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International Safeguards Against Non-Government Nuclear Theft: A Study of Legal Inadequacies†

It has been over thirty years since the first atomic bomb was exploded at a test site in the New Mexico desert. In that relatively short timespan the concept and manifestations of nuclear energy—from reactors to weapons stockpiles—have spread the world over. With nuclear energy has spread a whole body of new law: nuclear law, which transects such diverse fields as national and international private law (regulating liability for nuclear damage), international public law (creating agencies and endowing them with authority to apply safeguards), and national public law in the forms of constitutional and administrative law (regulating the organization, licensing, and supervision of nuclear activities), as well as criminal law (providing sanctions for offenses against nuclear regulations).

Two major trends became apparent during this period: a very slow and still restricted increase in the number of nuclear weapons states to the present six, and a much more rapid increase in the spread of peaceful nuclear power technology. The prime focus of international concern and discussion has been to stop the former trend while enhancing the latter, and international public law has responded to that challenge, beginning in 1956 with the establishment of the International Atomic Energy Agency (IAEA). In the nearly two decades since the writing of the IAEA Statute, a series of Agency conferences and resolutions has produced a fairly comprehensive system of international safeguards designed to detect any significant diversion of nuclear materials by a non-nuclear-weapon state from its peaceful sources of nuclear energy to a clandestine weapons program.

Alongside this IAEA activity has been a large body of bilateral, trilateral, and multilateral accords in the safeguards field, culminating in the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT).[1]

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†Editor's note: Because of the time lag between submission of the manuscript and date of publication, the author desires to append a caveat that the statistics and technical data contained herein may not now be completely current.

[1]21 U.S.T. 483. (Entered into force, 1970).

But while the efforts of nuclear law have been directed against nuclear proliferation by the world's non-nuclear-weapon *states,* little attention has been given to the problem of the dramatic increase in *non-governmental*—i.e., terrorist, or organized criminal—violence *and the potential for such violence to become nuclear.* A few preliminary questions have begun to be asked in national and global forums: what groups would want to steal nuclear material and for what purpose? What resources would they need and how easy are such resources to acquire? And, most importantly, do international safeguards effectively deal with the threat of non-governmental diversion of nuclear materials? It is these questions which this article will explore, in the course of a broader discussion on the present breakdown of nuclear law in the face of nuclear terrorism and sabotage.

The Diversionary Potential

In October, 1970, a letter was sent to Orlando, Florida, threatening that the city would be blown up by a hydrogen bomb unless the writer were given $1 million and safe passage out of the United States. The letter included a diagram of a device which the local police showed to an Air Force armament officer, who said that it would probably work. When alarmed city officials contacted the then-Atomic Energy Commission (now split into two offices, the Environmental Research and Development Administration, and the Nuclear Regulatory Commission), the most they could be assured of was that there were no missing shipments or overt displacements of nuclear materials. The million dollars was actually assembled, but the perpetrator of the threat was discovered before the ransom could be paid: he was a 14-year-old honors science student.

This incident highlights a number of deficiencies in the nuclear safeguards system and the ability of that system to cope with a criminal threat. First is revealed the fact that design aspects of an atomic bomb are beyond neither the research access or intelligence of an ordinary, intelligent citizen. Second, although understanding how a bomb works, and actually constructing a workable device are orders of magnitude apart, in terms of technical skills and equipment needed, the mere existence of a workable drawing alone can pose a credible threat. And finally, the AEC could not assure Orlando—or any city—that there were no *covert* displacements of nuclear materials, displacements so small and made over such a period of time that they could escape detection.

The 14-year-old never revealed the motive behind his hoax, but a number of motives for a nuclear theft, and the types of groups that would attempt such a theft, can be easily ascertained. Two basic incentives are the political leverage and/or the monetary profit that the holders of a homemade atomic bomb could acquire. Such holders could be an organized criminal group, political terrorists, or perhaps members of an opposition political faction within a nation.

The incentives sharpen their focus when it is seen that stolen nuclear material

which can be used to make weapons has a commercial value of between $3,000 and $15,000 per kilogram, depending on the substance stolen (uranium or plutonium) and its technical grade.[2] On the other side of the balance should be weighed the criminal penalties for unlawfully possessing or manufacturing an atomic weapon: in the United States such an offense is punishable by a fine up to $10,000 or 10 years imprisonment, or both; if the intent of the defendant is to injure the United States or obtain an advantage for a foreign nation, the maximum penalty becomes $20,000 and/or life imprisonment.[3]

To the organized crime operative, perhaps one who has not been deterred by similar penalties from committing homicides or extortion, the lucrative nature of a nuclear theft may well outweigh the risks and sanctions of apprehension. And the fanaticism which political terrorists have exhibited in the commission of their worldwide bombings and kidnappings, even at the cost of their own lives, indicates that criminal sanctions for nuclear theft would be a weak deterrent indeed.

The uses to which nuclear material stolen by such groups can be put are many and varied:

- it can be sold back to the nation from which it was stolen;
- it can be sold to a second nation eager to acquire nuclear weapons but unwilling to divert its own nuclear power plant materials due to the risk of IAEA detection;
- it can be sold upon a nuclear black market;[4]
- accompanied by a threat to explode a device in a large city, it can be used to obtain political concessions (e.g., redistribution of wealth: the SLA's first demand; acquisition of territory: an early demand of the Black Muslims; release of prisoners: a recurring PLO demand; or perhaps the withdrawal of a foreign military presence: the Vietnamese NLF);
- or, in the case of a rival political faction, the threat of a nuclear explosion can be a means of ousting the present government, an especially credible means in those many nations where force and violence are the most often used tools for transferring governmental power.

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[2]MASON WILLRICH and THEODORE R. TAYLOR, NUCLEAR THEFT: RISKS AND SAFEGUARDS, (Cambridge, Mass.: Ballinger, 1974), ch. 6, p. 107.

[3]42 U.S.C. § 2272 (1970); for fines & penalties concerning communication of, receipt of, and tampering with restricted data, see §§ 2274-6.

