

Guarding Nuclear Reactors and Materials from Terrorists and Thieves

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Abstract

The September 11 attacks were a wake-up call alerting us to the need to strengthen standards for protection of nuclear facilities and nuclear material from theft and sabotage, the subject of possible revisions to the Convention on the Physical Protection of Nuclear Material (CPPNM). However, the May 2001 Final Report of Experts convened to consider revising this treaty did not make recommendations on what standards an amendment extending the treaty to domestic use, storage and transport should cover except that the amendment should apply to sabotage as well as theft. The information available on what threats countries protect their nuclear material and facilities against shows great variation from country to country. Some countries do not perceive any threat that their weapons-usable material may be stolen by insiders for sale to terrorists, and some have not protected their nuclear power plants against terrorist truck bombers. As the Director General's preface to INFCIRC/225/Rev.4 says, although responsibility for physical protection rests with the state having the nuclear material or facility to be protected, "it is not a matter of indifference to other States whether and to what extent that responsibility is fulfilled."

The May 2001 Final Report of Experts opposed any form of international oversight for physical protection. What will be the point of strengthening the CPPNM if parties can say: "We have already done all that is necessary to comply with the amended CPPNM. Our facilities can meet all the threats that they will face. What we have done is confidential and of no business to anyone else."

This paper urges amendment of the CPPNM to raise national physical protection standards and immediate strengthening of national practices in light of the September 11 attacks and the Board of Governor's approval of new fundamental principles for nuclear security. It also urges an upgrading of INFCIRC/225 and institution of some form of cooperative, reciprocal international oversight over national physical protection programs.

Introduction

This is a report on what is needed after the events of September 11 to strengthen national and international standards for protection of nuclear material and facilities from theft and sabotage. Just after these attacks, Director General ElBaradei said:

“The tragic terrorist attacks on the United States were a wake-up call to us all. We cannot be complacent. We have to and will increase our efforts on all fronts—from combating illicit trafficking to ensuring the protection of nuclear materials—from nuclear installation design to withstand attacks to improving how we respond in nuclear emergencies.”

As this quotation suggests, the September 11 attacks require a fundamental rethinking of the threats that systems to provide nuclear security must protect against. Even if protection against “dive-bombing” by a large hijacked jetliner loaded with fuel may be impractical for most existing facilities, the injury that such terrorists could inflict on the ground without use of jetliners is probably greater than most are designed to protect against. On September 11 there were parallel suicide attacks by 19 well-trained terrorists bent on killing as many people, and causing as much destruction, as they could – for which they would be rewarded by being transported to heaven. We believe this to be a much larger threat than civilian nuclear security systems are generally designed to deal with—even without use of hijacked, fuel-laden super jetliners.¹ Suppose that these 19 had formed into teams to drive four vans with large high explosive bombs into the power reactors and spent fuel ponds for a large nuclear facility. Suppose several armed trucks had crashed gates of weapons-usable nuclear storage facilities with guns blazing and the 19 terrorists on board. Suppose these terrorists used several medium-sized aircraft loaded with both fuel and high explosives? Does any civilian facility’s design basis threat suggest protection against such threats?

The September 11 attacks made a major impression on the IAEA General Conference meeting. Unanimously, the General Conference asked the Director General “to review thoroughly the activities and programmes of the Agency with a view to strengthening the Agency work relevant to preventing acts of terrorism involving nuclear materials and radioactive materials and to report to the Board of Governors as soon as possible...” In addition to urging member states to support these efforts by the Agency,

the General Conference called on all states that have not done so to accede to the CPPNM.²

At their September meetings, both the Board of Governors and the General Conference welcomed the decision by the Director General to convene a drafting committee to produce a draft amendment to strengthen the CPPNM. Presently, the CPPNM is limited to protecting nuclear materials in international transport against theft. It does not establish requirements for nuclear materials in domestic use, storage and transport, and it does not require protection against sabotage, including that by terrorists.

The work of the Informal Open-Ended Expert Meeting that recommended a CPPNM amendment to establish such requirements was completed long before September 11. The events of that day reinforced the Experts' recommendation that the CPPNM should be amended, but suggest the need to go further than the Experts had proposed. Those events show the *desire* of these terrorists to advance their cause by killing thousands of innocent civilians – as the Al Qaeda terrorists see it, such killings are commanded by their God.³ Death to many civilians could also result from a nuclear explosion, or even from a conventional explosive truck bomb used against a poorly-protected reactor or a vulnerable cooling pond where large quantities of spent fuel were stored--assuming each of these was near a city.

