Crowson, head of OSMM, audits for plutonium-239 loss average within +0.18 to 0.51 percent, with 0.2 percent "not unusual."§

However, scientists working for AEC on this problem say that the above figures do not reflect the margins of uncertainty involved—which sometimes run as high as 1 percent or more. Current calculations, they say, are based on estimates, for example, of how much strategic material might be in a scrap heap—not on precise, actual measurement.

AEC is now working to revise its guidelines for industry so as much guesswork as possible will be eliminated. Thus, when the amount of material involved begins to climb, and IAEA begins its formal inspections in March 1972, AEC will have a more realistic tab on the materials.

But critics of AEC safeguards find the holdup or hijacking scenario more likely—and less well guarded against—than smuggling. Crowson told *Science* that the most likely point for materials theft is the fuel reprocessing plant. But critics, including Dr. Theodore Taylor, former safeguards consultant to the AEC, believe that loading, shipping, and transfer processes are most vulnerable. Dr. Taylor believes there is a good chance that the planes which carry the materials by commercial air freight could be hijacked.

There is not much chance for the public to examine the security measures now in force. But in early 1969, a *Wall Street Journal* reporter visited the one commercial reprocessing plant now in operation, of which four more are being built or planned.

Writing in *Esquire* magazine in May 1969, the reporter, Alan Adelson, reported that security seemed weak at Nuclear Fuel Services, Inc. (NFS), in West Valley, N.Y. He alleged that a third of the NFS employees have "the lowest level security clearances" and that the "room where the nearly bomb-ready plutonium solution" is prepared for shipment "is directly accessible to the outside through a glass-paned door." He said the drivers of the van which were to carry a shipment of plutonium equivalent to that needed for 12 atomic bombs across the country had "no escort, no radio transmitters, and no weapons."

NFS officials reply that the glass door is on the other side of the building from the room where the plutonium is prepared, and that all the plant employees are now in the process of being cleared by the government. They also say that in certain processes, materials unaccounted for can run as high as 1 percent.

Boffey to Head Nader Study

Philip M. Boffey, a member of the News and Comment staff for the past 3½ years, has resigned, effective 12 April, to conduct a study of the National Academy of Sciences–National Academy of Engineering–National Research Council under the sponsorship of Ralph Nader's Center for the Study of Responsive Law. The study is expected to take about 9 months and to focus on Academy activities that have an impact on public policy. Boffey can be reached at his home, 5511 Montgomery St., Chevy Chase, Md., 20015. Telephone: (301) 657-8129.

The Lumb Report

Taylor, citing, among other things, Commissioner Larsen's speech, told *Science* that AEC's posture on safeguards had in fact improved. "The pre-Lumb view of safeguards was that it was an accounting problem, that the government had to track the material because it was expensive. The post-Lumb view of safeguards is that AEC should be concerned about the possibility of removal."

The turning point, he said, was the report of a special advisory panel on safeguards chaired by Ralph Lumb, then at AEC, which was submitted in March 1967.

The panel was skeptical at first that a black market was a real possibility; but the Bradwell, England, and Apollo, Pennsylvania, incidents which occurred during their study apparently helped change their minds.||

The panel reported on a comprehensive series of safeguards actions, ranging from U.S. international responsibilities to criminal penalties.

To date, while some of the recommendations have been implemented, many have not. And Dr. Lumb, who is now a private consultant, told *Science* that although he had not kept close track of developments at the AEC, he did "not believe a great deal has changed since that report was issued."

The panel recommendations included the establishment of a single AEC safeguards office, safeguards research and development, design review of all proposed facilities, establishment of quantitative standard losses, U.S. support of the IAEA, and establishment of an international school of inspectors. All of these have been done.

But in two key areas, criminal penalties and security clearances, the Lumb panel has not borne fruit. The panel requested that personnel having access to "significant" quantities of unclassified special materials should have the lowest level security clearance. But as reporter Adelson learned at West Valley, N.Y., many people there were still not cleared.

The panel's first recommendation was that the Atomic Energy Act of 1954 and the Atomic Weapons Rewards Act of 1955 should be modified to provide severe penalties for diverting nuclear materials and to reward information about diversions.

The 1954 act has indeed been amended, but the penalties are still fairly light. Only if the lawyers can prove the difficult legal point of intent, that a suspect diverted materials "with intent to injure the United States or gain advantage to a foreign power," can he be given life imprisonment, or a $20,000 fine and jail sentence. Otherwise, he is subject to a fine of up to $10,000 and perhaps a sentence of 10 years or less.

But now, 4 years later, there is still no statute installing the much-recommended bounty system rewarding information on diversions, which both the Lumb panel and many others have urged.

Shipping: The Weakest Link

One of the anachronisms of AEC policy is that strategic nuclear materials which are to be used for military purposes are shipped under military rules. But, if the same materials are to be used for civilian purposes—although they too could fuel a bomb—they are usually shipped, in the words of Crowson, "like a special delivery letter."

Part of AEC's mandate is to promote private industry. In this case, it gives its business to commercial carriers. Sometimes the carriers, particularly railroads, have refused to ship

§ Reprint from Safeguards Techniques, "Progress and Prospects for Nuclear Materials Safeguards," by D. L. Crowson, IAEA SM 133/60, Vienna, 1970.

|| "Report to the Atomic Energy Commission by the Ad Hoc Advisory Panel on Safeguarding Special Nuclear Material" submitted 10 March 1967.