IAEA Seeks Better Ways to Detect Nuclear-Material Diversion

The Nonproliferation Treaty poses a basic challenge to the International Atomic Energy Agency: Can it develop the skills to prevent the diversion of nuclear materials to bomb making by signatory nations that now do not have nuclear weapons?

By the end of June, 11 countries had ratified the treaty, including one weapons country, the United Kingdom. When 40 countries have ratified—of which three must be weapons countries—the treaty will go into effect. (The USSR has signed but not ratified. The US has signed and the Senate given its approval; the treaty now awaits ratification by President Nixon.) IAEA then will have two years to put its inspection system to work.

The treaty is designed to prevent the spread of nuclear weapons in two ways:

- prohibit the nuclear powers from transferring atomic weapons to others or helping other states develop a nuclear arsenal.
- bar the non-nuclear states from acquiring or developing atomic weapons. The non-nuclear states would be required to accept IAEA inspection.

To find out what the problems are and how IAEA is meeting them, PHYSICS TODAY talked to Allan D. McKnight, who until last October was IAEA inspector general, responsible for existing diversion-safeguards inspections and intimately concerned with preparing for Nonproliferation Treaty inspections. (He was succeeded by Rudolf Rometsch of Switzerland.) McKnight sees real progress being made in solving the technical problems of inspection, but the margins for error that exist today are still large enough for a country with a large atomic-energy program to divert enough nuclear material for several weapons a year.

Reprocessing plants. McKnight thinks that currently the most likely point of diversion is the plant where reactor fuel elements are processed. He cites two reasons.

- Classic chemical analysis today leaves a measurement error in calculating losses that "should hopefully always be under 1%—but I think you have to run the risk that it will be as high as 2%." McKnight added that 2% of output could be enough to make several weapons a year.
- Plutonium is in its most accessible form at the reprocessing plant. (IAEA leaves the question of hijacking fuel-element and plutonium shipments to each country's own internal security measures.)

US physicists at Los Alamos, Brookhaven and Gulf General Atomic are trying to develop instruments that would use neutron bombardment and emission to measure very precisely the isotopic and chemical composition of fuel elements. The British are working on permanently installed, tamper-proof monitors that by gamma sensing would record all fuel movements.

At least five countries are doing research on the problem under IAEA contract: Canada, Czechoslovakia, South Africa, the USSR and the UK. IAEA has a $150,000 budget for such work, but recipient nations commonly

ALLAN D. MCKNIGHT, former IAEA inspector general, talks to PHYSICS TODAY editors Gloria Lubkin and Jack Wiley about diversion-safeguards inspections.

RESONANCES

A National Science Foundation appropriation of $420 million has been approved by the House of Representatives, which must still give its authorization. NSF had asked for $500 million.

Two Tokomak proposals have been endorsed by the AEC standing committee on controlled thermonuclear research. Of the five proposals submitted (PHYSICS TODAY, July, page 67), those of Princeton and Oak Ridge were considered most likely to yield definitive data quickly.

Federally supported research in universities will be one discussion topic when AIP invites its society officers and Corporate Associates to their annual meeting. Gerald Tape, president of Associated Universities, Robert A. Frosch, assistant secretary of the Navy and Jay Orear of Cornell will be panelists at an evening session on 29 Sept. (held at the Carnegie Endowment International Center in New York City).

spend five times as much of their own money.

For protection while the elements are actually in the reactor, IAEA will rely where it can on physical security —traditional devices such as seals on reactor heads.

Scientists are trying to refine calculations of how much uranium is burned up and how much plutonium is produced in the reactor. These calculations could become redundant if other researchers succeed in finding ways to fingerprint—uniquely identify —individual fuel elements. McKnight feels the prospects are good for fingerprinting large American-type fuel elements. Problems arise with smaller elements used in constantly refueling reactors of the type found in Europe. Fingerprinting would make it impossible to divert a fuel element and replace it with a dummy.

The agency has relatively little experience with full-scale reprocesing plants. McKnight said the only one it has ever had access to is the Nuclear Fuel Services facility in upstate New York. IAEA has made inspections there since August, 1967. A 12-man team was there in June and July.