Where and how should physical protection practices be strengthened in light of the events of September 11?

Is the United States the only country threatened by terrorist attacks such as those of September 11? Concerns about such threats have been voiced and security of nuclear installation has been stepped up since September 11 in Japan, Russia, Eastern and Western Europe, Canada, Australia and Mexico, as well as the United States. Is the threat worldwide? Only time will tell.

Meanwhile, the long process of amending the CPPNM to require greater protections against such threats should begin. The Director General has called for a drafting session in December. The May Final Report of the Informal Experts' Meeting contains many suggestions for amendments. But it says nothing about what the new standards for protection should be for the amendment extending the CPPNM to domestic use, storage and transport except that it should apply to sabotage (including terrorism) as well as theft. The Report contains some useful "fundamental principles" for physical

protection, but does not otherwise specify requirements for physical protection for the CPPNM such as those that appear as recommendations in IAEA Information Circular 225, Revision 4 (INFCIRC/225/Rev.4). It does not even suggest that parties should take INFCIRC/225 into account in planning their physical protection practices. By their terms, the “fundamental principles” are not a bridge to specific protection suggestions like those in INFCIRC/225. They are no substitute for a reference to INFCIRC/225 in the CPPNM or to the specification in the CPPNM of some minimum requirements.

The CPPNM now has limited minimum requirements for the one kind of domestic protection against theft that it already covers--storage of nuclear material within a country when the material will be, or has just been, in international transport. For example, the existing CPPNM requirements for more than two kilograms of unirradiated plutonium or more than five kilograms of unirradiated highly-enriched uranium (containing more than 20 per cent U-235) are storage in a “protected area” with access restricted to “persons whose trustworthiness has been determined,” with surveillance of this material by guards in close communication with response forces. Could a description of the “protected area” minimum requirements be added, given the concerns about terrorists or their emissaries stealing weapons-usable material to make nuclear weapons? What about requirements for protection of nuclear reactors from sabotage?

Some in the Experts’ group have resisted detailed requirements for physical protection arguing that threats vary from place to place and that the design of protections for a particular facility should be based entirely upon the threats that facility faces – its own “design-basis threat” (DBT). The Agency’s recommended standards, INFCIRC/225/Rev.4, mention the importance of “design-basis threat” in several places, but they recommend specific protections at even more places. They thus call for a mixed “perceived-threat” and “rule-compliance” approach. Should the CPPNM do the same? Doesn’t it need some regulatory specifics on the assumption, for example, that all weapons-usable material faces some threat of theft? Unless there are at least minimum standards in addition to a design basis threat, a state’s own perception of the threat to itself will likely be the only basis for its physical protection. If a state believes there is no threat of theft by terrorists or their emissaries for its weapons-usable materials, should it be free to ignore specific protection provisions such as those in INFCIRC/225/Rev.4? Would that be fair to other states against whom the weapons-usable material might

be used in the form of nuclear explosives? Would it be possible in a revision of INFCIRC/225 to define and recommend protection against agreed *minimum* design-basis threats for various categories of protection facilities, particularly those the breach of which by thieves or terrorists could threaten other countries?

Variation in protection practices.

The limited information that is available on how countries perceive the threats against themselves shows variation from country to country. For example, in a Stanford survey of information on 1997 physical protection practices provided to a Stanford workshop and to an IAEA conference, 12 of 19 countries said they perceived some kind of insider threat to their nuclear materials, six provided no information on insiders and one insisted that it faced no threat from insider theft. Only 11 of the 19 reported dangers of sabotage from terrorists or others.⁴

Dissatisfied with this data, we developed a detailed country questionnaire on physical protection and have received six completed questionnaires so far. The answers are confidential and the countries' names will not be revealed. None of them are nuclear-weapon states, but all have peaceful nuclear programs. They are located in Asia, Eastern and Western Europe and South America. Their answers show considerable variation. Four of the six had previously agreed with their nuclear suppliers to follow the recommendations of IAEA Information Circular 225 or to take those recommendations into account. However, the Nuclear Suppliers' Guidelines do not specify which version of INFCIRC/225 should be applied, the 1993 Revision 3 or the 1999 Revision 4. All of the six countries said they applied INFCIRC/ 225 but two reported applying Revision 3, three reported applying Revision 4 and one reported applying both. There was, of course, considerable variation in their actual practices.