[4]Though the chances of any such market presently developing are slim, any one or more future nuclear thefts would increase the chances and motives for such a market; once so formed, a black market would then further increase the potential for nuclear theft. In the opinion of then-AEC Commissioner Clarence E. Larson at a 1969 Safeguards Symposium, "Once special nuclear material is successfully stolen in small and possibly economically acceptable quantities, a supply-stimulated market for such illicit materials is bound to develop." (Quoted in *Nuclear Hijacking: Now Within the Grasp of Any Bright Lunatic,* Timothy Ingram, THE WASHINGTON MONTHLY, vol. 4, No. 11, January 1973, p. 25.)

The key issue concerning all these potential motives for diversion is "are such risks credible?" Certainly, in the case of terrorism, the risks of such groups going nuclear are increasing, considering (1) the growing amount and intensity of terrorism in recent years; (2) the increased technological capacity and sophistication of such groups (note the January, 1974 Surface-to-Air Missile threat at London's Heathrow Airport); and (3) the developing international links between such groups to aid the flow of information, personnel, and arms.

Moreover, international legal norms are not sufficiently honored when certain nations show a willingness to shelter terrorist groups and their conventional weapons stockpiles; indeed, in many parts of the Third World, the norms act to *encourage* such shelter for terrorists in their guise as "revolutionaries in the struggle for national liberation." Such nations might be willing as well to host a clandestine nuclear bomb manufacturing operation, and to provide a safe haven after the nuclear threat has been delivered.

Even without such a haven, present national and international legal sanctions—extradition, or guaranteed prosecution, with long prison sentences and possibly death—seem unlikely deterrents against terrorist ardor.

It should be noted that the chances of any group—criminal, terrorist, or political faction—are enhanced if they include among their number an employee or employees of a nuclear power plant; such individuals possess the necessary access to nuclear materials, as well as the key knowledge concerning (1) the in-plant physical security system, (2) the amount of material that could be stolen over time and remain undetected, and perhaps (3) technical bomb-making capabilities.

This threat of diversion by plant insiders can be countered in the field of public administrative law by the setting up of stringent personnel screening and security clearance regulations in nuclear industry. But once again, nuclear law faces serious roadblocks in its attempts to prevent non-governmental nuclear theft: requiring full employee security clearances may be opposed by management as too expensive, by labor as violative of employment practices reached through collective bargaining agreements, and by local government as a denial of equal opportunity employment regulations. Already this latter factor has been expressed by elements of nuclear industry committed to hiring the hardcore unemployed, the very people for whom screening presents the most problems.[5]

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[5]Remarks of David J. Haymon, Assistant to the Manager, Operations, Nuclear Fuel Division, Westinghouse Electric Corp., in *International Inspection of U.S. Industry*, in PREVENTING NUCLEAR THEFT: GUIDELINES FOR INDUSTRY AND GOVERNMENT, Leachman and Althoff, eds. (New York: Praeger, 1972), p. 171.

Technical Considerations

The three essential elements needed to successfully divert nuclear materials and create an effective explosive are knowledge, skilled manpower, and materials. Regarding knowledge, all the information required for the design and construction of a number of crude nuclear explosives is available, published, and largely unclassified.

As to skilled manpower, there are thousands of people in the world today who have direct experience in the design, construction, and testing of nuclear explosives. Moreover, tens of thousands of others possess the specific knowledge of various technical skills required to make a nuclear bomb. And, indeed, there are millions of others—engineers, scientists, technicians—who have a basic working knowledge in the necessary scientific fields involved. People in any of these categories can be kidnapped or persuaded to join a clandestine operation. Or they may already be part of one voluntarily.

The conventional explosives, and other materials needed to construct the actual device as well as ignite the nuclear chain reaction are easily obtainable throughout the developed world, either by purchase or theft. Such materials should be no harder, and probably much easier, to acquire than the fissionable nuclear material itself for the bomb's core. At this point it is necessary to examine in more detail the nuclear fuel cycle, since *the special nuclear material (SNM) that has been discussed all along, supra, is the same for both reactor fuel and nuclear explosives.*

The most commonly used SNM in the nuclear fuel cycle (*see* Chart I on page 498[6]) are uranium in its U-235 isotopic form, and plutonium in its Pu-239 form.[7]

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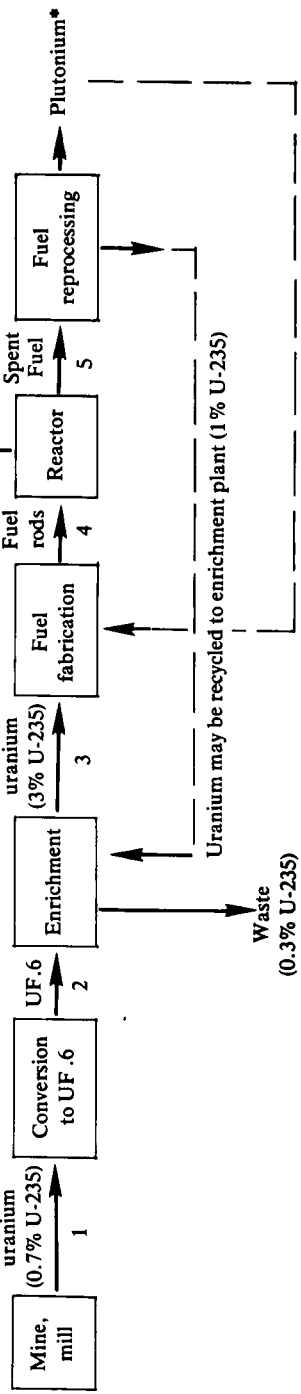
[6]Victor Gilinsky, *Military Potential of Civilian Nuclear Power,* in NUCLEAR PROLIFERATION: PROSPECTS FOR CONTROL, Mason Willrich, ed., (Cambridge, Mass.: Dunellen, 1970), p. 47.

