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whether material has been diverted. The other is that no one pays sufficient attention to the matter of physical security. Says the ex-official, "NRC and DOE have wasted millions of dollars a year trying their damnedest to improve material control and accounting—money that would be far better spent in adding more sophisticated physical security measures." He says the NRC "mind-set" is comparable to their attitude about reactor safety before the Three Mile Island episode. Any discrepancies are regarded as "just another glitch in the system" because diversion could not happen. Cochran, for his part, quotes an NRC memorandum about Erwin to the effect that officials "have not yet identified the causes of the large ID fluctuations . . . [or] identified any fact that leads us to believe that strategic special nuclear material has been stolen or diverted. It, therefore, is the NRC staff judgment that the safeguards system in place at NFS has been effective in preventing the theft or diversion of a significant quantity of strategic special nuclear material." Cochran sums up this statement as meaning: "we don't know the reason for the ID so we assume there has been no diversion."

The NRDC and some people within the federal government believe that one way to improve the situation is to transfer the four NRC-licensed facilities that are involved in fuel cycle operations for the nuclear submarine program to the Department of Energy, which oversees most facilities involved in nuclear work for the military. The former safety official contends that "they are a continual embarrassment to the NRC," which is basically in the business of regulating civilian nuclear power facilities. Even if accounting procedures are sloppy, "the NRC can't shut these plants down permanently. In the minds of the American people the operation of these plants is an accepted imperative. If shutting them down means putting a crimp on the Admiral's fuel-making capacity you can be sure it won't happen." In his opinion, "Erwin doesn't belong under NRC jurisdiction any more than Rocky Flats does." Cochran concurs, saying, "the present system is making liars out of honest men—the NRC feels obligated to keep the plants operating for national security reasons even if it means they have to fudge on safeguardability." He adds that if a plant such as the Erwin one were removed to a military reservation, physical security could be enhanced.

According to a government expert on arms control, the problem at Erwin has "important implications for proliferation policy. There has been a lot of talk recently about multinational plants to make plutonium processing facilities [in nonnuclear weapons states] safer. Here we have an example of a plant in a very sophisticated country having inventory problems. It reemphasizes the problem of whether anyone can make facilities with weapons-grade nuclear materials safe." So, he says, it bolsters the case for avoiding commitments to reprocessing facilities and breeder reactors, both of which produce weapons-grade fuel. "If we introduce weapons-usable materials into civilian nuclear power there will be orders of magnitude more material than goes through the Tennessee plant. . . ." So, "maybe we should limit ourselves to low-enriched uranium for civilian nuclear power."

As for NFS-Erwin, Dircks of NRC sounded stern about its future. "We have been very critical of their operations and have told them they are living on a short tenure till they have convinced us that they can control that plant."—CONSTANCE HOLDEN

Relaxation Seen in Nonproliferation Policy

Rowen and Wohlstetter criticize shift from "policy of denial," but Ford study calls for a "less heavy handed approach"

During the first 2 years of the Carter Administration, the U.S. position on the link between nuclear power and nuclear weapons proliferation became what some have called a "policy of denial." That is to say, the government, in the Nuclear Nonproliferation Act of 1978, adopted policies that would, as a general rule, seek to deny to nonnuclear weapons countries access to nuclear fuels and equipment that could be readily used to make nuclear weapons. But, accordingly to some nongovernment critics, the State Department officials charged with implementing the policy are now trying to make it more flexible and permissive.

Opinion is divided both inside and outside the government as to the wisdom of the perceived change, and the stage may be set for a review of the policy. Two recent reports reinforce the opposing sides in this emerging debate. One is a contract study by two prominent academic specialists on nonproliferation issues, Henry Rowen of Stanford University and Albert Wohlstetter of the University of Chicago; they argue strongly against the apparent relaxation of the U.S. position. The other is a Ford Foundation–sponsored report on energy policy (see box); it maintains that a policy of denial is mistaken and counterproductive.