Variations in the application of INFCIRC/225 were also reported by country experts who were involved in the first 10 missions of the International Physical Protection Advisory Service (IPPAS), the IAEA's advisory program that has been limited both by funding and by the lack of applications for advice. Based on their experience in the ten countries, these experts reported that the implementation of INFCIRC/225 recommendations "will vary from State to State. Differences in culture, perceived threat, financial and technical resources, and national laws are some of the reasons for variations." This variation in practices came about even though the

states involved said they had reviewed and considered either Revision 3 or Revision 4 of INFCIRC/225.⁵ Of course, the language of revisions permit considerable variation in national practices. The latest, Revision 4, was a consensus document agreed in 1998, long before the events of September 11, 2001. When it is revised again, which we hope will be soon, should the revision attempt to state some minimum protection practices for the newly perceived threats?

All six respondents to our new questionnaire reported that they had national regulatory systems that required licensing of facilities containing nuclear material, and four of the six reported that inspections of protected areas for nuclear materials were conducted at least once a year by authorities not under the supervision of the managers of the facilities. Thus the Experts' "Fundamental Principles" calling for regulatory bodies and inspections independent of the nuclear facility operators, principles that were approved by the IAEA Board of Governors in September, are likely to be acceptable to most of these respondents.

Five of the six respondents said they had established a DBT. These five said they used their DBT either to design or to evaluate their protection facilities. However, only three of the six said that they kept their DBTs current. Moreover, two reported that they did not consider illicit trafficking in other countries in devising their own DBTs. While illicit trafficking may not suggest the dangers of terrorist sabotage, it is evidence of both the risks of poor protection and the active market for nuclear material. It should not be irrelevant to countries not yet feeling threatened by thieves or terrorists. Furthermore, two of the six respondents reported that they did not take into account *any* risk of an attack on a protected area by *terrorists* in establishing their DBTs. In addition, three did not take into account "the danger of unauthorized *removal or sabotage* by insiders."

These differences in threat perceptions must have helped cause some of the many differences in physical protection practices. The differences in perception also suggest risks in relying entirely on national DBT's to establish national physical protection standards. Should an attempt be made to achieve closer agreement on DBT's or on the methodology to determine them so that more consistent DBTs can be developed? Are there really as many differences in risks faced by different countries as the responses to our questionnaires might suggest? If terrorists want to steal weapons-usable material, won't they seek out the places where protection is weakest? If

they wish to demonstrate their power and their contempt for all who reject their views by bombing a reactor or a spent-fuel repository, will they only attack facilities in the United States where, after the attacks of September 11, the protections are likely to be stronger? Are they not likely to seek out reactors or spent-fuel repositories in other parts of the world that are less well protected?

The answers to our questionnaire suggest that facility operators in many parts of the world worry about theft and sabotage by armed outsiders. Indeed, the greatest *theft* threats perceived by the four responders who answered our threat ranking questions was from a single insider acting (voluntarily or involuntarily) with an armed outsider or outsiders. *Sabotage* was also perceived as an outside threat by all these four. All four ranked the *most likely* sabotage threats as “armed attack by outlaw, terrorist or military unit on the facility,” or “surreptitious entry by outsiders” in some cases assisted by insiders. But not one of the six reported plans for dealing with protected-area sabotage from a truck bomb “which spreads radioactive material over and beyond the protected area.” None of them had developed plans “to minimize radiological impact” to the health and safety of the public *beyond the protected area*. Sabotage that causes radiological impact beyond that area is simply not perceived as a threat that they need to deal with. The bomb-laden truck which penetrates the protective area fencing and crashes into a reactor or spent-fuel storage facility causing dispersion of radioactivity outside the protected area is simply not a risk that they are protected against. If that is the case, and if U.S. reactors and their spent fuel are better protected against this truck-bomb threat, as the U.S. Nuclear Regulatory Commission says they now are, why would terrorists choose to attack U.S. facilities?

In response to a question whether their fenced-in protected areas had “vehicle barriers stronger than the fence at the points where vehicles such as a truck bomber might try to crash the fence” only three of the six respondents said “yes.” Similarly, when asked what level of protection best described their protected area, three responded: “Area or material can be accessed by defeating lightly reinforced barriers (e.g. crossing two or more fence lines, crashing a heavy gate, breaking a reinforced door or window, etc.)” Only one of the six reported stronger protection than this. This one’s protected area could only be accessed “by defeating heavily reinforced barriers and active measures (e.g., vehicle traps or pop-up crash barriers, man-traps, booby traps...)”

