3. NUCLEAR SECURITY

§3.1 Overview

3.1 "Nuclear security" means measures designed to address the risks associated with theft and trafficking in nuclear and radiological materials (including for the benefit of would-be proliferators), sabotage of nuclear facilities, and the danger of terrorists acquiring and using a nuclear weapon. Despite recent advances global nuclear security is inadequate. Because a major nuclear security incident would have far-reaching consequences, effective nuclear security must be a global concern. But most countries regard nuclear security as primarily a national concern, devoting insufficient attention to the development, promotion and application of international standards.

3.2 The nuclear security regime consists of agreements, regulations, resolutions and guidelines that either existed or were close to being finalized before 2010. Further progress has been made in national implementation since leaders’ level Nuclear Security Summits (NSS) began in 2010. National ratifications of treaties and several projects were accelerated so that they could be announced at the summits. But nuclear security still lags well behind the other nuclear regimes for safety, safeguards and arms control. The current regime is reliant almost entirely on national protection and control systems in those countries that possess nuclear and radiological materials. It needs to be more comprehensive instead of incremental, covering all materials and all facilities at all times; integrated rather than disparate and piecemeal; and backed by global mechanisms in order to make the regime both robust and resilient. It also needs effective monitoring requirements, and authority, procedures and institutions for enforcing agreed commitments: without these, accountability is lacking and states cannot have confidence in the international nuclear security system.
3.3 **Global Nuclear Security Architecture.** Globally, nuclear security is less well developed than nuclear safeguards and nuclear safety. The three main elements of the nuclear security regime are national laws and regulations; international agreements, instruments and institutions; and ad hoc and voluntary cooperative measures. The main global components are: The Convention on the Physical Protection of Nuclear Material (CPPNM) (1980) which applies primarily to the protection of nuclear material in international transport; the CPPNM Amendment (2005) which extends the convention’s application to protection of nuclear material in domestic use and of facilities against sabotage; the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT) (2007); United Nations Security Council Resolution (UNSCR) 1540 (28 April 2004); IAEA guidance documents like INFCIRC/225/Rev.5, the Fundamental Principles of Physical Protection of Nuclear Material and Nuclear Facilities, and INFCIRC/153; and various multilateral, regional and bilateral agreements and initiatives.

3.4 The need for effective nuclear security has been widely recognized. The Final Document of the eighth NPT Review Conference (2010) noted “the paramount importance of effective physical protection of all nuclear material and the need for strengthened international cooperation in physical protection,” and supported nuclear security improvements. Two NSS have been held so far, on 12–13 April 2010 in Washington, DC and 26–27 March 2012 in Seoul. A third is planned for 2014 in the Netherlands. Nuclear security was an important issue for the International Commission on Nuclear Non-proliferation and Disarmament (ICNND), with its 2009 report including a number of recommendations on strengthening the international regime (ICNND Recommendations 27–31).

3.5 The CPPNM has 148 States Parties, which means that about one-quarter of the world’s states have still not acceded to it. By December 2012, only 61 of the 99 accessions needed for the 2005 amendment to enter into force had been received. The long delay with entry into force of the CPPNM amendment is starkly at odds with continued international concern about nuclear security standards.

3.6 The Nuclear Security Series are International Atomic Energy Agency (IAEA) publications “relating to the prevention and detection of, and response to, theft, sabotage, unauthorized access and illegal transfer or other malicious acts involving nuclear material and other radioactive substances and their associated facilities.” They embrace such fields as nuclear security fundamentals, recommendations, implementing guides and technical guidance. In the series, INFCIRC/225/Rev.5, a set of non-legally-binding guidelines, is generally considered to be the cornerstone of the international physical protection regime for nuclear materials and facilities and has been incorporated into the domestic law of many states, and also in some suppliers’ bilateral agreements as a condition of peaceful nuclear cooperation. Inclusion in bilateral nuclear supply agreements of a provision that recipient states apply INFCIRC/225 requirements is a means of making them legally binding in particular states. Effective nuclear security demands that all nuclear suppliers include the INFCIRC/225 condition (and a requirement that recipients be party to the CPPNM) in their agreements.
3.7 ICSANT is an important legally binding multilateral instrument establishing obligations to take domestic measures to prevent and punish nuclear terrorism and strengthening international cooperation in this area. The convention came into effect in 2007 but remains far from universal. A total of 115 nations have signed and 83 have ratified the convention to date.

3.8 UNSCR 1540, passed by the UN Security Council to counter the dangers of nuclear terrorism by, inter alia, improving and enhancing international cooperation on nuclear security, has resulted in some significant progress but has yet to be fully implemented.

3.9 The Code of Conduct on the Safety and Security of Radioactive Sources, approved by the IAEA Board of Governors in September 2003 with a supplement approved in September 2004, established detailed, non-legally binding guidance on international best-practice standards to prevent the misuse of radioactive sources including for “dirty bombs.” By December 2012, 115 states had expressed support for the Code of Conduct and 73 countries supported all aspects of the supplementary guidance as well. Continued regional and global assistance to states requiring it is vital to the effective control of radioactive sources.

3.10 Global cooperation mechanisms have made an important contribution to improving nuclear security, particularly those launched in the post-Cold War period to reduce the risk of leakage of nuclear and radioactive materials, technology and expertise from the former Soviet republics. Among the most successful and effective is the 21-year old Cooperative Threat Reduction (CTR or Nunn-Lugar) program. In October 2012, Russia announced that it would let the program expire in May 2013 because it no longer needs foreign assistance and has concerns about nuclear security information being leaked. Another initiative to have made a significant contribution to nuclear security is the $20 billion Global Partnership of the Group of Eight (G8) countries. The G8 Global Partnership’s mandate was to expire in 2012 but has been extended indefinitely. The Global Initiative to Combat Nuclear Terrorism (GICNT), set up by Russia and the United States in 2006, had by December 2012 expanded its membership to include 85 countries plus four observers.

**Overall Evaluation of Global Nuclear Architecture. Some Progress** States have implemented many NSS commitments, additional states have ratified the CPPNM and its Amendment, more are taking advantage of IAEA tools and services, and states have cooperated with one another. However, NPT 2010 and ICNND 2009 support for universal application of the CPPNM and early ratification of the 2005 amendment is not in sight. Much of the architecture lacks any means to judge whether commitments are being met.
3.11 **Role of the IAEA.** The IAEA’s lead role in strengthening international nuclear security – in particular through the services and assistance it provides under the Nuclear Security Plan for 2010–13, the third plan of its kind – is not reflected in the funding available for the agency’s nuclear security work which, as well as being insufficient, is not guaranteed because it overwhelmingly comes from voluntary contributions. In addition to the funding issue, consideration is needed on whether the IAEA’s authority and responsibilities in the nuclear security area should be expanded.

*Overall Evaluation for the Role of the IAEA. Some Progress.* The IAEA is providing a wide range of advisory services and other assistance on nuclear security issues. The centrality of the IAEA’s role makes a predictable and stable budget for nuclear security essential.

3.12 **International Cooperation.** In 2011 the IAEA published a reference text on computer security at nuclear facilities and several countries and organizations have held workshops and other events on this subject. A total of 116 states have joined the Illicit Trafficking Database Programme (ITDB). International cooperation such as the US Megaports Initiative is providing training, technical assistance and equipment to strengthen detection and interdiction capabilities. But the historical bias towards national secrecy and sovereignty on nuclear security continues to result in inadequate transparency and accountability, notwithstanding the global consequences of vulnerability. This is reflected in insufficient international cooperation on developing and implementing nuclear security best practice, although it is demonstrably possible to develop and share such practices consistent with the confidentiality of commercially or militarily sensitive information.

*Overall Evaluation for International Cooperation. Some Progress.* Significant international cooperation is taking place on detecting and thwarting illicit trafficking, but this needs to be expanded as gaps are identified. States need to commit more fully to cooperation in developing and sharing nuclear security best practices.

3.13 **National Nuclear Security Regulations.** In 2011 the UNSCR 1540 Committee was able to report that: “at least 140 States have now adopted legislative measures to prohibit proliferation of nuclear, chemical and biological weapons, as compared to 65 States in 2006.” However, work remains to be done in the national implementation of nuclear security measures. Continued provision of assistance to states requiring it is essential.
Overall Evaluation for National Nuclear Security Regulations. Significant Progress. UNSCR 1540 has played a significant role in this area, resulting in a substantial increase in the number of states with legislative measures to prohibit proliferation of nuclear weapons. But more needs to be done in national implementation.

3.14 Sensitive Nuclear Materials. With civilian uses, progress continues to be made on global efforts to eliminate excess weapon-grade plutonium and to shift from highly enriched uranium (HEU) to low enriched uranium (LEU). The industrialized countries have assisted many others in HEU to LEU conversion efforts, but there has been a reluctance to ban outright HEU use in civilian applications. As to non-civilian uses, the United States and Russia have committed to the elimination of significant quantities of excess weapon-grade plutonium and are on track to complete the conversion of 500 tonnes of Russian HEU to LEU by the end of 2013, but no sensitive nuclear materials held anywhere for these purposes are subject to any international standards or assurance.

Overall Evaluation for Sensitive Nuclear Materials. Some Progress. While progress is being made on minimization of civil HEU use, states have been reluctant to ban HEU use in civilian applications. On non-civilian uses, the United States and Russia are on track to complete the conversion of 500 tonnes of HEU to LEU by the end of 2013 and have also agreed to eliminate significant quantities of excess weapon-grade plutonium.

3.15 Nuclear Forensics. Nuclear forensics needs to continue to develop and expand with the aim of increasing its capacity to provide information on the source, production and history of nuclear material outside regulatory control. The IAEA in particular has published descriptions of nuclear forensics tools and procedures and provided training to states on this.

Overall Evaluation for Nuclear Forensics. Some Progress. In addition to significant work going on at the national level in some countries, the IAEA continues to provide assistance with building nuclear forensics capacity in member states, both through its own activities and by teaming with member states to hold workshops and other training.
3.16 Role of Nuclear Industry. The shared responsibility for nuclear security between state authorities and the nuclear industry has been recognized, including at the two NSS. But implementation of public–private sector cooperation to strengthen nuclear security is not significant.