The Rowen-Wohlstetter study was commissioned by the Department of Energy (DOE), the National Security Council (NSC), and the Council on Environmental Quality (CEQ). It came about as the result of conversations more than a year ago between Jessica Mathews, then of the NSC staff (and now an editorial writer at the Washington *Post*), and Gus Speth, a member of CEQ who had long been concerned about the hazards of a "plutonium economy." A trenchantly worded document, the study warns, in effect, that America's nonproliferation policy is being compromised:

> The U.S. position . . . has been undergoing a significant shift in recent months. The direction of this change is on the whole backwards; like the pre-1976-77 position, it would permit ready access to nuclear explosive materials to nonweapon states. Faced with opposition, U.S. spokesmen on these matters have been shifting from a position of opposition to fuel cycles that increase access to readily fissionable materials to trying to win international acceptance of the position that this access is appropriate for industrialized countries but not for developing ones. Moreover, they are increasingly asserting that these materials will be safe enough if "controlled" by international organizations. This exercise in line drawing seems virtually certain to fail.

(Gerald Oplinger, an NSC staffer, told *Science* that "it's probably a bum rap" to suggest that there has been a deliberate attempt to change the policy on non-

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proliferation. Instead, he said, it has been more a matter of officials exploring various ways to overcome the problems confronting the policy's implementation.)

The Ford Foundation study argues for a "less heavyhanded and more positive approach" to nonproliferation. It calls for "economic incentives and supply assurances to dissuade others from premature or otherwise undesirable" steps to acquire uranium enrichment and fuel-reprocessing capabilities and plutonium-fueled fast-breeder reactors.

Among the participants in this study were several academicians and government officials who have been involved with nonproliferation issues. They included Robert W. Fri and John C. Sawhill, high-ranking energy officials for a time during the Ford Administration; Theodore B. Taylor, an energy specialist, former nuclear weapons designer, and an early proponent of strict anti-proliferation safeguards; Richard L. Garwin, science adviser at IBM and professor of public policy at Harvard; and George Rathjens, a political scientist at the Massachusetts Institute of Technology.

Rathjens wrote the report's chapter on nuclear power. He had largely completed it before he accepted a part-time appointment in January with the Department of State as deputy U.S. representative for nonproliferation, making him responsible for U.S. participation in the International Nuclear Fuel Cycle Evaluation (INFCE). The INFCE study, an effort initiated by President Carter in 1977 and participated in by some 50 nations, is due to be completed by next February and could itself have a major bearing on how U.S. policy evolves.

The Ford Foundation study, which reflects more the situation that existed a year ago than the one described in the Rowen-Wohlstetter report, says the policy of denial is unnecessarily contentious:

> While we agree with the objective, the approach has, in our view, become counterproductive. It is a source of friction between the United States and others, and it reinforces doubts about the reliability of U.S. commitments and of foreign sources of nuclear technology and services in general. Countries simply go elsewhere for what they need and have more incentive to develop domestic capabilities that cannot be so easily disrupted by U.S. action.

One of the principal State Department spokesmen on nonproliferation issues is Thomas R. Pickering, assistant secretary for international environmental and scientific affairs. Testifying on 26 July before the House Interior subcommittee on energy and environment, Pickering said that "plutonium use for fast reactor R & D would be appropriate in states where electrical grid and nuclear energy requirements, together with economic and resource considerations, indicate that a substantial number of breeders make sense for the long term." He also said that "when new sensitive facilities are appropriate, they should incorporate institutional and technological barriers to proliferation, including multinational arrangements."

Such statements by Pickering and other officials have led one government arms control specialist, who wishes to go unnamed, to observe that U.S. policy has drifted toward a "discriminatory re-

A Kind Word for OPEC

Energy is expensive today, is likely to be more expensive tomorrow, and society will gain from a resolute effort to make the price the user pays for energy reflect is true value, says, the latest Ford Foundation—sponsored report* on energy.

The report was prepared by a group chaired by Hans H. Landsberg of Resources for the Future (RFF), the Washington-based research organization which administered the study. Its 19 members, mostly academics (six are from Harvard), included nine economists and several scientists and specialists in law and government. Consumer groups, worried about the escalating price of home heating oil, will regard the report as harsh medicine. It insists that the best way to contain future energy costs is to let them rise now. "The more oil prices increase, the more important other energy sources [and conservation] will become, providing an automatic damper on the overall energy costs." The report adds that, although higher energy costs are painful, they can be accommodated. "The attempt to hold down energy prices in the United States is particularly insidious now, because of their interaction with oil imports."