To start its inspection, the team observes the mechanical chopping of newly arrived fuel elements. The team tries to establish a statistical basis for how much plutonium is lost in the discarded metal casings.

Next the team determines to its own satisfaction the volumetric content of the dissolver tank; new techniques are being developed for this. Finally classical analysis is used on the dissolver, waste stream and the plutonium output stream. The carboys are weighed as they leave.

IAEA inspectors use two checks on their chemical sampling:

- Some of the samples are analyzed in another laboratory in a different country.
- Standard samples are fed into the stream, and the inspectors match the plant's own analysis with what they know to be present.

McKnight explained that the same schedule of inspections used under the existing diversion safeguards agreements probably would hold for Nonproliferation Treaty inspections. One check is made for each 5 kg of fissionable material in the inventory or annually being put through or produced by a reactor. When the activity level exceeds 60 kg or 12 inspections a year, the agency has access at all times. It also would have constant access to a fuel fabrication plant with a throughput of 5 kg or more a year.

He feels that the potential cost has been exaggerated greatly in some quarters. A professional staff of about 200 in the field, with a headquarters staff in Vienna backing it up, could do the job, he said. Estimates of hundreds of millions of dollars a year are way out of line.

Once a country has enough nuclear activity to warrant its own reprocessing plant, McKnight suggested, IAEA could establish resident inspection teams that would be based at the most vital plant but which could take a few days now and then to check other plants around the country.

Treaty ratification. Neither McKnight nor anyone else knows when the treaty will come into effect. He said he is disappointed that some of the nations that have or nearly have the ability to make weapons, such as Australia and Sweden, have not ratified the treaty.

The treaty does not take into account clandestine plants in signatory countries. IAEA has no intelligence-gathering apparatus, no satellites for remote inspection; even if it should learn of a secret plant, it would have no mandate to go in and inspect.

What does an exinspector general do? McKnight, a lawyer who came up through the Australian civil service, is now writing a study of IAEA experience with diversion safeguards as an example of how world society might verify treaty obligations by an inspection system. The United Nations Institute for Training and Research is sponsoring the study. —JPW

How the President Gets his Science Advice: A Visit to OST

The US government's regard for science and technology reveals itself in the elaborate machinery it has established to obtain scientific advice. The most important channel for such advice has to be that to the White House: Congress may have the power to dispose, but it is still the president who most often proposes.

The advisory apparatus extends from the White House through the government and through the scientific community. Within the Executive Office of the President Lee A. DuBridge, the present science adviser, has his own staff in the Office of Science and Technology. Within the entire executive branch, science policy makers meet with DuBridge as the Federal Council on Science and Technology. The scientific community is represented by the President's Science Advisory Committee.

The central figure is DuBridge. Almost all scientific advice that reaches the President goes through him. When the President needs information, whether on the future of the space program or telecommunications policy, he counts on DuBridge to get it for him.

Daniel Margolies, an OST staff member, explained that DuBridge considers himself to be exactly what his title implies—an adviser to the President—rather than a special pleader for science. He works very closely with the Bureau of the Budget and advises in a larger context.

After his appointment last December, DuBridge spent several months studying the existing scientific advisory structure to see how he could be most effective. He finally decided to follow the example of his predecessor, Donald F. Hornig, and head all three advisory organizations.

Early days. DuBridge liked what he found in the Office of Science and Technology. It has come a long way since James R. Killian Jr put together a staff of two or three when he came down from the Massachusetts Institute of Technology to be the first science adviser. David Z. Beckler, an engineer and lawyer, has remained ever since and is now de facto chief of staff.) The staff grew slowly under Killian and George B. Kistiakowsky and numbered about 15 in 1962 when President Kennedy decided to make it a new independent agency in the Executive Office of the President. Now it has the same statutory status as the Council of Economic Advisers and the National Security Council.

When DuBridge was appointed the OST professional staff numbered just over 20. The new director had the option of replacing any or all of the staff, but asked everyone to stay. The feeling was reciprocated: When DuBridge sat down for his first staff meeting the day after inauguration, not one man had left. (Changes have occurred since: Charles V. Kidd has re-