nium is going to be retired?" He says that the need for more plutonium may arise from new weapons which will replace nonplutonium bombs.

Government officials will not say whether the new warheads will enlarge the present supply, estimated at 20,000 warheads, because the information is classified. Brzezinski's assistant remarks, "The only thing I can say is that the number of weapons has trended downward in the past."

The Natural Resources Defense Council, in an effort to push the Departments of Energy and Defense into a public discussion of the need for more plutonium, is asking the two agencies to discuss the issue in environmental impact statements covering consequences beyond those involving the immediate geographic region. In a recent letter to the department heads, NRDC said that the government should make an evaluation of whether the weapons program increases or decreases the likelihood of nuclear war.

NRDC may or may not have a case. A DOE official says that in his opinion the department is not obligated to examine these wider concerns. A member of the Council on Environmental Quality says that NRDC raises some "reasonable questions," but notes that the courts may have to decide whether the government will have to answer them.

—MARJORIE SUN

# Nuclear Fuel Account Books in Bad Shape

## *NRC statisticians find many discrepancies, say a clever thief could beat the system*

"Would you rather put your money in a bank with a battalion of guards and a sloppy accounting system, or would you choose a bank with a few guards and good accounting?" The question is posed by Sidney Moglewer, an official in the safeguards division of the Nuclear Regulatory Commission (NRC).

Moglewer would choose the latter, and that is why he and a group of NRC statisticians are trying to persuade the NRC to improve the methods it uses to keep track of special nuclear materials such as highly enriched uranium and plutonium, which can be used to make nuclear weapons. The consensus of these staffers is that the NRC's statistical checks on fuel shipments have become so muddled in recent years that they are now meaningless.

The staff brought the problem before the commission twice in 1980, once in an open briefing on 31 March and more recently in an information report* filed on 20 November. The report lists 13 specific deficiencies in the NRC's accounting techniques, some of which are fundamental and easily remedied, others of which would require an enormous campaign to rectify. The significance of the report is clear, however. One can have little confidence at the moment that the NRC's system of accounting would catch a skillful fuel thief.

There are physical barriers to prevent the theft or loss of weapons-grade material. Processing plants are well policed, and workers are screened. The NRC maintains controls on the handling, packaging, and shipping of radioactive fuel. Yet these systems are not as strong as they could be with good accounting, which serves as a general monitor on security. It is a simple and sure way of telling whether or not there are leaks in the network. If the statistics are unreliable, one must depend heavily on inspection and physical controls, which have never proved very successful in stopping thieves in other circumstances, certainly not embezzlers.

This problem is especially important for international programs to control nuclear material, for they rely exclusively on statistical monitoring techniques to guard against diversion.

There are several indications of trouble in the accounting shop, but the best evidence comes from a recent study of discrepancies in the records of 17 processors of special nuclear materials (see chart). The NRC asks each processor to keep track of material delivered and shipped out, just as a bank keeps records of funds received and paid. The purpose is to impose high standards of management on the plants and to give the NRC a technique for spotting sloppiness. A sudden discrepancy in the books, which

### WHAT DOES EXPERIENCE SHOW?

**NRC Inventory Experience**
**April 1974 - December 1978**

| | | |
|---|---|---|
| Number of Facilities | 17 | |
| Number of Inventories *With LEID Reported:* | *803* | |
| Number of Inventories Where \|ID\| > LEID. | 375 | — Nearly Half !!! (When There is No Loss/Diversion, about 40 \|ID\|s Would Be Expected to Exceed LEID) |

Opinion: Something is wrong !

Source: Nuclear Material Safeguards Status Report (White Book), IE, June 1979

***Where the system breaks down***

*This chart showing the record of discrepancies (ID's) in nuclear fuel accounts was presented to the NRC in an oral briefing last spring. Prepared by statistician Dan Lurie, it reflects the staff's view that "something is wrong" in the monitoring system. Significant discrepancies turned up far more often than one would expect.*

* "Report on the Statistical Treatment of Inventory Differences," filed 20 November 1980 before the NRC.


0036-8075/81/0109-0147$00.75/0 

usually shows up as a surplus in the receipts column, may indicate that material has been lost or stolen on its way through the plant. On the other hand, it may indicate only that supervisors have failed to keep good discipline over those who measure and account for the goods. The risk in tolerating bad bookkeeping is that, although not harmful in itself, it creates an atmosphere in which theft is easy.

The NRC refers to discrepancies in the fuel shipment records as "inventory differences" or ID's. Normally, one expects a certain amount of sloppiness in keeping accounts. This is especially true of nuclear fuel handling, where the material being counted may be inaccessible and, in some chemical processes, very hard to measure. Nevertheless, the NRC officials decided that they wanted to allow for no more than a small variability in the discrepancies on the fuel account books. They devised a term for this concept, strongly disliked by statisticians who have looked at the problem, called the "limit of error" on inventory differences or LEID. The statisticians say the term has not been defined in a precise or even in a consistent manner. Each processor may come up with his own definition. But in any case, LEID is meant to represent the degree of uncertainty in measurement one may tolerate under normal conditions and still be confident—95 percent of the time—that no theft or loss has occurred.