Overall Evaluation for Role of Nuclear Industry. **Minimal Progress.** There is general understanding that effective nuclear security is strongly in the interests of the nuclear industry. More work is needed on identifying practical ways the nuclear industry and state authorities can work together to improve nuclear security.

3.17 Nuclear Security and Safety Interface. The interface between nuclear safety and security has been recognized, including at the 2012 Seoul NSS. The overlaps between nuclear safety and security need to be fully reflected in the regulation, design and operation of nuclear facilities, including in risk assessments and training.

Overall Evaluation for Nuclear Security and Safety Interface. **Some Progress.** The IAEA in cooperation with member states is providing training and other assistance in this area. A number of training centres have been established which emphasize an integrated approach to nuclear safeguards, safety and security.

3.18 Nuclear Security Culture. In the absence of universal, binding nuclear security standards and adequate transparency and accountability mechanisms, a robust nuclear security culture is critical. The IAEA organizes training activities and workshops based on findings from the work of advisory missions. Its International Physical Protection Advisory Service (IPPAS) is particularly noteworthy in helping states to develop and improve national nuclear security on request.

Overall Evaluation for Nuclear Security Culture. **Some Progress.** Increasing organizational activity suggests some progress here. However, the extent to which a genuine nuclear security culture exists is unclear because of the lack of monitoring and reporting on whether states are implementing best practice standards and recommendations.
§3.2 Objectives and General Strategy

3.19 Nuclear disarmament, nuclear non-proliferation and peaceful uses of nuclear energy are the three main pillars of the NPT regime. Particularly since the terrorist attacks of 11 September 2001, nuclear security concerns have been heightened owing to several developments: fears that terrorist groups with cadres of suicide bombers not deterred by the thought of their own deaths are interested in acquiring radioactive and fissile material or in attacking nuclear facilities; revelations of illicit trafficking in nuclear materials, components and technology; unresolved security vulnerabilities at nuclear facilities in Russia and some other former Soviet republics; and several nuclear security incidents in recent times (see Box 3.1).

3.20 It is possible to interpret these in either of two contradictory ways. The first is to argue that the catalogue is unnecessarily alarmist and exaggerates and magnifies the importance of the incidents. After all, what is important is that none of them has actually led to anything consequential. Recalling them, therefore, is equivalent to crying wolf, alerting the international community to a non-existent danger. The alternative conclusion is that significant risks are inherent in this sphere and that the authorities have to be vigilant and succeed in preventing theft and attacks every single time.

3.21 Like the list of incidents involving temporary loss of secure control over nuclear weapons in storage or during transport, accidental or false reports of incoming attacks, and the like, the truth is that so far, no such alarms have resulted in a major incident, let alone a catastrophe. Unfortunately, however, this is no guarantee of the good luck holding always and forever. After all, the boy who cried wolf did indeed get killed and eaten by a wolf.

3.22 The working definition of nuclear security used by the IAEA since 2003 is: “The prevention and detection of and response to theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.”¹ A comprehensive definition of nuclear security would include regimes and protection, control and enforcement measures:

> To prevent, detect and respond to acts of nuclear terrorism using fissile material and radiological sources, illicit transfers or thefts of fissile material and radiological sources, and sabotage of nuclear and radiological facilities;
> To promote a nuclear security culture; and
> To strengthen a comprehensive, integrated and global regime as well as a suite of national laws, agreements, instruments and systems to this end.

3.23 In his speech in Prague on 5 April 2009 in which he outlined his dream of a world free of nuclear weapons, US President Barack Obama also announced the start of “a new international effort to secure all vulnerable nuclear material around the world within four years.”² The justification was to reduce the risk of nuclear terrorism which the president described as both the most immediate and the most extreme threat to global security.

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² “Remarks by President Barack Obama, Hradcany Square, Prague, 5 April 2009” (Washington DC: White House, Office of the Press Secretary, 2009), http://www.whitehouse.gov/video/The-President-in-Prague#transcript.

According to the IAEA, between 1993 and 2011, there were more than 2,000 cases of illegal trafficking, theft, or loss of nuclear and radiological materials around the world, of which only 40 per cent has been recovered. Some recent worrying incidents include:

- In 1998, insiders at a Russian nuclear weapons facility were discovered trying to steal 18 kg of highly enriched uranium (HEU);
- In 2006, Russian citizen Oleg Khinsagov was arrested in Georgia with 100 grams of HEU, attempting to find a buyer for several kilograms of HEU;
- On 8 November 2007, two groups of armed men broke into South Africa’s Pelindaba nuclear research facility outside Pretoria from two different directions, deactivated several layers of security, penetrated into the control room for 45 minutes and escaped but without taking any nuclear material. The site is believed to store enough weapon-grade HEU for up to 25 nuclear bombs held in “locked-down” secure conditions;
- In April 2012, another violation of protective measures at the Pelindaba facility was described as an act of “common” criminality. The national nuclear regulator spokesperson Gino Moonsamy was quoted as saying that thanks to “adequate physical protection, no nuclear or radioactive material was accessed, lost or stolen”;
- In May 2008, nuclear bombs were despatched from a North Dakota base without proper controls; three US Defense Threat Reduction Agency staff were dismissed;
- In 2009, about 100 grams of HEU, lodged inside a nuclear fission chamber that likely came from a decommissioned Soviet nuclear facility, was recovered from a scrap metal yard in Rotterdam;
- In November 2010, Belgian activists evaded NATO guards to expose security weaknesses at a base in Kleine Brogel where nuclear weapons are kept;
- In 2011, Moldavian authorities arrested six people for smuggling 4.4 grams of weapon-grade uranium. They had plotted to sell up to 9 kg for $31 million. The Russian ringleader is still at large;
- Serial attacks have done little to dispel international fears over “the risk of terrorists breaching Pakistan’s defences.” Just before dawn on 16 August 2012, several gunmen wearing military uniforms and suicide vests attacked the Minhas base of the Pakistan Air Force in Kamra, about 60 km northwest of Islamabad. In September 2012, the Inter-Services Intelligence (ISI) reportedly intercepted plans by the Tehreek-e-Taliban Pakistan (TTP) to attack one of the country’s largest nuclear facilities in Dera Ghazi Khan in what a military officer described as “the first-ever serious security threat” from the TTP. These incidents show the urgent need to raise international nuclear security standards. Terrorists need only to identify and exploit the weakest link in the chain of international nuclear security to acquire enough fissile material to make and detonate a bomb in a major city. And because the amount of fissile material required is as small as 5 kg of plutonium or 15 kg of HEU, the margin of accounting error for nuclear materials is dangerously small.

8. That said, the risks are further reduced, because an essential part of safeguards at processing plants (for example, enrichment, reprocessing, fabrication) is containment and surveillance (for example, cameras, radiation monitors) to ensure material cannot be removed.
3.24 Nuclear terrorism is defined in Article 2 of ICSANT\(^9\) as the making, demanding, possession, use, or threat of use of radioactive material or device by any person with the intent to cause death or serious bodily injury; cause substantial damage to property or the environment; or to compel a person, legal entity or international organization to do or refrain from doing an act.

3.25 While “defense against terrorism must succeed every time... terrorists must succeed only once. This is true from plot to plot, but within each plot, the logic is reversed. Terrorists must succeed at every stage, but the defense needs to succeed only once.”\(^{10}\) According to Harvard University’s Belfer Center in 2010, five terrorist groups “may be capable of acquiring and using nuclear weapons”; four are known to have “demonstrated an interest” in getting a nuclear weapon; and two are known to have tried to buy nuclear material on the international black market. In addition, al Qaeda is known to have been pursuing a nuclear weapon since the early to mid 1990s.\(^{11}\) Although a successful act of nuclear terrorism remains difficult for terrorists, the potential consequences are such that it must be treated as a serious threat.

3.26 Several regimes have been refined and additional ones promulgated to treat nuclear terrorism as a matter subject both to domestic and to international law, to outlaw it, to require states to use and, if necessary, strengthen domestic legal systems to fight nuclear terrorism, to use international law as a basis and the United Nations as a key forum for international collaboration and action to meet the threat of nuclear terrorism, and in other ways to encourage and facilitate interstate cooperation in meeting the challenge. However, the development and widespread adoption of international best practice in nuclear security culture is inhibited by concerns over national sovereignty if multilateral standards are made more stringent and international institutions are given an expanded remit to monitor compliance.

3.27 As distilled from the sources described below, the objective of nuclear security is to ensure that nuclear weapons and materials are secure from unauthorized access and theft, the facilities in which nuclear weapons and radioactive material are manufactured and stored are secure from sabotage, and terrorists and criminals are prevented from acquiring, making and using nuclear explosive devices.

3.28 The strategies for ensuring nuclear security may be described as:

- To protect nuclear facilities, weapons and material against theft and sabotage by:
  - minimizing the number of locations at which nuclear weapons and fissile materials are stored;
  - strengthening security at all locations;
  - encouraging the switch from highly enriched uranium (HEU) to low enriched uranium (LEU);
  - reducing the size of global nuclear weapons and fissile materials inventories; and

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- bringing all remaining excess military and civilian stockpiles of fissile materials under international monitoring;

> To prevent, detect and respond to the theft and sabotage of nuclear material during international transport;

> To prevent, detect and respond to any illicit trafficking in nuclear material;

> To prevent, detect and respond to acts of terrorism using nuclear material and radiological sources;

> To promote the adoption of rigorous and reliable nuclear and radiological material and inventory control systems;

> To strengthen the nuclear security regime of national laws and regulations, bilateral and multilateral agreements, UN resolutions and international guidelines in order to fully and effectively implement the above strategies.