[7]Natural uranium contains only minute amounts of U-235, and must be slightly enriched at a nuclear enrichment facility to be of use in most modern reactors. After this step, the uranium goes to a fuel fabrication plant, is converted into a powder, compressed into pellets, loaded into fuel rods, then sent to a reactor. During reactor use, part of this uranium is converted into Pu-239, but both such elements are highly radioactive at this stage and must be handled with heavy shielding equipment when the old fuel rods are removed and replaced each year.

In light of the nuclear fuel cycle chart, the fuel fabrication plant becomes the key point in the fuel cycle for diversionary activity: uranium before the enrichment stage is not usable in an explosive, while U-235 or Pu-239 in the fuel wastes after reactor use and before reprocessing is far too radioactive to be handled. It is at the fuel fabrication stage that the SNM is in a clean (i.e., not too highly radioactive), solid (powder or pellet), easily transportable form, and thus, the easiest form to be diverted. In addition, the fuel fabrication process results in the production of dust and scrap containing some amount of SNM; this waste is difficult to account for precisely, making possible a theft that would never be discovered. (The NRC, realizing it cannot keep track of all SNM throughout the fuel cycle, has established certain standards of missing material which must be tolerated. This figure, called "Material Unaccounted For" or MUF, for Pu is .5-1.0%. Source: 10 C.F.R. § 70.51, 1975.) Finally, the storage of SNM after this fabrication stage, and after the reprocessing stage, as well as the transportation pathways between these stages (see chart, paths numbered 3, 4, and 7) pose the likeliest targets for diversion.

Chart 1—Example of a Civilian Nuclear Fuel Cycle for Reactors Fueled with Slightly Enriched Uranium*



*The plutonium could be recycled in the reactor or stockpiled for future use in a following generation of fast breeder reactors.

Although the slightly enriched U-235 reactor fuel is not suitable for direct use in an explosive device, the Pu-239 produced, while difficult to use in an efficient explosive, can be easily adapted to a crude bomb. However, one reactor type now in limited use—the high-temperature gas cooled reactor (HGTR)—uses highly enriched uranium (90% U-235) as a fuel; such fuel is weapons-grade.[8] Under intense development is a new type of reactor—the Breeder—which will be capable of using either highly enriched U-235 or Pu-239 for fuel. Both such SNM are weapons-grade. *It is estimated that as little as 20 kg. of U-235, or 5 kg. of Pu-239 could form the basis of a workable nuclear explosive.*[9]

As noted in the chart, the plutonium produced in nuclear reactors can be reprocessed and recycled into the system as a reactor fuel. The economic incentive to begin large scale Pu recycling increases as natural uranium reserves are depleted, but present United States safety, environmental, and security factors have caused a delay in the Pu recycle. As a result, Pu produced domestically is now largely stored, still highly radioactive, at the various reactor sites; some reprocessing (which lessens radioactivity) is being done on a demonstration basis and for research and development purposes.

Europe and Japan by contrast face different pressures concerning the start of Pu recycling: since these areas contain little natural uranium deposits, and are more dependent on OPEC oil, they may be more inclined to begin large scale recycling sooner than the United States. It must be noted that even before the start of large scale United States recycling, the amounts of domestic, non-military SNM (the demonstration Pu-239 plus highly enriched U-235) that are low enough in radioactivity to be safely transported—*and thus diverted*—is calculated by one weapons design and control expert to be "of the order of several thousand kilograms. This is sufficient for the construction of hundreds of nuclear explosives."[10]

The general potential for diversion described above becomes alarmingly focused when seen in the perspective of the growth of the world's nuclear power

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[8]The fuel being used for the few existing HTGRs contains a great deal of graphite and other elements that dilute the U-235 to a point where it cannot be used directly to make a bomb. However, the fuel planned for HGTRs now on other may contain undiluted, and therefore directly-usable weapons-grade U-235. Note also that from the output end of the enrichment plant to the point in the fabrication plant where the graphite is added, and the transport steps in between, the U-235 is also undiluted and directly usable.

[9]Theodore Taylor, *Diversion by Non-Governmental Organizations*, in INTERNATIONAL SAFEGUARDS AND NUCLEAR INDUSTRY, Mason Willrich, ed., (Baltimore: The Johns Hopkins University Press, 1973), p. 180.

[10]Dr. Theodore Taylor, former nuclear weapons designer for the United States government, and consultant to the AEC, the IAEA, and the Organization for Economic Cooperation and Development. Quoted in "The Need for a Systems Approach to Preventing Theft of Special Nuclear Materials," in Leachman and Althoff, *op. cit.*, p. 219. Dr. Taylor estimates non-United States inventories of SNM to be in the same range.

industry (*see* Table 1 on page 501, current to 1974[11]). Estimates of plutonium accumulation in the civilian nuclear industry worldwide run to between 250,000 and 450,000 kg. by the early 1980s; even at the best MUF figure (a United States measure; *see* footnote 7) there remains up to 1,250 kg. that could be covertly stolen worldwide without discovery (not to mention an overt theft from storage or transportation of a far greater amount). Even a crude explosive with a low yield—made from less than 10 kg. Pu-239—could kill tens of thousands and cause hundreds of millions of dollars of property damage in an urban area.

Fuel fabrication and reprocessing plants, as well as reactors, are spreading throughout the world, as is development in new enrichment techniques. As these facilities spread, so widens the potential for SNM diversion; yet in the sense that these plants are still limited in relation to the number of reactors worldwide, there must necessarily be a great deal of global movement of uranium and plutonium in various stages, with the concomitant risk of theft at any point along such routes of transport. All such SNM transportation can occur by conventional commercial air, rail, truck, and sea carriers, as well as by special licensees. A chilling example of the risk involved can be found in the fact that at least one, and probably more of the planes hijacked to Cuba in the last decade contained SNM in amounts sufficient to make a bomb; fortunately, the nature of the plane's cargo was not discovered by either the hijackers or Cuban authorities, and the jets were returned intact.[12]

With all the risks mentioned in the above discussion of nuclear fuel cycles, the worldwide spread of atomic reactors and their plutonium byproduct, and the growing transnational transportation of SNM, the system of international safeguards becomes of crucial importance for study. What follows then is such a study of that system: its highlights and gaps, its international legal underpinnings, and the reasons why, as it now exists, it is vastly unprepared to cope with the threat of non-governmental nuclear diversion.