If statisticians were allowed to define the concept, they would say that the ID is the estimator of losses or discrepancies, and that two times the standard deviation of the ID gives you a figure for uncertainty in measuring the ID—called in this case the LEID. If the ratio of the ID to the LEID is less than 1, one may accept the statistical hypothesis (with a 5 percent level of significance) that there has been no loss or theft. In practice, one may feel confident that no thefts or losses have occurred if, 95 percent of the time, the reported ID is less than the index of LEID.

When the statisticians applied this concept to actual figures sent in by NRC licensees, they got the disquieting results shown in the chart. Between 1974 and 1978, the NRC received 803 inventory reports which included data on ID's and LEID in computing the ID's. Among these, the statisticians found, the ID exceeded the LEID in 375 cases—nearly half the time. Had this happened at a bank, a massive search for the embezzler would have been launched. The statistical alarms were ringing almost continuously.

The NRC staff recently tested these results a second time to find out if there had been a flaw in the calculations. Using more recent and more carefully selected data, the staff managed to lower the statistical alarm rate. In this study, the ID exceeded the LEID only about one-third of the time. But that is far above the business-as-usual rate of 5 percent. Dan Lurie, the statistician who briefed the commission on the problem last March, simply concludes: "Something is wrong."

No one can say for certain just what is wrong, although many possibilities have been discussed. The one judged by the NRC staff to be the least probable is that large quantities of fuel are being lost or diverted. There is a mundane explanation for the discrepancies. Most of the trouble derives from sloppy accounting and measuring at the plants, the NRC staff thinks. The statisticians at the NRC also see flaws in the theoretical structure of the accounting system. As one said, "There is blame for everyone: there have been sloppy measurements, bad calculations, and—what's a nice word for coercion?—management impositions."

The NRC statisticians think several things could be done to reduce the false alarm rate (which is what they judge the problem to be) and thereby make the account books more meaningful. The first step, according to Roger Moore, a Census Bureau official who until recently was in charge of applied statistics at the NRC, is to do away with the NRC's vague and inconsistent regulatory term, "limit of error." He says, "It should have been drowned when it was born." A standard statistical term should be substituted in its place, and he has one in mind: twice the standard deviation of the ID. Then, Moore says, something should be done to repeal a letter of guidance sent out to licensees by the NRC in 1974. The letter "got us into trouble," he thinks, for "that was when things began to come apart, I mean really apart."

The letter, sent out in December 1974 by R. G. Page, put a limit on what the NRC called the limit of error. It seems to have been an attempt to tighten up the original regulation, but it made matters worse. Instead of developing a better statistical basis for reading the books, this action switched the NRC to a purely arbitrary system of investigating discrepancies. Although expressed in more complicated terms, the revised rule of 1974 triggers the alarm when the reported ID is larger than 1 percent of a plant's deliveries or shipments. It is an unso-

*(Continued on page 150)*

## A Cooler Look at Laser Weapons

The Department of Defense, which has spent two decades trying to produce a new tank, has been talking a lot lately about laser beam weapons. Apparently, the generals are going to build some space-based laser stations, castles in the sky that will strike down Russian missiles a few seconds after launch. The Air Force is going to equip its planes with laser-beam antiaircraft and antisatellite guns, the Army will field laser-toting tanks, if it has managed to build any tanks by 1990, and of course the Navy will go to sea with lasers galore.

Supporters of laser weapons say that the Reagan Administration will make still larger the sizable sums already being expended on laser research. For the last several years the Pentagon has been funding these high-vacuum theoretical weapons at an annual budget of around $200 million on the largely implicit premise that, with infusion of sufficient money, Buck Rogers can be made to live. Unfortunately, a number of physical obstacles still stand in the way of this reanimation.

One is the weather. The lasers can mug a MiG in a clear sky, but are very disappointing in fog or drizzle. What if the other side should be so disobliging as to attack on a rainy day? While the generals are working on that problem, the technicians are trying to fix another of nature's quirks, that so far one of the best materials for lasing is deuterium fluoride. New deuterium is a substance expensive even by the Pentagon's standards of gold-plating, and fluorine is too unpleasant a gas to risk having aboard any military vehicle.

There is of course the carbon-dioxide laser. This is the leading candidate for arming the Pentagon's Battlestar Galacticas. The first difficulty with these fancy space stations is that of deciding where to put them. If you place them in low orbit, their field of view is rather small and you need a great many to cover Redland. If, on the other hand, you put them in high, geosynchronous orbit, they are sitting targets. Of course, you can then build a fleet of small space stations to protect the vulnerable big one, following the Navy's principle of constructing air-


0036/8075/81/0109-0148$00.50/0 

(Continued from page 148)

phisticated approach to accounting, based, Moore says, neither on good theory nor on good observations. It is "a regulation imposed to accommodate a problem in a previous regulation. But this new one made the problem worse."