3.29 These descriptions are derived from the outcomes of the two Nuclear Security Summits (NSS) held in Washington (2010) and Seoul (2012); the outcomes document of the eighth NPT Review Conference (2010); and the ICNND report (2009). The NSS, a third and probably last of which is planned for 2014 in the Netherlands, have been convened to strengthen, consolidate, elevate and energize the many existing national, multilateral and cooperative institutions and structures to ensure nuclear security and prevent nuclear smuggling. They are important for having affirmed US presidential leadership on this critical area of the nuclear challenge and for elevating the issue to the level of a global leaders’ summit.

3.30 In January 2012 the Nuclear Threat Initiative (NTI) published a benchmark study, *The Nuclear Materials Security Index.*<sup>12</sup> Based on five categories (quantities and sites, security and control measures, global norms, domestic commitments and capability, and societal factors like political stability and corruption), subdivided further into 18 indicators that went beyond “guns, guards and gates” and also beyond nuclear materials control and accountancy practices, the study concluded that although governments have become more aware of the threat:

> There is still no global consensus on the most important steps to achieve nuclear security;

> State accountability is problematical because of a deliberate lack of transparency;

> Stocks of weapon-useable materials continue to rise in some countries;

> Almost a quarter of the states scored poorly on societal factors; and

> Many lag on joining international agreements.

3.31 The NTI Index was complemented by an assessment of national commitments carried out by a team for the Arms Control Association and Partnership for Global Security.<sup>13</sup> Tracking the implementation of pledges made in Washington in April 2010 by 30 countries, the study concluded that of the more than 60 national commitments made

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by the 2010 summit participants, 80 per cent had been completed by February 2012 (the most recent publicly available data).

§3.3 Global Nuclear Security Architecture

3.32 The three main elements of the nuclear security regime, addressed in sequence below, are international agreements, instruments and institutions; ad hoc and voluntary cooperative measures; and national laws and regulations. The two NSS to date have reaffirmed the international treaties, instruments and institutions (clustered into the “global nuclear security architecture” in Seoul) that backstop national efforts to strengthen nuclear security and prevent nuclear terrorism. But both summits took care to reaffirm the rights of states to develop and utilize nuclear energy for peaceful purposes and that measures to strengthen nuclear security must not hamper these rights.

3.33 At the 2010 and 2012 NSS the leaders accepted that all states are responsible for ensuring the security of nuclear materials and facilities under their control, to seek assistance from others if necessary and to provide assistance to others if asked. The leaders have used the summits to renew their commitment to ensure that nuclear materials under their national control are not lost through theft or diversion, evaluate the threat and improve security as required on a continuing basis, and to share information and exchange best practices to these ends.

3.34 The main global components of the nuclear security regime, discussed in detail in following sections, are:

- The Convention on the Physical Protection of Nuclear Material (CPPNM) which applies primarily to the protection of nuclear material in international transport, together with the CPPNM Amendment which extends the convention’s application to protection of nuclear material in domestic use and of facilities against sabotage;
- International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT);
- United Nations Security Council Resolution (UNSCR) 1540;
- IAEA guidance documents like INFCIRC/225/Rev.5; the Fundamental Principles of Physical Protection of Nuclear Material and Nuclear Facilities; and INFCIRC/153; and
- Various multilateral, regional and bilateral agreements and initiatives, in particular the Cooperative Threat Reduction (CTR or Nunn-Lugar) program, the Global Partnership of the Group of Eight (G8) countries, and the Global Initiative to Combat Nuclear Terrorism (GICNT).

3.35 All these various elements were the subject of close attention by the 2010 NPT Review Conference. Noting “the paramount importance of effective physical protection of all nuclear material and the need for strengthened international cooperation in physical protection,” the 2010 Final Document welcomed the 2005 CPPNM Amendment, affirmed the important role of the IAEA in promoting international cooperation by establishing “a comprehensive set of nuclear security guidelines” and in helping member

states, on request, enhance national security (paragraphs 27–28). It also acknowledged the need for international cooperation and coordination, with IAEA support, “in preventing, detecting and responding to illicit trafficking in nuclear and other radioactive material” (paragraph 29). Importantly, the conference noted that “While nuclear safety and nuclear security are national responsibilities, the IAEA should play the key role in the development of safety standards, nuclear security guidance and relevant conventions based on best practice” (paragraph 58). As well as endorsing the non-legally binding Code of Conduct on the Safety and Security of Radioactive Sources, the conference...
encouraged all non-parties to the CPPNM to accede to it and to ratify the 2005 amendment "so that it may enter into force at an early date" (paragraphs 62–63). Finally, the conference took note of the first NSS held in Washington in April 2010, welcomed the voluntary efforts by states to minimize the use of HEU in the civilian sector, and encouraged states to promote the sharing of best practice in nuclear safety and security, including through dialogue with the nuclear industry and the private sector (paragraphs 65–69). These were translated into action points 40–46.

3.3.1. Convention on the Physical Protection of Nuclear Material (CPPNM) 1980

3.36 The basic knowledge and skill to make a crude nuclear explosive device is readily available and acquired. But it is far more challenging to produce fissile material – weapon-grade HEU (90 per cent U-235) or separated plutonium – on any substantial scale. Only states are likely to have the necessary level of infrastructure. But if their material, facilities and personnel have security vulnerabilities, then terrorists, criminals or other unauthorized actors could steal the nuclear material or even a nuclear bomb (see Box 3.1). They will raid not the facility or the country with the most nuclear material, but that which is the most vulnerable. Any country could be a target; all could feel the effects.

3.37 This is why measures for the physical protection of all nuclear materials, facilities and activities are an essential and critical component of nuclear security. As well as guards, gates and fences at nuclear plants and facilities, this requires thorough background checks on personnel employed there and rigorous training after recruitment in order to inculcate a culture of nuclear security. In a ‘whole-of-nuclear-security-chain’, the amount of nuclear material could be reduced; the physical protection of materials and facilities could be reinforced; security measures could be strengthened for materials during transportation and transit; and export and border controls could be made more stringent. In sum, both HEU and separated plutonium, even for peaceful purposes, should be subject to security controls no less stringent than those prescribed for nuclear weapons, or what the US National Academy of Sciences describes as “the stored-weapon standard.”

3.38 The CPPNM, adopted in Vienna on 26 October 1979 and signed in Vienna and New York on 3 March 1980, entered into force on 8 February 1987. It establishes measures related to the physical protection of nuclear material during international transport and a general framework for cooperation among states in the protection, recovery and return of stolen nuclear material. At the end of 2012, the CPPNM had 148 states parties. That is, about one-quarter of the world’s states have still not acceded to it. Countries which attended one or both of the NSS and have not ratified or acceded to the CPPNM are Egypt, Malaysia, Singapore and Thailand.

3.39 A diplomatic conference was convened in 2005 to strengthen the convention in light of the terrorist attacks of 11 September 2001 and an amendment was adopted by

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15. Weapons of Mass Destruction Commission, Weapons of Terror: Freeing the World of Nuclear, Biological and Chemical Arms (Stockholm: Weapons of Mass Destruction Secretariat, 2006), p. 84. However, while the “stored-weapon standard” would apply to plutonium metal, it would not necessarily apply to everything, for example plutonium in mixed oxide (MOX) powder or fuel assemblies.

consensus on 8 July. The name was amended to the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities. The amendment was promoted and justified as a key measure of nuclear security. The obligations for physical protection under the original CPPNM covered nuclear material during international transport. The amendment requires states parties to protect nuclear facilities and material in peaceful domestic use, storage and transport. In addition, it also provides for expanded cooperation among states on measures to locate and recover stolen or smuggled nuclear material, and mitigate any radiological consequences of sabotage. It will enter into force upon ratification by two-thirds of the states party to the convention. Countries which attended one or both of the NSS and which are party to the CPPNM but have not yet become party to the 2005 Amendment are Armenia, Azerbaijan, Belgium, Brazil, Canada, France, Italy, Japan, Morocco, New Zealand, Pakistan, Philippines, ROK, South Africa, Turkey, and the United States. By the end of 2012, it had only 61 of the 99 required number of accessions.\(^\text{17}\)

3.40 On 11 September 2001 (the day of the terrorist attacks in New York and Washington), the IAEA Board of Governors approved twelve “Fundamental Principles of Physical Protection of Nuclear Materials and Facilities.” These were incorporated into the CPPNM Amendment (Article 3) and thus would apply to the 61 states that are party to the amendment.

3.41 Table 3.1 summarizes the current status of the CPPNM, CPPNM Amendment, and ICSANT. As can be seen, although the CPPNM was already adhered to quite widely (but not universally) before the first NSS in Washington in April 2010, the summit does seem to have injected fresh momentum into states becoming parties to the other two instruments. In the last two years, the number of states parties to the CPPNM Amendment has almost doubled, with 24 states becoming parties to it since the Washington NSS, and those acceding to ICSANT have increased by about one-quarter (14 additional states parties since April 2010).

Table 3.1: Status of CPPNM, CPPNM Amendment, and ICSANT (December 2012)

<table>
<thead>
<tr>
<th>Convention</th>
<th>Date adopted</th>
<th>Entry into Force</th>
<th>Parties Signed but not Parties</th>
<th>Acceded since 1.1.2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPPNM</td>
<td>26.10.1979</td>
<td>8.2.1987</td>
<td>148</td>
<td>1(^a)</td>
</tr>
<tr>
<td>CPPNM Amendment</td>
<td>8.7.2005</td>
<td>–</td>
<td>61</td>
<td>0</td>
</tr>
<tr>
<td>ICSANT</td>
<td>13.4.2005</td>
<td>7.7.2007</td>
<td>83</td>
<td>15(^d)</td>
</tr>
</tbody>
</table>

\(^a\) Haiti; \(^b\) Laos (29.7.2010), Lesotho (18.8.2010); \(^c\) Argentina (15.11.2011), Bahrain (9.6.2010), Bosnia & Herzegovina (2.1.2010), Czech Republic (30.12.2010), Denmark (29.5.2010), Finland (17.6.2011), Georgia (5.4.2012), Germany (21.10.2010), Greece (13.12.2011), Indonesia (27.5.2010), Israel (16.3.2012), Kazakhstan (26.4.2011), Latvia (23.11.2010), Luxembourg (24.2.2012), Former Yugoslav Republic of Macedonia (25.11.2011), Mali (27.1.2010), Mexico (1.8.2010), Nauru (14.6.2010), Netherlands (17.4.2011), Portugal (26.11.2010), Saudi Arabia (21.1.2011), Sweden (23.3.2012), Tunisia (7.6.2010), UK (8.4.2010); \(^b\) Algeria (3.3.2011), Armenia (22.9.2010), Australia (16.3.2012), Bahrain (4.5.2010), China (8.11.2010, Côte d’Ivoire (12.3.2012), Democratic Republic of Congo (23.9.2010), Georgia (23.4.2010), Lesotho (22.9.2010), Morocco (3.1.2.2010), Nauru (24.8.2010), Netherlands (30.6.2010), Poland (8.4.2010), St. Vincent & the Grenadines (8.7.2010), Tunisia (28.9.2010).

