

Technology May Help Contain the Nuclear Genie

Countries that sign the nuclear Non-proliferation Treaty commit themselves to making "safeguards" agreements with the International Atomic Energy Agency to facilitate information exchange and site inspections. The IAEA, which is an intergovernmental organization affiliated with the United Nations, currently keeps tabs on about 800 nuclear facilities in 60 or so countries, and in 1993 it conducted more than 2000 inspections for the purpose of "nuclear material accounting."

Since the IAEA's creation in 1957, and even since the NPT went into effect in 1970, great advances in communications and computing technology have contributed to the political transformation of the world. These capabilities may ease IAEA's watchdog burden, especially in its examination of the so-called declared nuclear facilities.

Remote monitoring

John Matter, a physicist who manages the cooperative monitoring systems department at Sandia National Laboratories, says that the most significant technological developments in materials monitoring have been the system integration of complementary sensors (that is, sensors that use different detection mechanisms and that monitor different types of activities) and the electronic transmission of the monitoring data, "which is just beginning to occur." The Department of Energy's Office of Nonproliferation and National Security has several international remote-monitoring evaluation projects under way, in collaboration with organizations in Australia, Japan, Argentina, Sweden and Germany.

DOE recently demonstrated remote monitoring of a storage vault at Argonne National Laboratory and a similar vault at the Kurchatov Institute, in Russia. (See the article by Frank von Hippel in *PHYSICS TODAY*, June, page 26.) The US monitoring

center, located at Sandia, and the Russian center, at the Kurchatov Institute, can each retrieve data from the instruments in the two vaults. Electronic seals on containers and switches on doors can also activate the system, as can motion sensors. After being triggered, video cameras (now analog, soon digital) capture images and relay them, via international telephone lines, to the other country. Satellite transmission is also possible, and monitoring may eventually occur via Internet. Although an occasional on-site presence will still be called for, such a system holds the potential to reduce greatly the need for frequent inspections, thus lowering expenses for both the IAEA and the host countries.

According to Ken Sheely, DOE's remote-monitoring manager, the IAEA recently made an official request for the US to conduct field trials of the remote-monitoring technology. The trials, still in the planning process, will probably occur at a light-water reactor in Switzerland and at Y12, at Oak Ridge National Laboratory.

In designing a system of this sort for full-scale international monitoring, several problems quickly arise. First, the equipment itself must be tamperproof. Then, at a minimum, stringent data authentication and encryption techniques are necessary. More than that, sophisticated data-analysis software will have to be developed to analyze the large amounts of digital information being transmitted. Ideally the computers receiving the data would flag nonstandard changes and other suspicious activities, which would probably be buried within legitimate operations that could be ignored.

Matter also said that real-time tracking of the movement of material from one site to another has become possible "from a technology point of view." In the US the

DOE tracks movement of special nuclear materials by its secure transportation system, and tracking systems can be assembled from commercial technology. Internationally, the development of commercial satellites and cheap signal reception from Global Positioning System satellites would allow tagged containers to be tracked and the information transmitted anywhere in the world.

Some try to hide

Covert operations represent a more dangerous problem, with solutions not easily amenable to international accords. As discussed in a report last month from the Office of Technology Assessment, the IAEA is not an intelligence agency, and unless it is given much greater access to the intelligence information of its member states, its resources for detecting undeclared facilities will remain limited. In a statement to this year's nonproliferation conference, Hans Blix, the director general of the IAEA, said that 61 countries "for which the NPT is in force" do not have the safeguards agreements that the treaty requires.

Environmental monitoring may be able to help here; samples taken from both inside and outside a facility can be analyzed for traces of escaped material that indicate nuclear activity. OTA's Alan Crane points out that this technique might be especially useful for detecting undeclared activities at declared sites. Crane says that the IAEA has decided to take a series of steps to implement environmental monitoring, which he called "potentially a very powerful adjunct to safeguards agreements."

In the end establishing compliance is a statistical problem. One cannot say with 100% certainty that a nation is not diverting material, only that it does not appear to be doing so.

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Korea and the NATO countries following World War II.

The US is now trying that approach with North Korea, which has been offered two new nuclear reactors to give up its weapons program. But it remains to be seen whether that agreement will stick—or if something similar could bring India, Pakistan and Israel into the treaty.

... Or not?

Disarmament, another NPT objective, has been progressing rapidly in recent years, with the US and Russia eliminating more than 2500 missiles and an entire class of weapons under the Intermediate-Range Nuclear Forces Treaty. The US is dismantling 2000 warheads each year. Still,

during most of the NPT's lifetime the two countries were pitted in an arms race that left behind huge nuclear arsenals; between the two, there are now more than twice as many long-range warheads as when the treaty went into effect—16 900 versus 7455—according to figures from the Natural Resources Defense Council.

Many of the non-nuclear countries that signed on to the NPT did so believing that they would gain greater access to nuclear energy technology, under article IV of the treaty. But as Nigerian Ambassador Tom Ikimi noted in a speech at the UN, "We cannot but reiterate our disappointment that while African countries have faithfully adhered to the treaty and concluded safeguards agreements with the IAEA, the

expected benefits have not been realized." That contention was recently underscored by the controversy surrounding Russia's sale of nuclear power plants to Iran. Fearing that Tehran would use them for destructive ends, the Clinton Administration condemned the agreement and imposed a trade embargo on Iran. But Iran countered that its compliance with the NPT entitled it to the Russians' help.

The flap over Iran gets at one of the most widely debated concerns about the NPT: By promising nuclear technology to all, does the treaty encourage the spread of the very thing it's trying to constrain? Nonproliferation groups such as the Nuclear Control Institute in Washington and the Wisconsin Project on Arms Control believe it does