There were many other variations in the questionnaire responses. For example: Two out of the six did not provide guns for their guards for protected areas where weapons-usable material is located. Three followed the better practice of providing only one exit for inner areas within the protected area where weapons-usable material is actually stored, but three did not. All required some sort of identification for personnel entering such an inner area, but there was considerable variation in the manner of identification. Within such an inner area, most required that two persons be present (the “two-person” rule) but that requirement was administered in quite different ways and sometimes not followed.

If a country does not perceive any “insider” threat of stealing even weapons-usable material, as some of the respondents do not, is it not a threat to other countries if the material is stolen? If a country with a power reactor or spent fuel pond near its boundary with another country does not perceive any threat that a truck bomber will attack its nuclear facilities, could its failure to deal with that sort of threat become a threat to the neighboring country if truck bombers could produce a reactor melt-down or a dispersion of radioactivity from the spent fuel? As the Director General’s preface to INFCIRC/225/Rev.4 says, although responsibility for physical protection rests with the state having the nuclear material or facility to be protected, “it is not a matter of indifference to other States whether and to what extent that responsibility is fulfilled.”

Amending the CPPNM.

Should the CPPNM contain some minimum protection standards for facilities and nuclear material? Remember that Non-Proliferation Treaty (NPT) safeguards do not do this job. The NPT does not require physical protection against outsider threats to steal or sabotage nuclear material. NPT safeguards are intended to detect diversion of nuclear material from peaceful purposes to weapons and they should detect the stealing of this material after it is stolen. But a danger of detection is not likely to deter outside criminals or terrorists who expect to be detected and to escape capture if they are stealing material or to die in the explosion if they are truck bombers. Barriers, monitors, sensors, guards and alarms that are part of physical protection systems are what is needed to deter these outsiders. They are

needed even for disgruntled insiders who plan to help the outsiders but to escape detection themselves.

As we have seen, for temporary storage of weapons-usable material while awaiting international transport, the CPPNM now requires a “protected area” with access limited to “persons whose trustworthiness has been determined” and it requires surveillance of the material by guards in close communication with response forces. If it is not a matter of indifference to other countries if such material is stolen, should not the country where it is located have an obligation to other countries to provide at least effective barriers, sensors and alarm systems for a protected area?

The US National Academy of Sciences recommended that one goal of physical protection should be to protect all weapons-usable material to the same standards as nuclear weapons are protected. The US Department of Energy accepted this as an ultimate goal for its handling of weapons-usable material – recognizing that getting to this goal might take awhile.⁶ The U.S. Nuclear Regulatory Commission has rules for storage of weapon-usable material by the licensed nuclear facilities which it regulates that approach this goal.⁷ While not all countries face the same threats or have the same resources, would not agreed *goals* of this kind be useful? If so, why not state them as CPPNM goals as well as stating the “fundamental principles” and some minimum protection requirements in the CPPNM?

The May 2001 Final Report of Experts opposed any form of verification or international oversight of the physical protection practices of CPPNM parties. But if adequate protection by one state is of concern to other states, should not some way be found for experts from other states to discuss with the state providing protection what the threats and the best methods for protecting against them are? What will be the point of adopting amendments if parties to the CPPNM can say: “We have already done all that is necessary to comply with the new requirements. Our facilities meet all the threats that they will face. What we have done is confidential and not the business of anyone else.” That is the sort of response that CPPNM amendments based on the Experts’ report would permit. Is that really what the parties want after the events of September 11?

Of the many related treaties dealing with nuclear energy, the nuclear safety treaties may be the closest analogues to the CPPNM. They solve the “oversight” problems without formal inspections but with a lot of exchange

of information and multilateral cooperation to maintain safety standards. The Nuclear Safety Convention calls for periodic reporting by each party on “the measures it has taken to implement each of the obligations of this Convention.” These are then discussed at periodic meetings of the parties.⁸ The Convention on Safety of Spent Fuel Management and Radioactive Waste Management adds to requirements like these an obligation that the party proposing a new spent fuel or radioactive waste management facility consult other parties “in the vicinity of such a facility, insofar as they are likely to be affected by that facility...”⁹ This is clearly designed to meet the view expressed by the Director General that the protections of nuclear material provided by one party are of concern to other parties.