Source: SIPRI

\(^{17}\) http://www.iaea.org/Publications/Documents/Conventions/cppnm_amend_status.pdf.
3.42 While the number of states that have signed the amendment is increasing, several significant states have still not signed. France, for example, hesitated to sign, signalling several reservations: disagreement with the scope of Annex II of the convention; lack of international control to ensure compliance with the convention; and that France already frames its bilateral cooperation through agreements for the peaceful development of nuclear energy, stating in particular that the parties agree to implement measures consistent with the convention. Notwithstanding these reservations, France now plans to sign the amendment.

3.43 Armenia, Canada, Belgium, France, Georgia, Italy, Mexico, New Zealand, Philippines, Republic of Korea, Singapore, South Africa, and Turkey, though they have not yet signed, made a commitment during the Seoul NSS to ratify the amendment. Canada, for one, has stated that the amendment overlaps with existing laws and that ratification can take place only once the necessary domestic implementing legislation is in force. In other words, in some cases not signing the amendment is not necessarily indicative of a weak nuclear security framework.

3.3.2. International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT) 2005

3.44 How can states prevent, investigate and punish acts of nuclear terrorism, and promote law enforcement and judicial cooperation with one another to do so? Drafted during seven years of negotiations by the ad hoc group based on a text presented by Russia, and its importance and interest in it increasing dramatically owing to the terrorist attacks of 11 September 2001, ICSANT was adopted unanimously at the UN General Assembly on 13 April 2005. It makes it a crime to possess or demand a radioactive device or material with the aim of causing death or serious injury or substantial damage to property. The convention came into effect in July 2007, 30 days after Bangladesh became the 22nd state to deposit its instrument of ratification with the United Nations secretary-general. As of December 2012, a total of 115 nations had signed, of whom 83 had also ratified the convention.

3.45 The background to the heightened concern was the so-called problem of “loose nukes” in Russia after the end of the Cold War. There were many reports awash in the international media of substantial amounts of enriched fissile material that remained unaccounted for from the days of the former Soviet Union, leading to fears that some or much of the material might be being smuggled across international borders into and out

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of Central Asia. The CPPNM was limited to nuclear material used for peaceful purposes, not covering nuclear material of a military nature.

3.46 ICSANT is closely linked to UN Security Council Resolution 1540 (discussed below). The convention seeks to do three things: to protect against attacks on a broad range of nuclear targets, punish the perpetrators through domestic criminalization of acts of nuclear terrorism, and promote international cooperation in the prevention and investigation of acts of nuclear terrorism and the prosecution or extradition of the alleged terrorists. To this end, states parties are required to make the offences specified in the convention criminal offences under national law, and to provide stiff penalties appropriate to the gravity of the crimes.

3.47 The convention's scope extends to a range of acts and potential targets, including nuclear power plants and reactors, and attempts or threats to commit terrorist acts or participate in them as accomplices. To facilitate the “prosecute or extradite” regime, these offences are explicitly described as “non-political” so that the defence of any of these acts being a political offence is not available to anyone seeking to block extradition.

3.48 In taking all necessary measures to ensure the protection of radioactive material, states are enjoined to take into account the relevant recommendations and functions of the IAEA. Should states detect and find unauthorized radioactive material, device or facility, they must take steps to render it harmless, ensure that it is held in accordance with applicable IAEA safeguards, exercise due diligence with regard to IAEA physical protection and health and safety standards, and ensure its return to specified parties.

3.49 ICSANT was deliberately designed to have the broadest possible coverage in order to fill perceived CPPNM gaps in scope and enforcement. However, ICSANT is limited to international offences involving more than one state, and does not apply where the offence is committed within a single state and the alleged offender and victims are nationals of that state. The convention is not subject to any particular monitoring mechanism and responsibility for its implementation lies with state parties.

3.50 Nor does the convention take a position on the legality or otherwise of the use and threat of use of nuclear weapons. Its focus is on individual criminal responsibility of persons for specific acts of a terrorist nature. Agreement on the text was delayed for several years because of the demand by some states that the use or threat of use of nuclear weapons must also be addressed and, therefore, acts of state actors too should be brought within the scope of the proposed convention. Others countered that the legal regime underlying the existing sectoral conventions is of a law-enforcement nature and exclusively focused on the individual criminal responsibility of persons for specific acts of a terrorist nature; questions of state responsibility are regulated by other principles of international law. The issue was resolved on the basis of a package, whereby the use

of a nuclear device by a state during an armed conflict is explicitly excluded from the scope of the convention but without conferring or implying impunity.

### 3.3.3. UN Security Council Resolutions

3.51 **Resolution 1540 (2004).** On 28 April 2004, the Security Council adopted Resolution 1540, establishing for the first time binding obligations on all UN member states under Chapter VII of the United Nations Charter to take and enforce effective measures against the proliferation of weapons of mass destruction (WMD), their means of delivery and related materials to non-state actors. Controversy arose over the authority of the Security Council to impose general obligations of a “legislative” kind for UN member states under Chapter VII of the UN Charter, but after seven months of negotiations, the resolution was adopted by consensus. Since 2004, Resolution 1540 has gained legitimacy as the legal basis for a range of national and international counter-terrorism activities.

3.52 The goal of Resolution 1540 is to ensure that no state or non-state actor is a source or beneficiary of WMD proliferation. Affirming WMD proliferation as a threat to international peace and security and expressing concern over the threat of WMD terrorism and of illicit trafficking in WMD material, weapons and delivery systems, UNSCR 1540 requires all states:

- To enact and enforce laws to prohibit non-state actors to develop, acquire, transfer or use WMD;
- To take and enforce effective domestic control, physical protection, accounting and border control measures to prevent proliferation to non-state actors and to prohibit assisting or financing such proliferation;
- To control the provision of funds and services that contribute to non-state proliferation; and
- To set up a committee of the whole to oversee implementation of the resolution.

3.53 UNSCR 1977, adopted unanimously on 20 April 2011, extended the mandate of the 1540 Committee by ten years. To facilitate the work of the committee, an expert group consisting of eight members was set up to deal with technical issues. UNSCR 2055 (29 June 2012) increased the size of the group of experts to nine.

3.54 The implementation of UNSCR 1540 will mean that each state’s actions will significantly strengthen the international standards relating to the export of sensitive items and support for proliferators (including financing) and ensure that non-state actors, including terrorist and black-market networks, do not gain access to chemical, nuclear or biological weapons, their means of delivery, or related materials.

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27. See also the section on UNSCR 1540 in the previous chapter 2 on non-proliferation.
Figure 3.2: UNSCR 1540 Reporting Mechanism

- Security Council
  - report on the implementation of Resolution 1540

- 1540 Committee of the Security Council
  - may recruit
  - facilitate consideration of national reports submitted by member states

- States
  - report on the implementation steps already taken/intended to take
  - (no later than 6 months from the adoption of this resolution)

*Resolution 1977 (2011) changed expert group membership to 8 experts, and Resolution 2055 (2012) increased it to 9 experts.
Source: SIPRI

Figure 3.3: Status of Implementation of Resolution 1540, paragraph 2

Figure 3.4: Status of Implementation of Resolution 1540, paragraph 3 (a) and (b)


Figure 3.5: Status of Implementation of Resolution 1540, paragraph 3 (c) and (d)

3.55 All member states were requested to report on the progress of their implementation to the 1540 Committee six months after the adoption of the resolution, and by 28 October 2004, 59 member states (and the European Union) had submitted their first reports. UNSCR 1673 (27 April 2006) noted that not all member states had yet submitted their first national report, and that full implementation of the resolution is a long-term task. According to the UN 1540 Committee website, 176 states had submitted reports by December 2012.

3.56 **Other Security Council Resolutions.** UNSCR 1373 (28 September 2001) called on all states to prevent and suppress the financing of terrorism and to criminalize the wilful provision or collection of funds for such acts. The funds, financial assets and economic resources of those who commit or attempt to commit terrorist acts, participate in or facilitate the commission of terrorist acts, and of persons and entities acting on behalf of terrorists, were to be frozen without delay. To this end, the resolution imposed uniform legislative and reporting requirements and established the Counter-Terrorism Committee (CTC), made up of all fifteen members of the Security Council, to monitor implementation and increase state capacity.

3.57 The scope of Resolution 1373 is quite broad, encompassing domestic legislation, national executive machinery and international cooperation. Operative paragraph IV links the resolution to nuclear security, noting the close connection between international terrorism and, among other things, the illegal movement of nuclear and other potentially deadly materials, and emphasizes the need for coordination from national to international level to strengthen the global response to this serious threat to international security.