Moore is not alone in his criticism of the NRC's accounting system. In 1979 Moglewer wrote a memo to the former NRC chairman, Joseph Hendrie, warning that because of problems in collecting data, the NRC "cannot meaningfully use ID data to detect diversion." The statistics are so weak, he wrote, that the entire regulatory framework built around the accounting system is unstable.

Carl Bennett, a statistician at the Battelle Corporation and a recognized industry specialist in the field, says that "it may come as a surprise to some people, but the entire decision structure that's in the current regulations [dealing with inventory losses] has essentially no statistical basis at all." It is, he says, a "purely arbitrary" regulatory system, one that sets off false alarms and demands unnecessary investigations.

Richard Gramann, an official in the materials accounting division of the NRC, reports that the agency is working on an "upgrade rule" designed to improve the accounting system. Changes now under discussion, he says, should make it possible to reduce the number of alarms and resolve discrepancies in data within days, rather than months, as is the case now. He expected the proposal would be ready for a public airing next spring.

Commissioners at the NRC are aware of the trouble with the fuel account books. But if the small sample of opinions taken last week is characteristic, they tend to see it as an intractable physical problem, not as a problem in data gathering. Commissioner Victor Gilinsky, for example, thinks that "people may be getting too sophisticated in trying to keep track of stuff at one or two facilities." The difficulty, he says, is that "you've got some old plants that are not set up to measure things accurately, and they happen to supply fuel for the Navy." Because the fuel is regarded as essential, the normal accounting standards have been waived in at least one case to permit the continuing production of fuel.

Another interested commissioner spoke on background about the problem, specifically identifying the chief source of trouble as the Nuclear Fuel Services plant in Erwin, Tennessee. It is the main supplier of fuel for the Navy's nuclear submarines. The intrinsic accuracy of material measurement at Erwin, he thinks, is not more than a percent or two at best. "The ships must go to sea," says the commissioner, and "although we continue to do materials accounting as best we can, we just have to face the fact that we're not going to be able to have the precision we would like—down in the kilogram range." He concludes: "We're just going to have to live with those ID's until we build a better processing line than Erwin."

Erwin, according to one member of the NRC staff, now produces discrepancies or losses of about 1 kilogram of highly enriched uranium a month. It has been estimated unofficially that it takes no less than 3 and no more than 15 kilograms of weapons-grade material to build a nuclear device. This fact makes the NRC statisticians quite nervous, even though the NRC as an agency has concluded that there is no danger that nuclear fuel is getting into the wrong hands.

The statisticians may have to live with their frustrations and worries for some time. Even the commissioners most sensitive to their concerns seem to think, as one of them said, that the root problem does not lie in statistics, but in ancient machinery which is not going to be replaced soon.—ELIOT MARSHALL

# Auto Crash Tests Unsettle Japan and Detroit

## *Consumer awareness will force auto safety improvements if Joan Claybrook has her way*

A newspaper advertisement in the New York area features ambulance attendants loading an accident victim into their vehicle, parked next to a demolished foreign auto. The copy reads, "But it got 43 mpg!" and goes on to ask, "In what are your children driving tonight? Is it a car which passed the latest U.S. safety tests?" The sponsors of the ad are local Chevrolet dealers, whose Chevette autos outperformed their foreign competition in recent crash trials.

The ad is attracting reproof on Madison Avenue and in Japan, but it leaves a smile on the lips of Joan Claybrook, the head of the National Highway Traffic Safety Administration (NHTSA). As the official with primary responsibility for persuading the automakers to design and build safer vehicles, Claybrook has long urged that safety features be advertised competitively. "This is an area where we can compete quite successfully, because the Japanese have never given a priority to safety," Claybrook says. "There's no question but that the U.S. manufacturers have missed a bet in terms of sales and have really denied the public the kind of protection it should have and that's really a shame."

Claybrook, 43, is critical of the industry for failing to provide better passenger restraints, improved crash protection, tougher tires, and exteriors less likely to cause serious pedestrian injuries. She recently wrote to the presidents of the large automakers (Ford, Chrysler, General Motors, and Volkswagen of America) and exhorted them to do better. "With the introduction of large numbers of small cars on American highways," she wrote, "we can anticipate an increase of 10,000 to 15,000 lives lost per year. You should consider that in the years ahead the automakers' view that safety has no market value could prove to be just as wrong as their attitude a year or two ago toward fuel efficiency."

Combative language is not unusual for Claybrook, who previously worked as an attorney for a public interest group funded by Ralph Nader, the industry's initial bête noire. She has received no official word from Andrew Lewis, Reagan's choice for secretary of transportation, but fully expects to be replaced. The industry, at least, would be delighted to see her departure. During the past 4 years she presided over controversial investigations of fuel tank hazards, tire hazards, and transmission defects; she also signed recall orders affecting three times as many autos as her predecessor


0036-8075/81/0109-0150$00.75/0 