International Safeguards

Safeguards systems are expensive, causing constant budgetary quarreling between drafters, industry, and government. The purposes behind an ideal system may be many, but for reasons of economy, IAEA and national planners generally choose a single purpose to highlight. In the case of the international (IAEA) system, that purpose is the detection of SNM diversion by governments from their peaceful nuclear power industry to a clandestine armaments industry. For most national systems, if they exist in a clear enough form to exhibit a unified purpose, safeguards act to prevent the theft of SNM.

Concurrent with a choice of purpose is one of method, and for each of the two

[11]NUCLEAR THEFT, *op. cit.*, p. 197.
[12]"Nuclear Hijacking," *op. cit.*, p. 24.

Table 1—Foreign Nuclear Power, By Country*

Country	*No. of Power Plants*	*Installed Capacity /MW(e)/*	*No. of Power Plants*	*Installed Capacity /MW(e)/*
Japan	5	1,756	41	31,636
West Germany	7	2,082	22	14,995
United Kingdom	28	5,335	43	14,479
USSR	10	2,457	23	11,997
Sweden	1	440	13	10,060
France	6	2,481	12	7,281
South Africa	—	—	8	6,898
Canada	5	1,974	9	5,482
Switzerland	3	1,006	6	3,406
Taiwan	—	—	4	2,808
Korea	—	—	4	2,328
Italy	3	597	5	2,163
East Germany	1	70	5	1,830
Czechoslovakia	—	—	4	1,760
Belgium	—	—	3	1,650
India	3	600	8	1,610
Argentina	—	—	3	1,518
Finland	—	—	3	1,480
Mexico	—	—	2	1,200
Netherlands	1	55	3	1,105
Spain	3	1,100	3	1,100
Romania	—	—	2	880
Bulgaria	—	—	2	880
Austria	—	—	1	700
Brazil	—	—	1	626
Yugoslavia	—	—	1	600
Thailand	—	—	1	500
Philippines	—	—	1	420
Pakistan	1	125	1	325
Other (not yet announced)	—	—	—	28,000
TOTALS	67	20.078	231	161,000

*Table 1 shows for each country the present and 1980 projected numbers of power reactors and the total electric generating capacity which these reactors represent. The "other" column includes power reactors that have not yet been officially announced, but that are expected to be installed by 1980.

basic purposes is a most efficient and cost-effective method. Internationally the method stresses *materials accountancy;* nationally, *physical protection* of SNM is highlighted.

It should be seen that terrorist or criminal groups do not need a large nuclear arsenal but only a small amount of SNM to pose a credible threat. And due to their more limited resource base, such groups are more likely to deal with stolen SNM in an already enriched or weapon-grade state. Since materials accountancy is not the best method to detect small losses over time, nor can it alone prevent the theft of any large amount in a single attack, such an accountancy

system offers no deterrence to the non-governmental diverter. Physical protection and personnel security measures do on the other hand provide a credible deterrent.

Rather, a material accountancy system is much more useful against non-nuclear-weapon state diverters who would need one or more fairly efficient explosive devices, and the time and larger quantity of SNM needed to build such an arsenal. That IAEA safeguards are designed as a hedge against governmental diversion can be seen in the Agency Statute's expression of objectives, written at the founding of the IAEA in 1956: "[The Agency] shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."[13]

The IAEA Statute does not require any agency member to submit to compulsory safeguards, but only creates a framework for controls, leaving members able to decide whether to submit (and if so, to what controls). Fortunately, the spread of nuclear weapons-making capabilities, and especially of peaceful nuclear power capacity, has proceeded slowly enough since 1956 to match the gradual development of improved IAEA safeguards and finally, the adoption of the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Unfortunately, the increased risk of non-governmental diversion, especially by terrorists, developed far too recently to have been realized in 1956 or protected against during the Agency's formative years.

The purpose of the NPT, though vague, seems as well to indicate an emphasis on the detection of governmental diversion: "Each non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards . . . for the exclusive purpose of verification of the fulfillment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices."[14] Though the NPT provides substantial additions to the non-compulsory IAEA Statute, it should be kept in mind that these following described provisions, plus most other international or multilateral safeguards accords made at the time reflect a purpose similar to the IAEA Statute and NPT Article III. And it must be remembered how limited an application such a purpose has to the prevention of non-governmental diversion.

In effect since March, 1970, the NPT contains three significant provisions:

1. each non-nuclear-weapon state which is a Party to the Treaty agrees not to manufacture or acquire nuclear weapons or any nuclear explosive device (NPT, Article II);

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[13]IAEA Statute, Article II; as of June, 1972, 102 states were parties to the Statute.
[14]NPT, Article III, § 1.

2. each non-nuclear-weapon Party is required to submit to IAEA safeguards through negotiations with the Agency to be begun within specified time limits (NPT, Article III. § 1, § 4);

3. each nuclear-weapon Party agrees not to supply any non-nuclear-weapon state (whether a Party or not) with certain types of nuclear items for peaceful purposes, except subject to IAEA safeguards (Article III. § 2).[15]

A state not Party to the NPT, or having not yet concluded a safeguard agreement with the IAEA, as required by the NPT, is not without some form of safeguards, however. Besides any existing national or regional safeguards systems (Euratom), there could be found some 49 non-NPT agreements in force by 1972; most of these were trilateral arrangements between peaceful nuclear power suppliers, receivers, and the IAEA. As member states of these agreements ratify the NPT, the NPT's safeguard requirements would be substituted for their previous arrangements; the United States has some 21 such trilateral agreements.[16]

By 1971, the IAEA had produced an extensive document entitled, "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons."[17] This document contains detailed guidelines for a safeguards system, including the role of the IAEA within any NPT states agreeing to the document, and those states' rights to terminate the safeguards arrangement. By March of 1975, 44 states had concluded NPT safeguards agreements with the IAEA, with many of these agreements following precisely the terms of the IAEA 1971 Document. Thirty-three such agreements are currently in force, with 22 more under negotiation.