3.58 Under Resolution 1535 (26 March 2004), the Security Council also established the Counter-Terrorism Executive Directorate (CTED) to assist the work of the CTC and coordinate the monitoring of the resolution’s implementation. UNSCR 1624 (14 September 2005) pertains to the incitement to commit acts of terrorism. It targets terrorism in general, and refers to nuclear terrorism only when it calls on states to give priority consideration to the signing of ICSANT in one preamble paragraph. This resolution also guides the work of the CTC and requires states to report to the committee on their implementation of the resolution. The CTC is further directed to include Resolution 1624 in its dialogue with states to help build capacity through spreading best legal practices and promoting the exchange of information. In addition, the CTC helps with the capacity building of member states through dissemination of best practices; provision of technical, financial, regulatory and legislative expertise; and facilitating cooperation between national, regional and international organizations. But the CTC has neither the resources nor the capacity to monitor state compliance with UNSC-imposed obligations.

3.59 In accordance with Resolution 1624, the CTED prepared two reports summarizing the responses submitted by UN member states, acknowledging that fewer than half of

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them have reported to it on their steps to implement Resolution 1624.\textsuperscript{31} The mandate of the CTED was extended to the end of 2013 by UNSCR 1963 (20 December 2010).

### 3.3.4. Radioactive Sources

3.60 The Code of Conduct on the Safety and Security of Radioactive Sources, approved by the IAEA Board of Governors in September 2003 with a supplement endorsed a year later, is meant to apply to the development and harmonization of policies, laws and regulations on the safety and security of radioactive sources from initial production to final disposal.\textsuperscript{32} Thus it applies also to radioactive wastes not covered by the CPPNM.\textsuperscript{33} More detailed and prescriptive than an international convention, the Code of Conduct includes provisions on national registers of high-activity sources, the international trade in radioactive sources, security requirements and prompt notification to potentially affected states of loss of control of sources, or incidents with potential cross-border effects. It prescribes the principles for states to ensure the security of radioactive sources within their territory, the training of personnel and the establishment of channels of information and communication. The 2004 supplement recommends that every state designate a point of contact. But it notably does not apply to radioactive sources within military or defence programs.

3.61 By December 2012, 115 states had expressed support for the 2003 Code of Conduct, 73 countries supported all aspects of the supplementary guidance as well, and only 13 (Colombia, Georgia, Ireland, Macedonia, Madagascar, Mauritania, Nigeria, Oman, Paraguay, Serbia, Turkmenistan, Uzbekistan, and Zimbabwe) had not designated a national point of contact. But several have failed to respond to the IAEA’s self-assessment questionnaire.\textsuperscript{34}

### 3.3.5. Global Cooperation Mechanisms

3.62 **US-Managed Threat Reduction Programs.** Since the early 1990s and the end of the Cold War, the United States has implemented a series of programs and projects, mainly on the territory of the former Soviet Union, to reduce the risk that nuclear and radioactive materials would escape from safe custody.\textsuperscript{35} The Department of Defense managed implementation of the Cooperative Threat Reduction (CTR or Nunn–Lugar) Program, begun in 1991, and named after the two US Senators who initiated it, Sam Nunn and Richard Lugar.

\begin{itemize}
\item \textsuperscript{31} Letter dated 18 January 2008 from the Chairman of the Security Council Committee established pursuant to resolution 1373 (2001) concerning counter-terrorism addressed to the President of the Security Council, S/2008/29.
\item \textsuperscript{32} http://www-ns.iaea.org/tech-areas/radiation-safety/code-of-conduct.asp.
\item \textsuperscript{33} Radioactive waste is covered, however, by a 1997 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
\end{itemize}
3.63 The CTR set of programs has been among the most successful and effective. It has helped the countries of the former Soviet Union to destroy nuclear, chemical and biological weapons and associated infrastructure under agreed procedures; to transport bomb-making materials to central and more secure storage sites; to upgrade security perimeters around sensitive sites and screening of personnel working there; and to install monitoring devices at border crossings. The programs have facilitated the elimination of significant quantities of nuclear materials, promoted habits of international cooperation and reinforced nuclear disarmament and non-proliferation norms. Since 2003 the CTR program has incorporated several new initiatives that are relevant to nuclear security. The WMD Proliferation Prevention Initiative, a biosecurity effort, is intended to assist partners strengthen their border controls, including the installation of monitoring and detection equipment at border crossings and in other appropriate locations on the border.

3.64 In 2004 a number of projects (not including the CTR program) were consolidated into the Global Threat Reduction Initiative (GTRI) under the management of the Department of Energy (DOE). These were intended to reduce and protect vulnerable nuclear and radiological material worldwide by a combination of reactor conversion, removal of material and physical protection. In 2011 the Global Nuclear Lockdown program was initiated to support efforts to secure weapon-useable materials in Russia, among other things. In 2012 a number of the efforts noted above have been combined under the Global Nuclear Security program.

3.65 By the end of 2012, the 21-year old CTR program had deactivated more than 7,600 warheads, dismantled and destroyed more than 900 intercontinental ballistic missiles (ICBMs) and 33 submarines (almost certainly a more substantial level of destruction of Russian nuclear assets than Washington could have achieved through war), secured 24 nuclear weapons storage sites, and overseen the shipment of nuclear weapons out of Belarus, Kazakhstan and Ukraine.36

3.66 The $500 million per annum program had been extended twice since inception in 1992. But in October 2012, Moscow announced that it would let the program expire in May 2013 because it no longer needs foreign assistance and has concerns about nuclear security information being leaked. While Russia has become visibly uncomfortable in recent years about receiving foreign aid, some conservative US politicians and commentators have expressed concerns about the money from the program permitting Moscow to divert other sources of money to spend on new armaments. But Moscow was careful to stress that it is not abandoning efforts to secure nuclear weapons; it wants to explore alternative frameworks to that end.37

3.67 In the meantime, other parts of the US government have also had important and active programs relevant to nuclear security. The International Nuclear Materials Protection and Cooperation program is particularly noteworthy in this context. This is a DOE umbrella program whose First Line of Defense projects cover nuclear materials

36. The Nunn–Lugar program also targeted chemical weapons, for example in Albania, and established monitoring facilities for the detection of biological weapons.
protection and cooperation. The program is intended to prevent “the spread of materials, technology, and expertise relating to weapons of mass destruction; detect the proliferation of weapons of mass destruction worldwide; provide for international nuclear safety; and eliminate inventories of surplus fissile materials useable for nuclear weapons.” The program thus addresses the danger of hostile nations or terrorist groups acquiring WMD weapons, material, expertise or technology. To achieve these ends the program has supported security upgrades at a large number of civilian and military sites of different kinds, predominantly in Russia. The program also supports projects to reduce the quantities of weapon-useable materials or make it less attractive to would-be nuclear terrorists.

3.68 The DOE has also implemented the Second Line of Defense and Megaports Initiatives, under National Nuclear Security Administration (NNSA) management, that is intended to reduce the risk of smuggling of nuclear and radioactive materials, and in particular to reduce the risk that such materials will enter the United States. The DOE programs have also included projects focused on radiological dispersal devices. In all, 35 nuclear waste sites on the territory of the former Soviet Union were identified, including agricultural research institutes, research reactors and medical facilities. In 2006 this program was merged with others into an International Radiological Threat Reduction initiative that is no longer limited to working in the former Soviet space.

3.69 G8 Global Partnership (G8–GP) 2002. The Global Partnership is an initiative of the Group of Eight (G8) countries (Canada, France, Germany, Italy, Japan, Russia, United Kingdom, and United States) committed to preventing terrorists, or those who harbour them, from acquiring or developing nuclear, chemical, radiological or biological weapons, missiles, or related equipment and technology. Launched at the 2002 G8 Summit in Kananaskis, Canada, the $20 billion G8 Global Partnership initially implemented projects in Russia and Ukraine but has expanded to deal with the spread of WMD weapons and materials worldwide. Non-G8 countries participating in the Global Partnership include Australia, Belgium, the Czech Republic, Denmark, Finland, Ireland, New Zealand, Netherlands, Norway, Poland, South Korea, Sweden, Switzerland, and Ukraine, and also the European Union. The G8 Global Partnership’s mandate was to expire in 2012 but has been extended indefinitely. Leaders have said that they would like to broaden the scope to include nuclear and radiological security, biosecurity, engagement of scientists and implementation of UNSCR 1540. Funding arrangements will be decided on a national, joint or multilateral basis. Unlike the first decade of the G8–GP, partners have not pledged any specific contributions going forward other than the United States which has planned to continue contributing up to $10 billion again.

39. NNSA was established by Congress in 2000 as a semi-autonomous agency within DOE, responsible for the management and security of US nuclear weapons, nuclear nonproliferation, and naval reactor programs.
3.70 Achievements of the Global Partnership include:\(^{40}\)

> Strengthened accounting, control, and physical protection of nuclear and radiological materials in Russia and Ukraine;
> Destruction of over 20,000 tons of chemical weapons;
> Dismantling of nuclear submarines and safe storage of removed spent fuel – out of the 198 decommissioned nuclear submarines by the Russian navy, only 6 remain to be dismantled, and the dismantling work was scheduled to be completed in 2012;
> Improved detection of nuclear and radiological materials and prevention of illicit trafficking by strengthening border security capabilities – the United States and Russia are partnering to place equipment for radiation detection at border crossings; and
> Engagement of scientists, technicians and engineers with WMD and missile expertise to redirect their efforts towards peaceful purposes. The International Science and Technology Center in Moscow and the Science Technology Centre of Ukraine, funded by the Global Partnership's partners, provide economic support for scientists during a transition period. The future of the centre in Moscow is however under review, as Russia has decided to withdraw from it.

3.71 **The Global Initiative to Combat Nuclear Terrorism.** GICNT is an international partnership working towards the individual and collective implementation of a set of shared nuclear security principles. It was set up by Presidents George W. Bush and Vladimir Putin in St. Petersburg on 15 July 2006. Its mission is to strengthen global capacity to prevent, detect and respond to nuclear terrorism by conducting multilateral activities that strengthen the plans, policies, procedures and interoperability of partner nations. Its eight guiding principles are:\(^{41}\)

> Improve accounting, control and protection of nuclear and radiological material;
> Enhance security of civilian nuclear facilities;
> Detect and suppress illicit trafficking of nuclear and radiological material;
> Improve ability to search for, confiscate and establish safe control of nuclear and radiological material;
> Assure denial of safe haven and resources to terrorists seeking to acquire or use nuclear and radiological material;
> Ensure adequate legal frameworks to combat activity related to nuclear terrorism;
> Respond to and mitigate the consequences of nuclear terrorism; and
> Promote information sharing to prevent and respond to acts of nuclear terrorism.