In the safety area, experts organized for the Nuclear Safety Standards Advisory Group (NUSSAG) are regularly accepted by states with nuclear facilities to look at the facilities and provide advice and make recommendations, and this leads to technical and sometimes to financial assistance. In the physical protection area, International Physical Protection Assistance Service (IPPAS) teams now provide this sort of “oversight” for physical protection in those instances where they are asked to do so. Is there a way to institutionalize this so that one country can assure others that its physical protection is adequate? So far the IPPAS teams have not gone to a large country with many important nuclear facilities. Perhaps such a country should volunteer – to show the way for cooperation in strengthening physical protection standards.

One of the 12 fundamental principles recommended by the Experts for inclusion in the CPPNM and approved by the Board as IAEA standards says that a country with nuclear material should be “responsible for establishing and maintaining a legislative and regulatory framework to govern physical protection,” and that an independent national regulatory agency be given responsibility for this task and provide inspections to see that the framework is observed by the regulated operators. Would it not help to reassure states that may be injured by inadequate protection in other states if each party reported the “legislative and regulatory framework” that it had adopted to other parties or to the IAEA? CPPNM parties are now obligated to report the regulations and legislation that they adopt pursuant to other provisions of the CPPNM¹⁰. Why not add reports on the “legislative and regulatory framework?”

Raising national standards pending amendment of the CPPNM.

Action to strengthen States' legislative and regulatory frame and physical protection practices should not await amendment of the CPPNM -- which may well take several years. Every state with weapons-usable material, power reactors, large spent-fuel storage ponds or other major nuclear installations should review its protection requirements for such facilities in light of the new threats suggested by the September 11 attacks even if physical protection against a hijacked, fuel-loaded super jet liner may not be realistic. (See discussion above) At a minimum, the protections suggested by Revision 4 of INFCIRC/225 against both theft and sabotage should be put in place as soon as possible if they have not already been -- and the discussion above suggests that the INFCIRC/ 225/Rev.4 recommendations have not yet been implemented in many facilities. Perhaps a wealthy state or states with major nuclear facilities can lead the way on compliance with Revision 4. The United States once urged that taking INFCIRC/225 into account should be a requirement of the CPPNM. Later it found such a requirement to be expensive for the United States and a departure from its existing methods for appraising physical protection. Have the attacks of September 11 made a difference in the U.S. evaluation of the risk vs. the cost of meeting that risk?

Given the differences in which version of INFCIRC/225 to apply shown in our questionnaire, supplier states should find out which revision the recipients of their supplies are applying. Some supplier states conduct inspections of recipient countries' installations every few years. After pushing for compliance with Revision 4 and providing time for such compliance, new inspections might be in order to consider jointly whether the protections seem adequate after the September 11 attacks. The IAEA's International Physical Protection Advisory Service could be used to provide advice to recipients as well as suppliers in assuring adequate protection.

In recent years, the IPPAS has provided advisory assistance to more than a dozen states (about two and one-half per year on the average), mostly in Eastern Europe and Central Asia. National experts recruited by the IAEA visit the country seeking advice, review the protections provided and make recommendations. Sometimes financial assistance to implement these recommendations has been provided by EU countries, Japan or the United States. Given the variation in practices already described, and given the risks of illicit trafficking and terrorism, it is surprising that more countries have not asked for assistance from IPPAS. New attention to physical

protection as the result of the September 11 attacks is likely to produce more requests for assistance – and the need for more funds for IPPAS and for improvements that IPPAS missions recommend.

In addition, the fundamental principles approved by the Board of Governors in early September should be implemented. They became effective as IAEA principles upon approval by the Board. They include the principles already mentioned that call for an independent regulatory agency that conducts inspections. They include an insistence that the holders of nuclear licenses take responsibility for physical protection, and that they and the regulators give priority to establishing a “security culture” to ensure continued effective implementation of security requirements. They include an insistence that protection be based on a *current* evaluation of the threats, that is, that a facility’s design-basis threat be brought up to date – something that was not the case for some of the respondents to our questionnaire.