The stated "Objective of Safeguards" in the 1971 Document represents the first major international statement in the field to include (though only implicitly) nuclear diversion by non-governmental groups:

> The Agreement should provide that the objective of safeguards is the *timely detection* of diversion of *significant quantities* of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices *or for purposes unknown,* and deterrence of such diversion by the risk of early detection. (Emphasis added.)[18]

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[15]Although only *non*-nuclear-weapon Parties must submit to IAEA safeguards, the United States and Great Britain have declared their intention to allow IAEA safeguards upon all nuclear activities except those with direct national security significance. It should also be noted that neither China nor France have signed the NPT, although France has stated it is prepared to behave as a signatory. As of July, 1974, 83 states had ratified the NPT, while 62 others had not yet signed or ratified; worldwide concern remains with the 13 states of these 62 which have neither signed nor ratified and which possess either a present or potential nuclear capacity: India, Israel, Spain, South Africa, Argentina, Brazil, Portugal, Pakistan, Bangladesh, Algeria, Chile, Saudi Arabia, and North Korea. (Source of 1974 figures: The New York Times, July 5, 1974, p. 1.)

[16]U.S. Dept. of State, Treaties in Force, January 1, 1974, p. 295.

[17]IAEA Document INFCIRC/153, 1971.

[18]*Ibid.*, Part II, ¶ 28.

But another section of the Document (Part I, ¶ 19), and the section on Sanctions in the IAEA Statute (Art. XII, § C) to which it refers, disclose a return to an earlier Agency objective. A careful examination of this Statute section reveals that the purpose of IAEA Sanctions (administered in the case of non-compliance with Agency agreements) is to publicly embarrass and put pressure upon the offending state by reporting any non-compliance to the United Nations. Were a non-governmental diversion to occur, the state in which it took place would be just as upset over the loss as the rest of the world, but world pressure of the sort envisioned in IAEA sanctions can only produce a tightening of state security for the *future.* Meanwhile, those who managed the successful diversion, and who plan to threaten the use of or actually use a nuclear explosive, would not be likely to feel subject to such world pressure.

The succession of IAEA documents above should illustrate a slow but growing recognition on the part of the Agency that there exist other purposes to which safeguards can be directed. But recognition of purpose must be followed by implementation of new methods to realize any significant effects. And in this implementation field the IAEA record is haphazard: hesitant advances followed by loud retreats. An analysis of that record follows, in terms of Agency safeguards methods: hopeful aspects of their expansion, and the grim aspects of their limitations.

IAEA safeguards comprise a limited materials accountancy system designed more to detect a past diversion than prevent a future one. But as such safeguards come to include all nuclear material, and all stages of the fuel cycle, diversion can be detected at a very early stage; thus detection can approach prevention, and early detection act as a significant deterrent to all forms of diversion. Similarly, as detection techniques improve to the point where they provide an on-line picture of current material flows, they can act to prevent theft through the ability to detect and apprehend stolen material in the very process of its being stolen. Both the Agency and national research and development programs are currently working on technological improvements in the field of materials accountancy.

In March of 1972, the Agency convened a panel of experts to formulate recommendations for the physical protection of nuclear material. These recommendations, published in a June 1972 IAEA document commonly known as the "Grey Book,"[19] include measures for the prevention of SNM theft from nuclear plant sites, recognition of various hazards during transit of SNM, as well as recommendations for a timely recovery system in case of completed thefts or

[19]"Recommendations for the Physical Protection of Nuclear Material," (Vienna: IAEA, June, 1972).

misrouting of SNM (this latter system to be developed in full coordination with public security forces). Highlights of the Grey Book feature such ideas as physical barriers, hard-to-counterfeit badges for all people with access to SNM, external and internal patrols, monitoring and guarding of transported SNM, and emergency response capabilities.

While such recommendations reflect a forceful start in the proper direction, other vital areas of concern have received inadequate Agency treatment. For example:

- no enrichment plant is subject to IAEA safeguards, and safeguards procedures for such plants are only in the developmental stage;
- the IAEA has no current responsibility for SNM physical security after reprocessing, a point when significant amounts of Pu-239 are present;
- since IAEA agreements are (excluding Euratom) signed with individual states, a special problem arises regarding transport of SNM over national borders, including those of non-NPT Parties or non-IAEA members. (E.g., responsibility vis-à-vis the Agency may rest with either the exporting or importing state, the SNM in transit and actually within the jurisdiction of a third state; the third state may itself have no responsibility toward the Agency and need not allow it to exercise any controls.)

The basic problem concerns a major reluctance on the part of both individual nations and the Agency to have the latter infringe on the national sovereignty of the former. Physical protection procedures, to be fully effective, need to be integrated with police intelligence and surveillance methods; but the IAEA does not want to become an international police agency, nor will individual nations allow their closely guarded police intelligence systems regarding nuclear theft to be compromised through international intervention.

The IAEA is reluctant to expand its role, perhaps fearing it would become too politicized (like some other United Nations bodies) in the process; or perhaps the Agency fears that to act too strongly, especially during a critical incident, would destroy it and all the good it has quietly done so far. For whatever reason, this crucial reluctance on the Agency's part is revealed even as it paves the way into the new areas of physical protection of SNM embodied in its Grey Book. The Grey Book recommendations stress at the very outset a reliance on *national* protection systems, on not wanting to infringe on the sovereign rights of states, and finally, on the *state* being the unit to initiate a request for advice (not the Agency requiring anything of the state).

International nuclear law has reached an impasse: IAEA/NPT safeguards stress materials accountancy techniques, but preventing non-governmental nuclear diversion depends on physical protection, rewards, search and recovery of stolen material, arrest or extradition of offenders, and criminal sanctions. Since the IAEA has no police or judicial powers, nor does it seem eager to push

for their acquisition, the extent of the role it can play in this field is to devise recommended standards which can act as models for national safeguards systems. Considering this IAEA weakness, the crucial point for further study now becomes the effectiveness, or even existence of national physical protection safeguards within and outside the United States.

