Briefing:

Sensitive Nuclear Technology Escapes Detailed Export Review

Sensitive nuclear technology, some of which could be useful for manufacturing nuclear weapons, has been transferred to at least one foreign nation without adequate screening by the Department of Energy, according to a study by the General Accounting Office. In a 78-page report released on 15 May, GAO blames the department for failing to establish standards for uniform evaluation of requests to export nuclear technology.

Testifying before a House subcommittee on energy conservation and power, Patricia Abel, a nuclear engineer at GAO, noted that DOE is in an awkward position because it has a dual role of promoting nuclear technology and policing its international transfer. It is responsible for approving or denying export of information and technology related to uranium enrichment, reprocessing, heavy water production, and plutonium fuel fabrication.

Applications to export nuclear technology frequently escape detailed interagency review because DOE places them in a so-called "general authorization" category, GAO says. The result, according to the report, is that American companies are able to "develop and provide to foreign countries proprietary documents that not only include previously published information, but also incorporate the experience and special knowledge of the firm." When the information is enhanced in this way, GAO observes, it may then become "sensitive nuclear technology," a designation requiring specific export authorization.

In preparing its report, GAO focused on seven incidents that occurred between 1980 and 1985. The areas of prime concern were nuclear fuel reprocessing studies and reviews conducted for Japan by Bechtel Group, Inc., and for South Korea by Battelle's Columbus laboratory. In the case of South Korea, a report contained new analyses of nuclear fuel reprocessing together with data citing how coprocessing affects production of plutonium, which can be used for nuclear weapons.

Under the general authorization provisions, companies are explicitly prohibited from supplying documents to foreign countries that contain analyses or conclusions. According to GAO, the Subgroup for Nuclear Export Coordination, an interagency task force, concurs with GAO's finding that "significant assistance to foreign nuclear programs" appears to have been provided.

The report, prepared at the request of Representative Edward J. Markey (D–MA), who chairs the House energy conservation subcommittee, recommends that Secretary of Energy John Herrington overhaul general authorization regulations to include only literature that has been previously published and is readily available. GAO also suggests that any new documents, even if compiled from public data, be subject to review by DOE. Edward V. Badolato, deputy assistant secretary for security affairs at DOE, says the department will soon be adopting tighter procedures for screening exports of nuclear data and technology. ■

MARK CRAWFORD

A Math Image Problem

Mathematicians have an image problem. Most people, the mathematicians lament, think their field is abstruse and fail to appreciate how even the most abstract mathematics can be crucial to important problems in other disciplines. It was to help remedy this situation that the National Academy of Sciences' Board on the Mathematical Sciences held a symposium on 12 May, called "Mathematics: The Unifying Thread." Their goal

Steven Weinberg. *Some mathematicians write in "a lapidary style."*

was to inform journalists and policy-makers of "the essential element linking . . . diverse scientific endeavors—mathematics."

But the attendance at the meeting amply demonstrated the image problem. Out of 40 Washington area journalists invited, only five showed up. Three of the five were from the AAAS, one was from a math society, and one was from the Voice of America.

The lecturers at the symposium, all Nobel laureates, were Allan Cormack of Tufts, who spoke on CAT scans, Herbert Hauptman, president and director of the Medical Foundation of Buffalo, who spoke on x-ray crystallography, and Steven Weinberg of the University of Texas at Austin, who spoke on elementary particle physics.

Weinberg, in particular, stressed what he termed the "spooky" connection between math and physics. String theory, for example, the hot topic in elementary particle physics today, makes use of highly abstract math as its very language to describe the strings and speak of their interactions. Yet this math, the topology of fiber bundles, was developed by mathematicians who had no thought of physical problems in mind. Weinberg takes delight in using pure math in his work and told his appreciative audience that he particularly enjoyed referencing a paper by the English mathematician G. H. Hardy, who studied number theory and wrote a book, *A Mathematician's Apology*, in which he bragged that his work is of absolutely no practical use to anyone.

Yet during a panel discussion following the talks and at the dinner that concluded the meeting, at least some explanations of the mathematicians' image problem emerged. Weinberg pointed out that mathematicians sometimes seem to be purposely inaccessible. "When physicists write an article, they generally start with a paragraph saying, 'Up until now, this has been thought to be the case. But now so-and-so has pointed out this problem. In this article, we are going to try to suggest a resolution to this difficulty.' " But in mathematics, says Weinberg, "I have seen not just articles but *books* in which the first sentence in the preface was, 'Let A be a nilpotent subgroup.' Those books are written in what I would call a lapidary style. The idea is that there should be no word that is not absolutely necessary inserted merely to help the reader understand what is going on."

Mathematicians also seem to fail to understand what the press considers news. They believed that having three Nobel laureates speak at their symposium should, by itself, draw the press. "Don't you think it is news when three Nobel laureates get together to talk about how mathematics is important to their work?" one mathematician asked *Science*.

And, finally, mathematicians are inexperienced in translating their work for the general public and for policy-makers. At the symposium, they distributed copies of a pamphlet called "Mathematical Sciences: A