got a taste of retrenchment this year when it had to apply a 4.3% reduction in spending mandated by Gramm-Rudman.

Although no radical surgery was required, the imposition of the 4.3% reduction probably offered some clues to Bloch's priorities. Bloch says he did not like the Gramm-Rudman provision for across-the-board reductions and was able to protect several programs. Those sheltered were mathematics and ocean drilling programs; graduate fellowships; special programs for women, minorities, and the handicapped; and a program to bolster the ability of states that have ranked low on winning NSF funding to compete for funds.

Mathematics had been relatively neglected in the past, says Bloch, and the program had been rebuilt at great cost. "To hit it makes no sense." The ocean drilling program represented an important international commitment. If the United States had reduced its share of funding, others would likely have followed suit.

The foundation also decided not to reduce the number of graduate fellowships or cut the fellows' stipends. That portion of the budget had to be reduced to conform to the law, however, and cuts were made in the educational allowance that goes to the fellowship holders' universities and is used for such things as salaries of principal investigators.

Special programs for women, minorities, and the handicapped are relatively low-budget items, but they have been regarded as vulnerable in the past. NSF officials familiar with Gramm-Rudman decisions say Bloch's sense of fairness came into play in protecting these programs as well as a recognition that such underrepresented groups will be an increasingly important source of scientists and engineers in the coming decade when demographic trends may result in shortages of scientific manpower.

On Capitol Hill, Bloch's penchant for planning and priority setting is apparently viewed favorably as a means of preparing NSF to make rational decisions if forced to pare programs. Bloch is regarded as frank in his dealings with legislators and apparently has scored well by taking responsibility when the foundation has been criticized and by providing information promptly when it is sought. As one Capitol Hill staff member put it, "He gets high marks on procedure."

On the other hand, members of the committees that deal with NSF have been getting expressions of concern from both constituents in the scientific community and from rank and file staff inside NSF about what may occur if new priorities are implemented at the expense of the foundation's traditional programs. A Hill staffer said the question being asked is "Would something important be lost in the traditional disciplines."

So far, Bloch's approach has affected the way things are done at NSF more than the results. In the coming months, however, the shape of the agency's budget for the fiscal year that begins in October will be decided. The outcome of budget negotiations between Congress and the Administration is in even greater doubt than usual. But the betting is that some of the hard choices Bloch has been preparing the foundation for will have to be made. ■ JOHN WALSH

Fill the Oil Reserve, Academy Report Says

While it saves money, the Administration's work stoppage at the reserve misses a chance to prepare for the 1990's

On 8 April, a group of oil experts at the National Academy of Sciences played Cassandra at the victory party. While others were celebrating the demise of OPEC, they released a study* warning that there should be no relaxation of the drive to complete the strategic petroleum reserve in the salt caverns of Texas and Louisiana.

This group, under the National Research Council's Energy Engineering Board, was chaired by Norman Hackerman, president of Rice University. It said that the availability of cheap oil from Saudi Arabia makes it more important than ever that the United States protect itself against import dependence in the 1990's. The recent price break, the panel members said, offers a chance to fill the reserve at discount rates.

The advice clashes with federal policy at present. In order to trim the budget this January, the Reagan Administration ordered a "moratorium" on filling the reserve. It also stopped construction at the sixth and final underground reservoir, at a site called Big Hill, near Beaumont, Texas. The decision ended what may have been the government's most effective single investment in dealing with the threat of an oil blockade. The budget cutback, together with technical weaknesses noted by the Academy group, may leave the reserve ill prepared for the next decade.

Meanwhile, members of the Academy panel conceded that dramatic changes in the market during the past few months have rendered parts of their report obsolete. Some of the recommendations now seem irrelevant, while others are understated. One year ago, the panel's main concern was with imported refinery products, and now, it is with cheap crude oil.

The most important change in the picture is the decline of crude prices from $30 per barrel last November to $13 in April, triggered by Saudi Arabia's decision to boost production. The collapse has thrown the foreign oil producers into chaos and disrupted the finances of U.S. oil states such as Texas, Oklahoma, and Louisiana. Most significantly, it has begun to dampen U.S. oil production and reduce commercial reserves. This adds urgency to the report's message that the federal reserve should be filled as originally planned, for U.S. sources of oil may decline more rapidly than expected.

While the market upheaval has hurt oil sellers, it has benefited the refiners. In this area the experts' advice fell farthest from the mark. Because prices at the gas pump will change more slowly than crude prices, refiners may be able to make unusual profits. In time, gasoline prices will come down, but during the period of adjustment, some refiners may reap a windfall. This means that U.S. refiners are far from desperate.

In addition, U.S. refiners have been helped, according to panel members, by Saudi Arabia's decision to abandon plans to compete with them. After investing heavily in new refineries, the Saudis have discovered that it makes no economic sense to ship gasoline and heating oil across the Atlantic

*"The Logistics of the U.S. Strategic Petroleum Reserve in the World Petroleum Market: 1990–2000," published by a National Research Council committee chaired by Norman Hackerman, president of Rice University.

in the current glutted oil market. Saudi Arabia profits more by competing strictly in the area where its strength lies, in large-volume crude sales. William McKinnell, Jr., director of research for the Marathan Oil Company in Colorado, said, "Today there is little incentive for a Middle East refiner to ship product to the United States."