National Safeguards Systems

Most United States safeguards, including all physical protection measures, are imposed upon private industry operators of nuclear facilities as a condition of obtaining and keeping a government license. A series of new, more stringent regulations, which became effective only as recently as December, 1973, are designed to prevent SNM theft "by the establishment and maintenance of a physical protection system of: (1) protective barriers and intrusion detection devices at fixed sites to provide early detection of an attack, (2) deterrence to attack by means of armed guards and escorts, and (3) liaison and communication with law enforcement authorities capable of rendering assistance to counter such attacks."[20]

Realizing that theft is most likely to occur during transportation of SNM between various steps of the fuel cycle, the regulations include such strict and often costly provisions as follow:

- no more than 20 gr. Pu or 350 gr. high enriched uranium to be shipped by passenger aircraft without special AEC (now NRC) approval;
- SNM shipped by truck must have 2 people in the vehicle plus either an armed escort vehicle or a specially designed truck or trailer;
- armed guards must monitor all intermediate stops and intervehicle transfers related to nuclear shipments;
- containers used in open trucks, railroad flat or box cars, or surface vessels must weigh more than 500 lbs., and must be sealed and either locked or carried in a locked vehicle.

But when one wades into the sections on in-plant physical protection, one can easily understand why some nuclear experts admit, "[w]hat exists can be aptly characterized as a regulatory jungle . . ."[21] Even if all published requirements are carefully observed (itself a questionable assumption), it is still possible to transport up to 2 kg. Pu and up to 5 kg. high enriched uranium without any special protective measures. Such gaps in the system, plus continued criticism from both within and outside government prompted the then-AEC to quietly conduct a special safeguards study.

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[20]10 C.F.R. § 73.1 (1975). Overall safeguards regulations can be found in 10 C.F.R. §§ 50, 70, & 73; all transport regulations discussed in the article come from 10 C.F.R. § 73.30-73.35.

[21]NUCLEAR THEFT, *op. cit.*, p. 102.

Parts of this study were released by Senator Ribicoff (D-Conn.) in April, 1974; among the more significant of those sections released were a list of key factors that have broadened the risk of nuclear theft: (1) the increase in urban terrorism, characterized by the Patty Hearst kidnapping, (2) the widespread dissemination of information on the construction of homemade nuclear weapons, and (3) the increasing numbers of people—of varying psychological attitudes—experienced in processing weapons-grade materials for nuclear industry. Finally, the study concluded, "that the new regulations are inadequate and that immediate steps should be taken to greatly strengthen the protection of special nuclear materials."[22]

Turning to national safeguards systems outside the United States, one finds fewer regulations, with a far different emphasis, and an alarming lack of concern—at least in the public record—with physical security measures. Outside of perhaps the more security conscious socialist police states, government regulations deal almost exclusively with reactor safety, food irradiation, third party liability, and radiation protection as standards for governmental licensing of nuclear facilities. Euratom (the European Atomic Energy Community), with one of the most complex safeguards systems, stresses centralized and detailed accountancy, field inspections, and the imposition of sanctions rather than a physical protection approach. Part of the difference in emphasis between United States and European systems can be explained in cultural and experimental terms; for example, one specialist on European safeguards techniques reports that among Euratom nations, no special transportation precautions exist "largely because hijacking is not common to the European political landscape."[23] Other explanations for the lack of detailed physical protection measures are that either such regulations are classified, or perhaps they do not exist at all.

Only one conclusion can be made from the foregoing discussion on national safeguards, and it is a dark one: if the international system leaves physical protection largely up to each nation, and the individual nations' systems are either weak or termed "inadequate" by their own authorities, then the possibility of successful non-governmental nuclear diversion looms very large indeed. Some hope, though, may be found in the actions of a few nations, alone or in small numbers, outside the safeguards field. Seen together, these actions (described below) begin to form the first dim outline of an approach to nuclear security encompassing the full reach of nuclear law; from prevention of theft,

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[22]D.M. Rosenbaum, J.N. Coogin, R.M. Jefferson, D.J. Kleitman, and W.C. Sullivan, Special Safeguards Study, unpublished. Excerpts appeared in the CONGRESSIONAL RECORD, April 30, 1974, p. S6621.

[23]Lawrence Scheinman, *Safeguarding Nuclear Materials*, BULLETIN OF THE ATOMIC SCIENTISTS, vol. 30, No. 4, April 1974, p. 35.

they move through apprehension, recovery, criminal sanctions, and finally to the enhancement of international norms—the fostering of a climate of hostile public opinion against the spread, especially by illicit means, of nuclear weapons.

Non-Safeguard Approaches to Nuclear Theft: Selected Documents

The following documents represent unilateral, bilateral, and multilateral attempts to cope with the threat of non-governmental nuclear diversion. Each international document (i.e., all those below which concern agreements of 2 or more nations) *is the only one in its field currently on record,* tending to make their appearance together more random than integrated. But seen against the backdrop of an imperfect international system fearing to infringe upon the sovereignty of similarly imperfect and uncoordinated national systems, these documents represent a fresh, fruitful approach.

1. *Treaty on Extradition Between the United States of America and the Republic of Argentina of January 21, 1972*[24]

This treaty provides for the extradition, on a reciprocal basis, of persons found in either state who have been charged with or convicted of certain enumerated offenses by the judicial authorities of the other state. Among those offenses listed in Article 2 is the following No. 13: "Unlawful manufacture, use, distribution, supply, acquisition or possession, or theft of bombs, apparatus capable of releasing nuclear energy . . .; manufacture, use, distribution, supply, acquisition or possession, or theft of bombs . . . with the purpose of committing an offense."

This section makes the extradition treaty significant, for it represents an official, transnational recognition of the problem of non-governmental nuclear diversion. Though its purpose is to prevent either state from being a safe haven for nuclear terrorists or other diverters, its effect is felt primarily *after* a diversion, and only indirectly in the sense of preventing diversion. Nonetheless, it is a step in the right direction, but to be more fully effective, its example needs to be followed by as many other nations as possible.