The principles include one saying that protection requirements should be based upon a graded approach taking into account current threats, relative attractiveness of the material or facilities to attackers, the nature of the material protected and the potential consequences of theft or sabotage. They say that the State’s requirements should reflect several layers and methods of protection and that the State should establish a quality assurance program to provide confidence that “specified requirements for all activities important to physical protection are satisfied.” The independent state agency inspections of the state’s own nuclear facilities that the principles call for could help to assure that these requirements are satisfied, as could IPPAS and supplier-state visits to nuclear facilities.

There is no need to wait for amendment of the CPPNM to put these “fundamental principles” into effect in every country to which they apply. Given the Board’s approval of them and the unanimous General Conference resolution welcoming that Board decision after the events of September 11, these principles now have special status. They should be the basis for major improvements in physical protection around the world.

As a result of the adoption of these “fundamental principles,” every State responsible for nuclear material and facilities has a new responsibility to the Board of Governors and to other countries to review its regulations, its design basis-threat decisions, its attention to teaching a “security culture,” and its facility operators actual protection practices.

While these new “fundamental principles” call for independent-agency inspections of physical protection systems, they do not require independent testing by mock, unannounced attacks (sometimes called “war games” in the U.S.) against such systems to see whether they can defeat intelligent, well-trained insider and outsider efforts to overcome the systems. This, however, can be an effective “wake up” call for on-duty employees as well as for facility operators. The U.S. Nuclear Regulatory Commission has used them to reveal major weaknesses in licensed civilian physical protection systems. After a regulatory agency has overseen compliance with the new “fundamental principles,” it would be well advised to test the results with such mock attacks. IPPAS experts who have been involved in mock attacks of this kind in other countries could provide advice and assistance to states that have not done this before.

Conclusion.

The September 11 events gave new urgency to efforts to amend the Convention on Physical Protection of Nuclear Material. The May 2001 Experts’ report contains many valuable recommendations to that end. But it does not provide any recommendations for raising existing CPPNM standards except that sabotage should be dealt with. It rejects any reference to INFCIRC/225 recommendations in the CPPNM, even a requirement that they be taken into account. It rejects international oversight of how each state applies physical protection standards in practice.

The variation from state to state in the manner of protecting comparable facilities – variation especially in the threats to guard against – suggest a need (1) for either specific standards in the CPPNM or for a reference in it to INFCIRC/225 for standards; and (2) for some form of international oversight, perhaps like that used in the IAEA safety conventions, to provide assurance that vulnerable facilities and materials will be appropriately protected.

Improving national physical protection practices should not await amendment of the CPPNM. Indeed, the Board of Governor’s adoption of “fundamental principles” of physical protection for immediate implementation should provide an impetus to states to institute reviews of their physical protection systems. The Agency’s International Physical Protection Advisory Service and its other technical services should be

expanded to assist in this effort. In addition, the revision of INCFCIRC/225 to reflect the new threats should be begun.

¹ For an example of the high design-basis threat used by the US Nuclear Regulatory Commission for protecting weapons-usable material, see George Bunn, "U.S. Standards for Protecting Weapons-Usable Fissile Material Compared with International Standards," *Nonproliferation Review* (Fall 1998), p. 137. This threat is different from that for reactors and it does not, of course, include protection against large jetliners loaded with fuel.

² General Conference Resolution GC(45)/L.8, September 20, 2001

³ See the instructions to the September 11 hijackers: "Instructions to Kill: Excerpts from Notes Found After Hijackings," *New York Times*, Sept. 29, 2001 (Nat. ed.) ("kill them as God said"). See also "Bin Laden's Statement: 'The Sword Fell'", *New York Times*, Oct. 8, 2001 (Nat.ed).

⁴ Kevin J. Harrington, "Physical Protection of Civilian Fissile Material: National Comparisons" (Sandia National Laboratories in cooperation with Stanford's Center for International Security and Cooperation, 1999).

⁵ Mark Soo Hoo, David Ek, Axel Hageman, Terry Jenkin, Chris Price, Bernard Weiss, "International Physical Protection Advisory Service: Observations and Recommendations for Improvement," *Proceedings of the 40th Annual Meeting of the Institute for Nuclear Material Management* (2000).

⁶ Department of Energy, "Nonproliferation and Arms Control Assessment of Weapon-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives" (1997), pp.5, 36-37.

⁷ G. Bunn, "U.S. Standards for Protecting Weapons-Usable Fissile Material...", *op.cit.*, provides citations of authorities for all of these points.

⁸ Articles 5 and 20.

⁹ Articles 6 (iv) and 13(iv).

¹⁰ Article 14.