3.72 The United States and Russia serve as co-chairs of the GICNT and Spain serves as Coordinator of the Implementation and Assessment Group. The Global Initiative has made some effort to improve the global nuclear and radiological detection architecture, including the installation of radiation detection equipment at major sea and air ports. By December 2012 its membership included 85 countries plus four observers (IAEA, IAEA,


\(^{41}\) http://www.state.gov/documents/organization/145499.pdf.
European Union, UN Office on Drugs and Crime (UNODC), and INTERPOL).42 Argentina, Mexico, Philippines, Thailand and Vietnam joined GICNT in 2010; Singapore in 2011; and Algeria, Azerbaijan and Malaysia in 2012. The plenary meeting in 2010 noted nuclear detection (working group chaired by the Netherlands) and nuclear forensics (working group chaired by Australia) as the two priority functions; the 2011 plenary added response and mitigation (working group chaired by Morocco) as a third priority function. GICNT facilitates information sharing among partners and official observers through expert-level workshops, seminars, exercises and other activities. As of December 2012, it had held more than 50 multilateral activities and exercises to share best practices and lessons learned in order to strengthen individual and collective capabilities for preventing, detecting, deterring, and responding to nuclear terrorist incidents. The three working groups will present their findings and documents to the plenary meeting of GICNT scheduled to be held in Mexico in 2013.

§3.4 Role of the IAEA

3.73 As discussed fully in Chapter 2, the IAEA carries the chief international institutional responsibility for marrying the NPT’s promise of assistance with peaceful uses of nuclear energy to non-nuclear weapon states to assurances of safety and non-diversion to weapons purposes. Because nuclear security is a much more recent concern, this has not been a priority item in the distribution of funding and agenda for the agency. Yet even here the IAEA has now taken on a lead role, if by default, because of its technical expertise, institutional credibility and legitimacy, and the lack of practical alternatives. This distinctive status quo – combining lack of mandated IAEA authority in nuclear security comparable to nuclear safeguards; technical capabilities to strengthen the global nuclear security regime through advisory services to member states on request; and the need to provide added resources to the IAEA in this field – is reflected in the decisions made at the 2010 NPT Review Conference and the 2010 and 2012 NSS.

3.74 The 2010 NPT conference encouraged all states parties to “broaden their support for the relevant IAEA programmes” and apply IAEA recommendations on the physical protection of nuclear materials and facilities; and encouraged the agency to assist states to strengthen their national regulatory controls of nuclear material (Actions 41 and 46). The 2010 NSS in Washington welcomed IAEA activities in support of national efforts to enhance nuclear security worldwide, commended the IAEA for the programs of assistance and advisory services and guidance to states on request, and acknowledged the importance of nuclear material accountancy. States participating in the NSS pledged “to work actively with the IAEA towards the completion and implementation” of the guidance series of documents and to incorporate the IAEA formulated principles into the planning, construction and operation of their nuclear facilities. The 2012 Seoul NSS reaffirmed “the essential responsibility and role of the IAEA in strengthening the international nuclear security framework” and participating states promised to “work to ensure that the IAEA continues to have the appropriate structure, resources and expertise needed.”

3.75 For all the IAEA’s role, the primary responsibility for nuclear security rests with individual states. In the near term, therefore, the main focus will be on universalization of the existing framework and its full implementation, plus identification and filling of any gaps in existing arrangements. The extent of voluntary reporting by states at the Seoul NSS in 2012, of the compliance of their nuclear security systems with commitments made at the first NSS in 2010, was encouraging. That is, the threshold of compliance of legally binding international commitments was raised significantly higher with voluntary promises of a heads of state/government involvement in summit diplomacy.43

3.4.1 Setting Guidelines

3.76 The IAEA publishes a Nuclear Security Series, providing detailed guidance “relating to the prevention and detection of, and response to, theft, sabotage, unauthorized access and illegal transfer or other malicious acts involving nuclear material and other radioactive substances and their associated facilities.”44 They embrace such fields as nuclear security fundamentals, recommendations, implementing guides and technical guidance. From 2012, the Nuclear Security Guidance Committee, established by the IAEA director general, is in charge of making recommendations to the agency on the development and review of the series. The committee is composed of representatives from all IAEA member states. Its objective is to improve the quality, increase transparency and encourage consensus and coherence among the member states while working on international publications in the field of nuclear security. Representatives of international organizations and non-governmental bodies can attend the committee meetings. New publications in the series provide guidance for states on new or developing issues in nuclear security, such as the latest 2012 publication, Nuclear Security Systems and Measures for Major Public Events.

3.77 In the Nuclear Security Series, Information Circular 225 (INFCIRC/225) is generally considered to be the cornerstone of the international physical protection regime for nuclear materials and facilities. First published in 1975 and revised five times since, INFCIRC/225 is a set of guidelines, not a treaty or binding resolution, and not requiring legal commitments, signature or ratification. This makes assessment of state compliance problematical.

3.78 The 2011 revision (INFCIRC/225/Rev. 5) reflects the threat of nuclear terrorism and the need to align the document with the changed security standards set forth in the 2005 amendment to the CPPNM. It introduced the concept of a physical protection “regime” and a graded approach to physical protection to take into account the nature, severity and likelihood of the threat, the relative attractiveness of the material, and the possible consequences of theft or sabotage. It included guidance for the rapid recovery of nuclear material found to be missing and for the mitigation of sabotage. And it included recommendations on physical protection for states embarking on the development of peaceful nuclear energy for the first time.

3.79 The IAEA guidelines serve as the international standard that has been incorporated into the domestic law of many states. But because the nuclear security series are guides for countries to use voluntarily, it is impossible to know how widely they are actually read or used by states. States have obligations written in their comprehensive safeguards agreements (CSAs) with the IAEA and in some cases, Additional Protocols, and some of those obligations overlap with what is written in the Nuclear Security Series. States, for example, can rely on the IAEA Nuclear Security Series for guidance in developing their own required nuclear material accounting systems, although it is not known how much they actually use that guidance.

3.80 The IAEA guidelines have been incorporated also in some suppliers’ bilateral agreements as a condition of peaceful nuclear cooperation. The US “section 123”45 civil nuclear cooperation agreement with the United Arab Emirates (UAE) is a good example of this. Inclusion of this requirement in bilateral agreements provides a means for making the application of INFCIRC/225 legally binding in particular states. The United States has 27 nuclear cooperation agreements that require partner countries to guarantee the physical protection of US-origin nuclear material. The US Nuclear Regulatory Commission and State and Energy departments visit partner countries to check on the physical protection measures.46 Australia, Canada and the EURATOM (European Atomic Energy Community) countries also have similar bilateral agreements. In addition, the Pelindaba and Semipalatinsk treaties establishing nuclear-weapon-free zones in Africa and Central Asia respectively (see chapter 2) also require member states to apply security measures comparable to IAEA recommendations.

3.4.2 Advisory and Peer Review Services

3.81 The IAEA also offers advisory and peer review services in the realm of nuclear security to member states on request, specifically, by providing them with professional assistance such as Nuclear Security Advisory Assistance Service and nuclear security publications. The IAEA has helped states to develop integrated plans for nuclear security improvements and assistance. In consultation with the hosting state, the IAEA drafts an Integrated Nuclear Security Support Plan (INSSP) which is tailored to the state’s specific needs on the basis of findings and recommendations from various technical services. A typical INSSP presents five components of work related to nuclear security: legislative and regulatory framework, prevention, detection, response, and sustainability. The INSSP identifies the needs of the state, responsible entities and organizations within the state, and the timeframe for the implementation of agreed activities.

45. The reference is to agreements pursuant to s.123 of the Atomic Energy Act that are commonly referred to as “123 agreements.”

### Table 3.2: IAEA Nuclear Security Advisory Services

<table>
<thead>
<tr>
<th>Nuclear Security Advisory Services</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Nuclear Security Advisory Service</td>
<td>INSServ</td>
</tr>
<tr>
<td>International Physical Protection Advisory Service</td>
<td>IPPAS</td>
</tr>
<tr>
<td>SSAC Advisory Service</td>
<td>ISSAS</td>
</tr>
<tr>
<td>International Team of Experts</td>
<td>ITE</td>
</tr>
<tr>
<td>Integrated Regulatory Review Service</td>
<td>IRRS</td>
</tr>
<tr>
<td>Integrated Nuclear Security Support Plan</td>
<td>INSSP</td>
</tr>
</tbody>
</table>

Source: SIPRI

### Table 3.3: IAEA Nuclear Security Publications

<table>
<thead>
<tr>
<th>IAEA Publications</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFCIRCs</td>
<td>Texts of Safeguards Agreements and Additional Protocols</td>
</tr>
</tbody>
</table>

### Nuclear Security Series

- **Nuclear Security Fundamentals**: Objectives, concepts and principles of nuclear security
- **Recommendations**: Best practices that should be adopted by Member States in the application of the Nuclear Security Fundamentals
- **Implementing Guides**: Measures for the implementation of the Recommendations

### Technical Guidance

- **Reference Manuals**: Measures on how to apply the Implementing Guides in specific areas
- **Training Guides**: Syllabus/manuals for IAEA training courses in the domain of nuclear security
- **Service Guides**: Guidance on the conduct and scope of IAEA nuclear security advisory missions

### Nuclear Security Plan

- **2002–2005**: Nuclear Security Plan of Activities
- **2006–2009**: Nuclear Security - Measures to Protect Against Nuclear Terrorism
- **2010–2013**: Program Implementation to achieve worldwide effective nuclear security

Source: SIPRI
3.82 The establishment of the INSSP has enabled the IAEA, the states concerned and any donors financing the work to plan and coordinate activities from both a technical and a financial point of view. It also permits some states to prepare and implement the necessary nuclear security improvements internally and without external assistance. As of December 2012, 66 INSSPs were in varying stages of development and completion.47