[24]23 U.S.T. 3501. (Entered into force September 15, 1972.) No other United States extradition treaty includes such specific language on nuclear diversion. Most United States treaties in this field were made a decade or more before the first atomic bomb; their relation to the nuclear problem can only be made through the circuitous reading of language concerning extortion, or in a very few cases, language concerning the use of explosives to endanger life.

2. *Organization of American States: Convention to Prevent and Punish Acts of Terrorism*[25]

The signatories of this Convention agree to cooperate in the prevention and punishment of terrorism, as defined by the Convention, including (among other things) exchange of information and compliance with extradition requests. 'Terrorism' is defined with special emphasis upon "kidnapping, murder, and other assaults against the life or physical integrity of those persons to whom the state has the duty according to international law to give special protection, as well as extortion in connection with those crimes." So defined, it excludes any application to nuclear terrorism with its large-scale murder and extortion. Perhaps this is too strict a reading, but even so, certain consequences are apparent:

a. should a nuclear terrorist situation arise, some measure of interpretation will be necessary to determine whether a nation involved is under any obligation imposed by this Convention;

b. to clarify this situation (which was tailor-made to the specific problem of threats against diplomats), a further convention on the particular nuclear aspects of terrorism might be needed or at least amendments to this Convention may need to be adopted;

c. if this Convention remains the definitional statement of terrorism for the OAS, then it is significant that among those nations not signatories (as of March, 1970) were Chile, Argentina, and Brazil: nations which are not signatories to NPT either, and which will soon possess a nuclear power capacity.

3. *Council of Europe Committee of Ministers Resolution on International Terrorism*[26]

This Resolution differs from the OAS Convention in that it defines terrorism in terms of a number of categories of acts (unlawful seizure of aircraft, offenses against diplomats, etc.), "or any terrorist act"; furthermore, it urges the governments of member states, when receiving an extradition request, to "take into consideration the particularly serious nature of those acts, inter alia: when they create a collective danger to human life, liberty or safety;. . ."

But, while the definitional language can be more easily seen to include

[25]Source: 10 INTERNATIONAL LEGAL MATERIALS 255 (1971); Convention Done at Washington, February 2, 1971. The only other international statement on this subject is the Convention on the Prevention and Punishment of Crimes against Internationally Protected Persons, including Diplomatic Agents; United Nations Resolution 3166 (XXVII Session, Gen. Ass.), December 14, 1973. This Convention has no application to a threat of nuclear blackmail.

[26]Source: 13 I.L.M. 471 (1974); adopted on January 24, 1974.

nuclear theft and sabotage than that of the OAS Convention, this document represents only a recommended guideline for action by member states.

4. *An Act to Amend the Atomic Energy Act of 1954, as Amended, and the Atomic Weapons Rewards Act of 1955, and for Other Purposes*[27]

This Act amends the Atomic Weapons Rewards Act of 1955 (69 Stat. 365) as follows:

> Any person who furnishes original information to the United States
> (a) leading to the finding or other acquisition by the United States of special nuclear material or an atomic weapon which has been introduced into the United States or manufactured or acquired therein contrary to the laws of the United States, or
> (b) with respect to the introduction or attempted introduction into the United States or manufacture or acquisition or attempted manufacture or acquisition of, or a conspiracy to introduce into the United States or to manufacture or acquire, special nuclear material or an atomic weapon contrary to the laws of the United States, or
> (c) with respect to the export or attempted export, or a conspiracy to export, special nuclear material or an atomic weapon from the United States contrary to the laws of the United States, shall be rewarded by payment of an amount not to exceed $500,000. . . .A reward of $50,000 or more may not be made without the approval of the President.

This Act is significant not only in terms of its specificity to the particular diversionary problem, but also because—unlike the previous documents discussed—it deals fully and firmly with prevention. Five hundred thousand dollars is a massive incentive toward the discovery of nuclear sabotage and theft before it occurs, perhaps so much so that a widespread knowledge of this Act could result in some diminution of certain suspected or reported individuals' civil liberties. But the legislative choice has been made for protection of the security of all citizens over the potential infringement of the rights of a few. In the light of the global nature of the nuclear diversionary threat, perhaps such strong action by the United States deserves to be followed elsewhere.

5. *Preventing Unplanned Sabotage Through Planned Sabotage*

In the spring of 1975, as Communist troops began their final offensive upon South Vietnam, a team of Americans flew secretly to the site of the South's only nuclear reactor, removed the nuclear fuel, and dynamited the reactor building. The fuel was sent back to the United States to prevent its use by the approaching North Vietnamese, who captured that city a week later.[28]

Conclusions and Proposals

All safeguards systems are caught in the grip of two opposite forces: to prevent diversion a system must appear credible; but to exist at all, a system

[27]Pub. L. No. 93-377, 88 Stat. 472; approved on August 17, 1974; Source: 13 I.L.M. 1217 (1974).
[28]Source: N.P.I., *San Francisco Sunday Examiner and Chronicle,* April 6, 1975, p. 22, sec. A.

must be acceptable to the relevant government and industrial elites who fund and abide by it. The IAEA/NPT system of safeguards, by purposely not infringing upon national physical protection or police intelligence networks, maintains its acceptability; it does so at the cost of any credibility to deter non-governmental diversion. With the physical protection burden on them, national safeguards systems are slowly rising to the challenge with new, credible lines of regulatory defenses; but as they push too hard, they begin to lose acceptance from the industries they regulate, and perhaps from the cost-conscious public who must ultimately pay the bill through taxes or increased power rates.

National and international systems must begin to interlock, to complement each other rather than be mutually exclusive, if this vicious cycle is to be slowed down. It will take a limited retreat from the altar of national sovereignty in the face of a common global threat, plus a boost of resolve on the part of the IAEA to play a more central role before we can begin to see a worldwide credible deterrent against non-governmental nuclear diversion.

Leading nations are already showing a willingness—at least by their words, though not yet their actions—to accord the IAEA more control in the physical protection field. At the May, 1975 five-year NPT review conference held in Geneva, United States and Soviet delegates agreed that international measures are needed to deal with the threat of nuclear material theft. Igor Morokhov, Deputy Chairman of the Soviet State Committee for Atomic Energy went so far as to suggest that IAEA security recommendations (presumably the 1972 Grey Book) be accepted by states as obligations.