The authors feel that OPEC has been as much the bearer as the creator of bad news about energy costs: "Oil prices are high and OPEC is important because energy in general is scarce or costly and is becoming more so, not the other way around," they write, adding that if OPEC were abolished and its member nations became noncommunicating, self-interested competitors, there might be little effect on world oil production and prices.

As for how best to develop new energy technologies, the report says: "A wide variety of competitive ideas generated through parallel approaches to the same technological end is both a useful spur to government program managers and a safeguard against premature selection of an intriguing but ultimately noneconomic concept. . . . Similarly, pursuit of generic technologies safeguards against getting locked into any specific system. . . ."

The private sector, says the report, should be given a "major hand" in selecting the research projects and technologies because this facilitates development of new energy technologies in the private economy. Frank Press, the White House science adviser, generally agrees with the report's philosophy that a new technology ordinarily should not be scaled up to near-commercial size "until the private sector is willing to take on a large share of the financial risk." But Press and the authors of the report agree that exceptions must be allowed. "I don't know how to make the market test apply to very-high-risk, distant technologies," he told *Science*, citing fusion energy, on which the government is spending hundreds of millions, as a prime example.

The report does not seek to discourage federal subsidies for development of synthetic fuels, but it warns of white elephants and recommends limiting the number and, in some instances, the size of demonstration plants and making the private sector bear part of the risk.

During the next two decades, energy conservation can be the most important energy "source" of all, the report says, noting that it has contributed more than twice as much as either coal or nuclear since the Arab oil embargo of 1973.—LUTHER J. CARTER

*_Energy: The Next Twenty Years_, Ballinger Publishing Co., Cambridge, Mass. $9.95

gime" whereby reprocessing facilities and breeders would be tolerated in major nonnuclear industrial countries such as Japan and West Germany but not in most developing countries. He also speaks of the emphasis placed by current policy on "multinational facades," an allusion to fuel cycle facilities that would be run by multinational entities. Such arrangements he regards as illusory, in part because the host country might take the facilities over, but more particularly because the plutonium contained in the mixed oxide fuel produced by them could be easily extracted.

Rowen and Wohlstetter conclude that a "precise, high-level public statement of U.S. policy on the nuclear fuel cycle has now become badly needed." They say that the backward shift in policy "seems to be occurring without a review at the top of the government."

According to one observer, implementation of U.S. policy is in the hands of officials who must deal with balky foreign governments that have resisted the hard-line approach as one that conflicts with their hopes of achieving greater energy independence and wounds national dignity. Having been put in the role of negotiators, the U.S. officials are said to want a policy that allows them room to negotiate.

Rowen may be in a position to promote the undertaking of a high-level review and lift it above the context of INFCE studies which he and Wohlstetter apparently feel are pointing toward a continuing relaxation of nonproliferation policy. He is chairman of a group of academic and other nongovernment advisers to DOE's Nonproliferation Alternative Systems Assessment Program (NASAP).

Along with some like-minded colleagues in this group, Rowen can argue his point of view directly with DOE, NSC, the Arms Control and Disarmament Agency, and the State Department. Some key officials from these agencies are expected to be present when this advisory group meets in early October.

The House Committee on Foreign Affairs, which had a big part in writing the Nonproliferation Act of 1978, also expects to take up in October the question of U.S. policy on the nuclear fuel cycle and nonproliferation. The committee staff has reviewed the Rowen-Wohlstetter report and will set up a hearing or forum to bring together before the committee members some of the principal Administration officials and independent specialists on nonproliferation policy, such as Pickering, Joseph S. Nye of Harvard, Rowen, and Wohlstetter.

One major aspect of the disagreement over nuclear fuel cycle and nonproliferation policy has to do with the extent to which nuclear power is linked to the development of nuclear weapons. Some people think that the possible diversion of sensitive nuclear materials from fuel cycle facilities associated with power generation is far less likely than the possibility that some nonweapon countries may establish facilities for the sole purpose of producing the plutonium or high-enriched uranium needed for nuclear bombs.