3.83 In 2002, the IAEA established the Nuclear Security Fund (a voluntary funding mechanism) and for the first time elaborated the Nuclear Security Plan whose objective is to combat nuclear security risk and support member states in the implementation of nuclear security instruments. The second Nuclear Security Plan for 2006–09 was approved by the Board of Governors in 2005. It concerned three main areas: needs assessment, analysis and coordination; prevention; and detection and response. The goal of the third Nuclear Security Plan for 2010–13 is to "contribute to global efforts to achieve worldwide, effective security wherever nuclear or other radioactive material is in use, storage and/or transport, and of associated facilities, by supporting States, upon request... through assistance in capacity building, guidance, human resource development, sustainability and risk reduction."48

3.84 At and since the Washington NSS, Belgium, Canada, Denmark, France, Japan, Norway, Netherlands, South Korea, and the United Kingdom have pledged contributions to the IAEA Nuclear Security Fund. Belgium agreed to provide $300,000, Norway $3.3

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million over four years, and the United Kingdom $6 million; Japan, New Zealand and Russia did not specify the amounts of their contributions. The IAEA’s €23 million 2010–13 nuclear security plan identifies four core areas of work: needs assessment, information collation and analysis; contributing to the enhancement of a global nuclear security framework; providing nuclear security services; and risk reduction and security improvement.49 Nuclear safety and security accounts for approximately ten per cent of the IAEA’s annual €333 million budget.50 Funding is also provided by Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Netherlands, South Korea, Spain and Sweden.

3.4.3 Filling the Gaps

3.85 Because nuclear security is a new “fourth” leg of the global nuclear regime (along with disarmament, non-proliferation and peaceful uses), it suffers by comparison from lack of clear authority, resources and governance architecture. The advantage of a leaders’ summit is that it can help to break down political barriers and overcome bureaucratic inertia, and the NSS have generally been given good reviews. According to the study conducted by the Arms Control Association, significant progress had been made in ratifying international conventions, securing and removing HEU and plutonium stocks, developing new nuclear security centres of excellence, conferences, and training activities, providing new funding support for HEU conversion and material removals and the like.51

3.86 But the force of the 2010 and 2012 NSS communiqués was weakened by the fact that they were vague, non-binding and full of escape clauses like “as appropriate,” “where technically and economically feasible,” “taking into account the need for assured supplies of medical isotopes,” and “consistent with national security considerations and development objectives.” The NTI study concluded that although governments have become more aware of the threat, there is still no global consensus on the most important steps to achieve nuclear security; state accountability is problematical because of a deliberate lack of transparency; stocks of weapon-useable materials continue to rise in some countries; almost a quarter of the states scored poorly on societal factors; and many lag on joining international agreements.52

3.87 It is appropriate, accordingly, to include a brief discussion here of gaps in the nuclear security regime that need to be plugged. At present there are a plethora of initiatives. The IAEA adopts a nuclear security plan and the Board of Governors expects an annual report on nuclear security from the director general. However, nuclear security is still a peripheral part of the IAEA institutionally. Should initiatives be combined under the IAEA umbrella or is it better to keep the current arrangements but try to make them more efficient in coordination and cooperation?

3.88 The IAEA’s work on nuclear security has been given much greater prominence, visibility and importance since the 2010 NSS. Its dedicated office on strengthening nuclear security has been given much greater prominence and has been given much more resources. The IAEA’s nuclear security plan identifies four core areas of work: needs assessment, information collation and analysis; contributing to the enhancement of a global nuclear security framework; providing nuclear security services; and risk reduction and security improvement.49 Nuclear safety and security accounts for approximately ten per cent of the IAEA’s annual €333 million budget.50 Funding is also provided by Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Netherlands, South Korea, Spain and Sweden.

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52. NTI Nuclear Materials Security Index.
nuclear security provides global leadership as well as invaluable technical information, guidance, training and assistance. But it lacks authority to establish mandatory baseline standards for nuclear security and to monitor and enforce compliance with the standards. Regular, independent international review of safety, security and safeguards measures should be the international norm. As the UN’s – that is, the world’s – premier nuclear regulator, the IAEA must be mandated to negotiate binding agreements that establish global nuclear security standards. The IAEA must also be given the authority and the responsibility to certify compliance with these standards by monitoring national implementation. The IAEA should have the lead role in setting international standards, promoting cooperation, and providing on-request peer reviews. To be able to discharge the additional responsibility, the IAEA nuclear security funding should be set at an appropriate level. All nuclear suppliers should include the INFCIRC/225 condition (and a requirement that recipients be party to the CPPNM) in their nuclear supply agreements.

3.89 The IAEA also lacks predictable and stable funding for its regular budget. An annual budget of 333 million euros (2012) is modest for such an ambitious enterprise. Consistent with trends in most areas of the UN system, the vast bulk of the IAEA Nuclear Security Fund is funded through extra-budgetary support; that is, on a voluntary instead of an assessed basis. The net result is that the funding base is neither secure nor sufficient. It is highly desirable that nuclear security should be funded from an increased regular budget. As with most international organizations, the IAEA also faces the problem of tardy payments, and non-payments, by member states. In September 2010 (the year of the first NSS), around 60 member states owed outstanding contributions totalling almost €90 million to the agency;53 almost 50 states still had outstanding dues of €15.6 million from previous years.54 In September 2012 (the year of the second NSS), about 70 states owed outstanding dues of over €100 million.55 There is no doubt that budgets are going to be cut in what have been the main donor states in the coming years, and this area is not going to be exempt unless there is a major incident that compels a response. There are going to be strong arguments for avoiding duplication in programs, and for looking for synergies, particularly on the technical side.

3.90 Should the IAEA become the main focal point for nuclear security cooperation? That will be one of the important issues at the 2014 NSS, possibly even the main one. The NSS was always envisaged as an ad hoc and temporary mechanism, not a permanent institution. There is a serious issue of how to sustain the commitment needed. The summits produce diminishing returns. The existing documents already make the political commitment and it is neither practical nor desirable to keep bringing large numbers of world leaders together to announce minor incremental steps towards the already agreed goal. One option would be for the IAEA to take over the NSS agenda after the third and final summit in 2014.

53. That said, even if everyone paid all their dues, none of that money would go to nuclear security projects as of today because nuclear security is not part of the IAEA core budget. This again reinforces the importance of shifting the nuclear security fund into the IAEA core budget.
54. Report by the Director General, Statement of Financial Contributions to the Agency [Vienna: IAEA General Conference, GC(54)/INF/9, 17 September 2010], http://www.iaea.org/About/Policy/GC/GC54/GC54InfDocuments/English/gc54inf-9_en.pdf.
3.91 To institutionalize the response under the IAEA will call for a major task of persuasion, requiring as it would the IAEA mandate, authority and powers to be greatly strengthened. Many IAEA members are concerned that incorporating a nuclear security budget into the regular budget while simultaneously freezing the regular budget will displace activities they see as more important (with technical assistance probably being the first casualty). At present states seek voluntary help and assistance from the IAEA to help improve their domestic regulatory, protection, control and accounting systems through services, guidance and recommendations, without needing to provide mandatory reports on implementation back to the IAEA.

3.92 Taken in conjunction with the effort to develop the so-called "state level approach" to safeguards (discussed in Chapter 2), this feeds into the wider complaint of some states that the IAEA is being re-configured as an instrument to implement Western priorities (non-proliferation, counter-terrorism) at the expense of global concerns (disarmament and development).

3.93 CNND believes that such complaints are not justified in this context and that the concerns that the IAEA is seeking to redress are genuinely global, and should be shared by all members of the international community. However, it is difficult within the foreseeable future to visualize enough states agreeing to give the IAEA mandatory and intrusive authority and powers, and the status quo – of IAEA services on request and non-binding recommendations as a de facto international nuclear security standard – is set to continue. One price of this is lack of uniformity in the interpretation and unevenness in the implementation of IAEA guidelines from one country to another.

3.94 Another possibility is the negotiation of a framework convention on nuclear security, similar to the UN Framework Convention on Climate Change (UNFCCC), that would bring together the existing disparate and loosely-defined nuclear security conventions, rules and standards. Such a convention would establish an agreed overarching framework, set out common principles, express political commitments, and create a periodic review mechanism (for example, meetings at regular intervals like two or five years). The Fissile Materials Working Group (FMWG) believes that a framework convention would solve the present problem of a "patchwork of voluntary, nonbinding, non-transparent national commitments, ad hoc bilateral and multilateral initiatives, and vague legally binding measures" without specific standards. The IAEA, the group further argues, should be made the convention's executive agent to monitor and assess national implementation of the international standards and requirements. However, given the continuing sensitivity of issues surrounding the UNFCC, an explicit parallel with that here may not be especially helpful.

3.95 A more mainstream view is that steps can only be taken nationally (since that is where the legal authority and resources are) and that it is not necessary to pursue either new legal instruments (we need to implement what we have) or a new coordination mechanism (if anything we already have too many). The IAEA is and will continue to be

an outstanding technical resource, but it may not help either the agency or the cause of nuclear security to introduce the question of a leading role in governance. An NTI-sponsored global dialogue on nuclear security has concluded that while legally binding mechanisms may be desirable in the future, the search for it now, when no consensus for it exists, is likely to delay urgently needed security upgrades that are feasible within voluntary mechanisms.\(^5^8\) Any lowering of ambition to pursue a legally binding IAEA mechanism should not, however, be seen as reducing the need for intense further international cooperation in a number of other nuclear security areas.