Will the Agency take the next step, and draft appropriate tentative regulatory and enforcement provisions? Dr. Sigvard Eklund, Swedish Director-General of the IAEA clouded the picture at the first day of general debate in Geneva when he first noted that the Agency had recently decided to extensively revise its previous nuclear protection recommendations, then advocated that states maintain national systems for guarding these materials.

Morokhov's suggestion can serve as a starting point for a final discussion on a number of proposals being made in various forums that seek to solve the acceptability/credibility dilemma. It seems unlikely that most nations would readily accept IAEA Grey Book recommendations, given the cost burden that would be placed on their economies. And the Agency itself does not appear prepared yet to face the confrontation that would certainly ensue were it to make the Grey Book mandatory. But growing mention of Grey Book ideas, plus their upcoming Agency revision is a step in the right direction, even if they remain only recommendations or international standards to be voluntarily applied. As the proliferation of both peaceful nuclear technology, and the perception of risks that goes with it, proceeds, the presence of such recommendations may enable a greater standardization and coordination of national nuclear security systems in the near and mid-future.

There have also been United States proposals for a National Nuclear Police Force to handle all in-plant and in-transit SNM protection. The development of such a force would eliminate the existing lack of coordination between the private security forces each nuclear facility operator is presently responsible for providing, and state or local public law enforcement agencies outside the facility. Taking this idea one step further, the IAEA could sponsor conferences to develop international standards of training and intelligence for nuclear protective forces. Items on the conference agenda might include indoctrination of the force for work in this field, effective communication methods, and coordinating recovery of SNM across national borders.

At that point the police intelligence field would have progressed as far as the physical protection field: the production of a set of recommendations. As with the Grey Book proposal, the final step could be an Agency requirement of a national nuclear police force in each nation desiring to receive SNM for its reactors. But, as with the earlier proposal, such an idea seems unlikely to gain widespread acceptance: national police intelligence is one of the most closely guarded and secretive institutions within a state's sovereign sphere.

A more modest proposal concerns the co-location of nuclear facilities, especially fuel fabrication and reprocessing plants. Such co-location eliminates the risk of diversion at most of the critical transportation steps, and offers convincing economies of scale. (There are disadvantages though, notable among them the increased risk of environmental damage at the location site.) Perhaps placing the co-location of facilities at international boundary lines—and giving the IAEA a role in facility site selection, design, and operation—could serve to mutually reinforce the security systems of the boundary states.

Speaking before the United Nations General Assembly on September 23, 1974, United States Secretary of State Kissinger warned of the potential for nuclear theft and blackmail. The Secretary then commented that, "The United States will urge the IAEA to draft an international convention for enhancing physical security against theft or diversion of nuclear materials. Such a convention should set forth specific standards and techniques for protecting materials while in use, storage, and transfer."[29]

The idea of such a convention, and its ultimate end point of usefulness—once a successful diversion occurs, prompted one expert to develop a broader approach to deal with the problem of responding to nuclear theft as well as preventing it. Dr. Forrest Frank, of Stanford University's Arms Control and Disarmament Program, has taken the existing Convention for the Suppression of Unlawful Seizure of Aircraft[30] as a model upon which to base an international agreement to suppress nuclear theft.[31] Frank's Draft Convention begins with

[29]United States Dept. of State Bulletin, vol. LXXI, No. 1842, October 14, 1974, p. 501.
[30]T.I.A.S. 7192. vol. 23, part 2 (1971), p. 1643-1684.
[31]Forrest R. Frank, "Suppressing Nuclear Terrorism: A Modest Proposal," unpublished paper,

national guarantees of either extradition or prosecution of nuclear terrorists; it continues with novel provisions to compensate persons suffering injury or property loss as a result of the unlawful use of a nuclear explosive, as well as assurances that stolen nuclear devices or other SNM would be returned to their legitimate owners.

These proposals for international conventions by Dr. Kissinger and Dr. Frank suggest a realistic and internationally acceptable approach to the problem. Once drafted, signed, and entered into force, such conventions would—in addition to existing national safeguards—form both a credible deterrent to diversion and a means of crisis resolution should diversion still occur. But international conventions take years to develop and years longer to gain sufficient ratifications. We cannot afford the luxury of such lengthy preparations toward a solution, unless we concurrently work upon other, quicker means of countering the diversionary threat. Fortunately, such quicker means are being quietly devised.

The nuclear materials supplier states have been and continue to make quiet bilateral arrangements on intelligence cooperation and physical security measures. There have even been exchanges of security hardware where such devices are not linked to still-classified weaponry hardware. At the same time, a clear majority of the world's nuclear suppliers have unilaterally announced tightened controls on their exports of certain nuclear items to any non-NPT Party recipient. By the end of 1974, 13 nations (including the United States and U.S.S.R.) had developed export requirements calling for recipients to accept IAEA safeguards and provide assurance that the items they import will not be re-exported by any means that could circumvent NPT objectives.[32]

Such bilateral exchange arrangements, as well as the actions by the nuclear supply oligopoly, are decidedly on the right track. They not only attack the problem while gaining time for the development of longer term, multilateral solutions, but provide the very framework of international cooperation and effort that can make those longer term solutions a reality. One final, and a bit perverse notion remains: as has happened before in human history regarding other threats, perhaps the first major reported illicit diversion of nuclear materials will have a beneficial effect upon the problem, either through agreements to radically tighten safeguards, or through a slowing down of the spread of nuclear energy use itself. Let us not hope that non-governmental nuclear diversion will never occur; rather let us hope that it does not take an occurrence to make us act.

Stanford University: June, 1975.

[32]IAEA Document INFCIRC/209, and 209 Addenda 1 and 3, September 3, 1974. The 13 nations are as follow: Australia, Denmark, Canada, Finland, Norway, U.S.S.R., U.K., U.S.A., Netherlands, Fed. Rep. of Germany, Poland, Germ. Dem. Rep., and Hungary.