,000 people.

"We didn't know what the reservoir of technology was worth, but we said, gosh, 1000 Ph.D.'s have got to be doing some worthwhile things," said Carpenter, who moved to Oak Ridge in 1983 from Martin Marietta's plant in Orlando, Florida. "We knew something about the complexity of someone adopting a technology they didn't originate, because we have a hell of a time right within our own corporation when we shift from development to production—it's one of the toughest problems we have," he said.

Carpenter set up an Office of Technology Applications to promote commercial licensing of ORNL technology. Twenty-seven license agreements have since been signed. Four of them have produced results so far—a total of $10 million in sales and $400,000 in royalties for ORNL.

ORNL's most extensive cooperative research agreement with industry centers on a remote-controlled robot that was originally developed at a cost of well over $1 million to carry out maintenance in contaminated areas of nuclear fuel reprocessing plants—none of which are now planned in the United States. ORNL has agreed to provide the entire system to a local company called Remotec in exchange for Remotec's help in developing a commercial version of the robot. ORNL will then get one of the commercial devices free of charge.

Private companies have been most interested in the laboratory's advanced materials, including new metal alloys and ceramics. ORNL's two hottest commercial spin-offs at the moment are a form of nickel aluminide that keeps its strength at extremely high temperatures, making it useful in engine parts or heating elements, and a reinforced ceramic material that promises 25-fold improvement in the durability of cutting tools.

By 1992, ORNL hopes to negotiate 50 licenses a year, generating $4 million each year in royalties from $100 million in commercial sales based on laboratory technology. "We've only just begun," said Jon Soderstrom of ORNL's technology applications staff. "I don't see any plateauing of these curves soon."

Hal Schmidt, a former ORNL physicist who helped start two companies based on spin-off technology, said that researchers at ORNL who want to work with private companies now face a completely new set of attitudes. "Twenty years ago, any involvement with industry was considered unethical," said Schmidt. "Now, it is enormously encouraged."

Once the question of who gets what rights is settled, it is crucial to have federal researchers working side by side with company engineers to develop commercial products, said several experts. "If you want to transfer technology, you have to transfer technologists," said one steel industry source. For this reason, Martin Marietta Energy Systems began encouraging ORNL scientists to work as consultants with industry on their own time. The number of consulting agreements reported by ORNL employees shot up from 71 in 1985 to 190 in 1987.

But despite the bullish trends at ORNL, the flow of technology from federal laboratories to private companies remains a mere trickle, and its potential for growth remains uncertain. "If you look at 27 licenses in comparison with all that's out there, its not a staggering number," said Joe La Grone, manager of DOE's Oak Ridge operations. ■ **D.C.**

in licensing, said Ditzel, has compounded the problem.

According to Don Jarad of Oak Ridge's technology transfer staff, the laboratory sometimes has to choose which companies will get rights to Oak Ridge's technology. "The name of the game is success," said Jarad. "We select them on the basis of who we think will be a success." Oak Ridge, in fact, has been particularly aggressive in transferring its technology to the private sector (see box).

Rivers of the Federal Laboratory Consortium says "the battle will go to the more aggressive, and the first one in the door." At least one firm has threatened to sue Martin Marietta, which operates Oak Ridge, over a license that was not granted, but so far no suits have been filed.

Laboratory administrators walk a fine line in promoting commercial spin-offs, yet keeping research within bounds of the laboratory's mission. "You're not going to allow a researcher to go off and work with some company if that's going to detract from the overall mission of the lab," said Ditzel. Supporters of the technology transfer effort, however, maintain that cooperation with industry is far from any danger of interfering with ongoing research. "I'll be retired by the time technology transfer starts seriously impeding defense work," laughed one DOE weapons laboratory official.

According to officials at a DOE nuclear weapons laboratory, a proposal now circulating within DOE headquarters would open the doors of the weapons labs to far more extensive cooperation with industry. Details of the proposal remain to be worked out, said one official familiar with it, but it would represent a sharp turn in DOE policy toward the weapons labs.