The Ford study says:

> For most countries that might be interested in producing enough material for a few weapons, the case for building small enrichment or reprocessing plants or both, rather than building commercial facilities, will be . . . strong. This is because economy of scale arguments suggest that enrichment and reprocessing will be commercially attractive only for plants costing a billion dollars or more and capable of servicing dozens of reactors. Small plants for a modest weapons program would, in contrast, cost perhaps a tenth as much.

The study acknowledges, however, that a nation having the elements of a power program "might elect to use them for weapons purposes." In fact, it alludes to India's building a pilot-scale reprocessing facility that was said to be associated with its civilian nuclear power program, but which produced the plutonium that was used to make the bomb that India detonated in 1974.

The Rowen-Wohlstetter study asserts that, over the last 3 years, all of the legs to the argument that the connection between the fuel cycle and proliferation is slight have been cut off, including the idea that the plutonium from a power reactor is denatured to the point that it cannot be used reliably in a weapon.

Another major aspect of the disagreement over nonproliferation policy has to do with the economics of breeder reactors as an energy source that might come into use perhaps late in this century or early in the next. For example, the Ford study points out that, while the United States may have such an abundance of uranium and other energy resources that breeders will not be needed until well into the next century (if then), less richly endowed nations find reprocessing and the breeder attractive. Although the study does not attempt to make an economic case for the breeder, neither does it dismiss the possibility that the breeder may be a serious energy option for some countries.

The Rowen-Wohlstetter study, on the other hand, suggests that within 2 or 3

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Eli Lilly Agrees Not to Monopolize Insulin Market

Eli Lilly & Co., which is considered to hold the lead in the production of finished insulin through techniques of recombinant DNA, has agreed under federal duress to license its know-how to any U.S. company that asks, and at no profit to itself. The agreement was reached with a regional office of the Federal Trade Commission (FTC) several months ago but was not announced until 19 September—after the Washington office gave its tentative approval.

Lilly agreed to license its past and future insulin technology after the FTC gathered evidence that Lilly has conspired for 27 years to monopolize the finished insulin market through exclusive licenses from firms holding key production patents, and through a lock-hold on the domestic supply of animal pancreases. The glands, which are sold by 1500 U.S. slaughterhouses, are necessary to produce insulin salt-cake and crystal precursors to the finished product.

According to the FTC, Lilly monopolized the market by ensuring that each slaughterhouse received only one bid for the glands—a bid that Lilly controlled through its arrangement with a handful of brokers and collection companies. This had the effect of eliminating competition, holding down costs, and ensuring a healthy profit from sales to insulin-dependent diabetics. Lilly allegedly enforced the conspiracy by cutting miscreant collection and brokerage firms out of the market through high bids and other devices. It dissuaded one firm, the Armour Pharmaceutical Company, from direct competition by buying up large quantities of its crystals and salt cakes, the FTC says. Lilly now shares the entire U.S. market with only one other firm, E.R. Squibb & Sons, Inc., and accounts for 85 percent of all domestic insulin sales (approximately $48 million in 1976).

Lilly, for its part, enters what is in effect a plea of nolo contendre; it signed the FTC order without admitting guilt merely to "avoid protracted and costly hearings and litigation." The company believes that its activities were responsible and lawful, states a public relations announcement. But FTC

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years the economics of the breeder may "look so poor" that even the French, the British, and German governments will doubt that the breeder will ever be needed. "Today we are going along with [those governments] and their programs because they are stonewalling," the authors say. "We are making it impossible—or at least much harder—for them to change their policy in the future."

The debate over what U.S. policy should be toward the nuclear fuel cycle and proliferation issue will almost certainly become increasingly audible over the next several months, as well it should. The stakes are high, and arguments put forward by people such as Rowen and Wohlstetter and Rathjens and company call for careful review.