As a result, Saudi refineries are said to be running at half-capacity. This turn of events "makes moot" one of the panel's chief worries, said Edward Krapels, president of Energy Security Analysis, a consulting firm that tracks oil inventories around the world. This was the fear that U.S. consumers might grow to depend on refined imports from abroad, and that the U.S. refining industry would go into decline. If this happened, an embargo could start a run on refined products, even if the reserve contained adequate supplies of crude. This led the panel to think it might be necessary to build new, complex storage tanks to hold gasoline and heating oil. That worry no longer seems relevant.

However, the panel did see a need to finish work on the Big Hill oil storage cavern in Texas, the final addition to the strategic reserve. The reserve was authorized in the Energy Policy and Conservation Act of 1975. Since then the law has been amended almost every other year. The last revision in 1985 called on the Department of Energy (DOE) to finish developing the reserve, so that it could store 750 million barrels and operate at a drawdown rate of 4.5 million barrels a day. However, the President twice has decided to "defer" the roughly $560 million to be spent on these goals, leaving the reserve with an anticipated 502 million barrels (as of the end of May 1986), and a drawdown capacity of 2.4 million barrels a day. With America's net petroleum imports last year hovering around 4.3 million barrels a day, the Administration has left a gap between what might be needed in a crisis and what is available.

The Academy group reviewed and endorsed recommendations of a National Petroleum Council study in 1984, to the effect that more local pipelines be built to increase the reserve's drawdown capacity. It pointed out that a sophisticated traffic plan would have to be drawn up to manage the ships crowding around the docks to collect oil during a crisis. And it urged DOE to run realistic tests, even to the point of taking large quantities of oil from the reserve once every 2 or 3 years to challenge the system. Finally, it said the reserve should be filled to its planned size of 750 million barrels, to make it credible as a 100-day source of supplies through the end of the century.

Thus far, the Administration has refused to change its mind about the budget, despite the fact that Congress explicitly overruled the deferral last year. For this reason, the U.S. Comptroller General, who comes under Congress's jurisdiction, has given notice that he will sue DOE this month for failure to obligate the funds.

Department of Energy

Site of a potential traffic jam?

The St. James Docks, Louisiana, where oil from the strategic reserve may be loaded onto tankers.

The main reason to be concerned about the adequacy of the reserve is that U.S. production cannot be expected to grow in the 1990's, according to Baine Kerr, a panel member and president of the Pennzoil Company of Houston. With lower prices, the demand for oil will increase. But even if it doesn't grow very much, Kerr said, several things indicate that the United States will continue to depend on imports. Kerr pointed out that all of the major estimates of undiscovered oil in the United States have come down in the last 10 years. For example, in 1981 the U.S. Geological Survey reduced its estimate of undiscovered oil in the United States to one-fourth the level given in 1976. A new study by the survey, due out this year, is expected to be even lower, according to Kerr. He added that offshore areas have not proved as rich as had been hoped, and production of oil from Alaska may peak around 1990.

As events have shown, the oil market is impossible to predict because it is so heavily influenced by politics. But it takes no genius to realize that oil that is not discovered cannot be produced. Thus, decisions by the industry to cut back on exploration will be translated into lower production rates 5 years from now. In his presentation, Kerr pointed out that six large oil producers have been acquired by other companies since 1982 and three major oil companies have been restructured. The result is that all are saddled with debt and administrative angst, and "must reduce exploratory and development activities, particularly long-term, high-risk ventures."

The price collapse has caused reductions as well. Exxon spokesman William Smith confirms that his company has cut its capital and exploration budget by 26%, and another oil company executive says, "everybody in the industry has cut back 25 to 30%. . . . We're talking about sharp reductions in exploratory drilling, especially in frontier areas." DOE reports that the active rotary drilling rig count in the United States has dropped from the peak of 3970 in 1981 to around 987 as of 7 April.

"Stripper" wells, yielding small incomes and less than ten barrels of oil daily, offer another indicator of the future. According to Timothy Dowd, executive director of the Interstate Oil Compact Commission (IOCC) in Oklahoma City, Oklahoma, the price collapse will bring a massive shutdown of these wells throughout the Southwest. A recent study done for the IOCC found that many of these wells do not pay for themselves at the price of $15 a barrel. The IOCC predicts that, if the price remains at $15 for a year, an above-normal number of these wells, amounting to 102,000 or 22% of the national total, will close down, probably for good. This would represent 277,000 barrels a day in lost production in the first year and a loss of oil reserves amounting to 733 million barrels. Once plugged, as environmental law requires, "We don't believe they will be redrilled," says Dowd. "Nobody intentionally drills a three-barrel well."

The price decline could kill programs aimed at "enhanced recovery" from declining oilfields as well. Dowd predicts that in many cases, if these operations are abandoned, they will never be resumed until oil reaches $100 a barrel because the cost of drilling is prohibitive. "At $28 or $30 a barrel, some of this stuff makes sense, but not if you have to drill the whole field again."

The message in the statistics is that the federal oil reserve is an adjunct to a much bigger system of privately owned reserves. And if the price of oil remains as low as it is now, private reserves and production will decline with it, leaving the United States once again susceptible to import dependence. Thus, it becomes more, not less, important to bring the strategic oil reserve into line with the original design plan. ■

ELIOT MARSHALL