The lab official said that promoting commercial spin-off might reinforce political support for the labs in Congress. Arms control success "doesn't bode well for continued funding of DOE weapons labs," he said. "But our national security has to be tied to our economic competitiveness," and the labs could contribute to that goal.

According to the weapons lab official, greater cooperation with industry need not compromise national security controls over technology. In fact, he said, commercialization might make the export control task easier. If technology was licensed to a single firm, he said, commercial secrecy during development of a product may aid in the task of restricting its export. "Computer source code licensed to a private company for resale [in machine readable form] isn't going to be freely available from Argonne National Laboratory." he said.

For many labs, however, classification remains a touchy issue. "One of the toughest things is making sure you don't cross the line into national security information," said La Grone. DOE officials say that manufacturing technology developed at the Y-12 weapons plant would be valuable for industry, but it is off limits because of classification.

No matter how faltering the progress toward formal cooperation, changing attitudes within both labs and industry contain the seeds of a bright future for collaboration, said Jon Soderstrom of Oak Ridge's technology applications staff. "People are interested, much more than before, in making people on the outside aware of their technology," said Soderstrom. "Our best leads on licensing come from our technical staff."

Contacts between industry and federal laboratories can break down the "cultural barrier" that divides government and corporate scientists and engineers, said Rivers. "Look, we send people back to school or to other federal labs, and there's an awful lot of smart researchers out in industry; our researchers can learn a heck of a lot from those people," said Ditzel.

Domenici agreed. "There's no question there's an enclave mentality in the DOE labs," he said, that hinders the transfer of technology into the commercial marketplace. "They were closed institutions for a long time."

"We've tried to remove the statutory barriers, we're trying to remove the regulatory barriers, but just to change the culture, that is a people problem, and that's not easily done," said Bill Carpenter, vice president for technology application at Oak Ridge. ■

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Crafoord Prize Winner Abstains

Paris

One of France's most distinguished—and most controversial—mathematicians, Alexandre Grothendieck, announced last week that he was turning down his share in the prestigious Crafoord Prize of the Royal Swedish Academy of Sciences, an award introduced in 1982 for scientists working in disciplines not covered by the Nobel Prize.

The academy had announced 2 weeks previously that the $270,000 prize for 1988 was to be divided between Grothendieck and his former pupil, the Belgian-born mathematician, Pierre Deligne, of the Institute for Advanced Studies in Princeton, New Jersey, for their pioneering work in algebraic geometry.

However, in a letter to the academy published in the French press last week, Grothendieck said he had no need for his share of the prize money, since his salary as a professor at the University of Montpellier was already "much more than sufficient for the material needs of myself and those I am responsible for." He added that one of his reasons for turning down the award was his conviction that the only decisive test for the fertility of ideas or new visions was the test of time. "Fertility is recognized by its offspring, and not by honors."

Although he has made substantial contributions to a number of fields of pure mathematics—in 1966 he won mathematics' top award, the Fields Medal of the International Mathematics Union—the work for which the 60-year-old, German-born mathematician is perhaps most widely known involved the development of a set of mathematical techniques needed to prove a key conjecture proposed by one of the fathers of algebraic geometry, André Weil.

Since his days as a postgraduate student, Grothendieck has also been known for his ascetic habits, for example, insisting to colleagues that one could live adequately off a diet of little more than milk and vegetables. In 1970, shortly after the work that led to the proof of Weil's conjecture, he resigned his research post at the Institut des Hautes Etudes at Bures-sur-Yvette, outside Paris, claiming that his move was a protest against increasing military sponsorship of mathematics research.

He became a militant supporter of the ecology movement, and moved to a farm in the south of France where he now lives, later accepting a post at Montpellier.

In his letter to the Swedish Academy, Grothendieck, whose parents fought as anarchists against the fascists in the Spanish Civil War, says that top-level scientists who receive prestigious awards such as the Crafoord prize already tend to enjoy a high level of material well-being and scientific prestige, as well as the power and perquisites that go with both.

"But is it not obvious that the excesses enjoyed by some can only come about at the expense of the needs of others?" Grothendieck said, adding that he was also concerned about declining ethical standards in the mathematical community which he did not want to condone by accepting the prize. ■ **DAVID DICKSON**