—LUTHER J. CARTER

Hughes Institute Reborn amid Strife

Hughes money for medical research is being pulled out of Stanford, while increases for UC San Francisco are causing discord

San Francisco. If plans currently under consideration at the University of California San Francisco (UCSF) come to fruition, the Howard Hughes Medical Institute of Miami, Florida, within the next 5 years will build a multimillion dollar laboratory on the campus of the medical school here. This generosity is not that surprising. The Hughes medical institute owns all 75,000 shares of the Hughes Aircraft Company, one of the nation's top defense contractors, and for many years has supported research at 12 medical schools across the country. What is perhaps more surprising is that this same charitable organization has decided to pull its money out of Stanford University, apparently because of a petty squabble over funding.

At issue is not so much the amount of money that goes into research as the manner in which it is spent. At both Stanford and UCSF, the institute wants to consolidate its researchers into a single physical area, rather than leave them scattered across the campuses in separate laboratories. The reason is simple. In 1976, the Internal Revenue Service (IRS) challenged the institute's long-standing status as a "public charity," and Hughes officials, though they are loath to admit it, are now desperately trying to change their style of funding so they can retain the institute's tax-free status (*Science*, 19 January).

At Stanford, however, Hughes officials found that the medical school would not make the asked-for changes fast enough or cheaply enough to suit the institute's needs. At UCSF, on the other hand, administrators are bending over backward to accommodate the wishes of the Hughes officials—much to the chagrin of some faculty members. "It's really frightening," said one. "There's a sense that the academic environment is no longer sacrosanct."

The problem centers on the fate of the genetics program at UCSF, and whether or not it is being sacrificed to the expanding Hughes empire. The issue is significant, for as government funding of research declines, it is hoped that private organizations such as Hughes will take up some of the slack. Issues of academic freedom and self-determination are also important to the institute. Howard Hughes Medical Institute is currently engaged in a massive lawsuit to retain its automony from the Suma Corporation, which has authority over most of Hughes holdings—except for Hughes Aircraft, the most profitable of all. To help sway the court, the medical institute is trying to clean up its image as a respectable charity, and how gracefully it does this is sure to be noted.

That the image of the institute has not always been the best is shown by the fact that many believe it is an elaborate tax dodge. In the past this has clearly been the case, as revealed by the institute's tax records. From its founding in 1953 until 1969, for example, the institute had received a total of $36.9 million for "medical research." Of that, however, some $24.7 million had been returned to Hughes, in the form of interest payments on a loan he had used to originally set up the institute, and on lease payments for Hughes property.

Things stayed pretty much that way until 6 March 1976, when the director of the IRS district office in Jacksonville, Florida, informed Hughes officials that the medical institute would be designated a "private foundation."

One can imagine the reaction within the institute. If so ruled, it would have to pay up to $2 million in back taxes, have to divest itself of more than half its stock in Hughes Aircraft, and have to sink 6 percent of its total assets into medical research—an amount that some estimated would come to at least $40 million each year.

The institute was not about to take the Jacksonville ruling without a fight. It immediately appealed the decision to Washington, and on 27 March 1976 adopted what it called an "Expanded Medical Research Program," which called for sharply higher expenditures. It also called for the consolidation of Hughes researchers at its 12 centers into the same physical space on each campus so that they would better fit the description of a "public charity," such as a hospital rather than a "private foundation" that handed out grants. A publicity campaign was also launched. In December 1978, George Thorn, one of the institute's three executive directors, said in an article in the *New England Journal of Medicine* that "during the calendar year 1977, the institute received approximately $18 million for its research activities from the after-tax earning of Hughes Aircraft Company."

Had the institute at long last cleaned up its act? A glance at its tax return for that year suggests something else. Thorn failed to mention, for instance, that the institute paid close to $1 million on its long-standing loan that year, and that after making deductions for a few other items the institute paid out only $8.3 million for medical research. All this from a "public charity" that owns every share of Hughes Aircraft—a company reported to have had sales of more than $2 billion last year.

The fight to retain its "public charity" status is not over, however. After 10 years, the IRS has still not handed down a final ruling. There are signs, moreover, that the tight-fisted finances of the institute's officials and their Expanded Medical Research Program may prove to be mutually exclusive.

At Stanford, for instance, which cur-

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