§3.5 International Cooperation

### 3.5.1. General

3.96 Major nuclear reactor accidents – Three Mile Island, Chernobyl and, most recently, Fukushima – have triggered substantial reviews and produced major advances in nuclear safety governance. Because of the added gravity of the risks in the case of nuclear terrorism, advances in nuclear security governance to identify and plug vulnerabilities, both domestic and international, must precede and prevent major security crises, not follow one. Nuclear security is a sovereign responsibility. But because the economic and security consequences of a nuclear security breach or failure could be catastrophic for some or all others, “other governments and the global public have an equity in having some insight into how well the global nuclear security system is functioning.”\(^5^9\) A major nuclear security vulnerability or crisis anywhere would pose an unacceptable risk and threat everywhere. Individual state determination of adequate nuclear security standards and national implementation of the standards will not be enough by themselves. In addition, strengthened international standards and accountability are required on early detection, prevention of attacks, thefts and sabotage, as well as recovery of missing nuclear materials. Securing the world’s most dangerous materials is the universal responsibility of all states and a common responsibility to all humankind.

3.97 Yet security lags well behind the other two nuclear “Ss” of safety and safeguards. The historical bias towards national secrecy and sovereignty must give way to international needs and standards of transparency and accountability. With safety, security and safeguards alike, states operating peaceful and/or weaponized nuclear programs must both manage the programs to international standards and be seen by the international community to be doing so.

### 3.5.2. Information Exchange

3.98 States parties are not required to report on how they are observing the terms of the CPPNM, the CPPNM Amendment, or the IAEA nuclear security recommendations. In addition to the lack of any reporting mechanism, there is no review mechanism. Nuclear


safety has a mandatory peer review mechanism: the members of the World Association of Nuclear Operators (WANO) have accepted mandatory peer reviews. The CPPNM has no such peer review mechanism, nor an external review of any other type, nor any form of international inspection system or provision. Sharing and exchange of information, and external reviews of national performance and reporting establish international confidence, may act as a check against vulnerabilities that may have escaped detection by national authorities, enable states to provide support and assistance to one another, and facilitate the development of international best practices. But for all the heightened concerns and awareness of the risks and dangers of nuclear terrorism, nuclear security is lacking in minimum transparency, reporting and accountability mechanisms.

3.99 In 2005 INTERPOL started project GEIGER with a goal of collecting and analyzing information on illicit nuclear trafficking and other unauthorized activities involving nuclear and radiological materials. In 2010 the IAEA launched the Nuclear Security Information Portal available for all member states in order to provide an “interactive knowledge-based environment to enhance nuclear security cooperation, facilitate implementation of joint activities and share relevant information.”

3.100 The Seoul NSS communiqué encouraged states to share best practices. Nuclear security standards and best practices play complementary and parallel roles in ensuring security. A “standard” is established by authority, custom or general practice. It defines objectives: performance requirements, specifications, guidelines or characteristics. It is static. It represents a consensus judgment – that is, a minimum level of agreement – on goals. It is politically or institutionally authoritative but can be slow to develop. The IAEA INFCIRC/225/Rev.5 is the primary nuclear security standards document.

3.101 A “best practice,” by contrast, is a method or technique that produces results consistently superior to those obtained with other means. It describes a process, not a goal, and aims to reach an optimum level of performance. Best practices can help to implement standards and also to inform their creation. They develop from the experience of many individuals and groups in government and industry in many countries and are constantly evolving.

3.102 The only existing schemes are voluntary and operated by the IAEA (the recommendations) and the World Institute for Nuclear Security (WINS). Modelled on WANO that was created after the Chernobyl nuclear accident as a forum for nuclear power plant operators to share best practices and exchange lessons learnt on reactor safety, WINS was founded in Vienna in September 2008. It facilitates the sharing of information and experience among security professionals in the nuclear industry.

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60. Some information will have to remain confidential for national security or commercial propriety reasons. But some other information can be shared with other governments, the IAEA, or trusted friendly or allied states, on a confidential basis.

61. It should be noted that some of the report on these issues is done via the UNSCR 1540 national reports. Using the reports it is possible to discern to some extent how states are living up to certain commitments.


64. The descriptions of standards and best practices is summarized from “Options for Strengthening the Global Nuclear Security System,” pp. 2–3.
promotes training and best practices, and develops peer review systems. Much of its effort so far has concentrated on the preparation of a portfolio of best practice guides. In consultation with both industry and government stakeholders, WINS has developed more than 30 best practice guides.\textsuperscript{65}

3.103 Both the IAEA and WINS have demonstrated that it is possible to develop and share best practices consistent with the confidentiality of commercially or militarily sensitive information. The best practice guides offered by WINS cover topics from nuclear security culture to threat assessment and effective security regulation and implementation. It offers a peer review mechanism for security management on a voluntary basis on request. It is creating training programs for professional managers and operators of nuclear security and is thus creating “a community of practice” in nuclear security.\textsuperscript{66}

3.104 Canada and Japan have helped to host and fund nuclear security best practice workshops with WINS. Canada pledged $100 million for new bilateral security cooperation with Russia. Japan set up a new Integrated Comprehensive Regional Support Centre for Non-proliferation and Nuclear Security in December 2010, and helped to fund R&D on nuclear detection and forensics techniques. Japan and the United States also set up a bilateral Nuclear Security Working Group to promote cooperation and collaboration. Nuclear security centres of excellence, training centres, workshops and conferences have been established or promised in China, India, Kazakhstan, France, Italy, Saudi Arabia and South Korea, often with US assistance.\textsuperscript{67} The meetings of the Institute of Nuclear Material Management and the International Technical Working Group on Nuclear Smuggling have also become important information exchange and standard setting forums.

\textbf{3.5.3. Information Security}

3.105 Information security is defined as the preservation of the confidentiality, integrity and availability of information.\textsuperscript{68} The past few years have witnessed new forms of nuclear security threats mirroring rapid changes in technology. In 2011, Iran experienced a high failure rate of its IR-1 centrifuges installed at a fuel enrichment facility in Natanz.\textsuperscript{69} A computer code named Stuxnet is believed to have been responsible, and while Iranian officials denied that it had caused significant damage, the incident marked the first international incident of this nature.\textsuperscript{70} The incident increased international awareness of threats to nuclear security due to gaps in information security. In light of the increased attention to the issue, in 2011 the IAEA published a reference text on computer security

\textsuperscript{65} NSGEG, \textit{Improving Nuclear Security Regime Cohesion}, p. 6.
\textsuperscript{66} “Options for Strengthening the Global Nuclear Security System,” p. 4.
\textsuperscript{67} See Cann, Davenport and Balza, \textit{Nuclear Security Summit}, pp. 8–11.
at nuclear facilities as part of its Nuclear Security Series. The publication highlights the specific situations where information security can be compromised to perpetrate an attack against a nuclear facility, viz:

> Information gathering attacks aimed at planning and executing further malicious attacks on nuclear facilities;
> Attacks disabling or compromising the attributes of one or several computers crucial to nuclear facility security;
> Compromise of one or several computers combined with simultaneous methods of attack, such as physical intrusion.

3.106 Owing to the highly sensitive nature of the information to be protected, little is known publicly about specific country measures taken in this context. Nevertheless, several countries and organizations have conducted workshops or other events to train employees of nuclear power plant facilities, and there are now more published resources to which states can refer for the implementation of information security measures, for example the IAEA Nuclear Security Series publication on information security.

### 3.5.4. Transportation Security

3.107 In 2011, the IAEA released the "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities" as part of its Nuclear Security Series. The 2011 text is the fifth revision of INFCIRC/225 (discussed above). The manual contains a set of guidelines concerning the transportation of nuclear material. At the same time, it reaffirms that "the responsibility for the establishment, implementation and maintenance of a physical protection regime within a State rests entirely with that State."

### 3.5.5. Combating Illicit Trafficking

3.108 The IAEA has operated the Illicit Trafficking Database Program (ITDB) since 1995 as an information system on incidents of illicit trafficking and other unauthorized activities and events involving nuclear and other radioactive material. Additional activities include performing analyses of confiscated samples, assisting states with border controls, testing detection and monitoring equipment, and conducting training courses. The IAEA encourages all its member states to participate and a total of 116 states have joined the ITDB as of 2012. From January 1993 to December 2011, a total of 2,164 incidents were reported to the ITDB by participating states and some non-participating states. Of these, 588 incidents involved the theft or loss of nuclear or other radioactive material, and 1,124 cases involved unauthorized activities like disposal of radioactive materials or discovery of uncontrolled sources. Another 399 incidents involved unauthorized possession, movement or attempts to illegally trade in or use nuclear material or radioactive sources. In turn, of these 399, there were 16 serious incidents involving HEU or plutonium.

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3.109 The UN Secretary-General’s High-level Panel on Threats, Challenges and Change noted that 20 cases of nuclear material having been diverted had been publicly confirmed by various states,74 and the IAEA’s ITDB Program cites 421 incidents of illicit trafficking in nuclear materials between 1993 and 2008.75 The most notorious example (albeit for non-proliferation rather than nuclear security) is the underground nuclear arms bazaar run by Pakistan-based Abdul Qadeer Khan, which showed the urgent and compelling need to detect, interdict and criminalize the clandestine trade in nuclear and dual-use components, materials, technology and skills. The other side of that enterprise is to secure them against unauthorized and illicit acquisition and use.

3.110 For obvious reasons, law enforcement and intelligence agencies are shy of publicizing their efforts to detect and thwart illicit trafficking in nuclear materials and components. But we know that significant cooperation is taking place. For example, the NNSA manages the Megaports Initiative within the US Second Line of Defense program to prevent and respond to incidents of nuclear and radioactive smuggling. It provides training, technical assistance and equipment to strengthen detection and interdiction capabilities in the maritime ports of partner countries. Italy, New Zealand, Norway and the United Arab Emirates have also contributed to the Nuclear Smuggling Outreach Initiative launched by the United States. Other donor partners include Canada, the Czech Republic, Finland, France, Germany, Japan, Netherlands, South Korea, Sweden and the United Kingdom; and the IAEA, European Union and UNODC.

3.111 In December 2011 Russia hosted a meeting with American experts to cooperate in improving national capacities to combat trafficking in nuclear materials.76 Similar cooperation between the United States and China was established in January 2011.77 On 1 November 2012, British scientists at the Atomic Weapons Establishment announced the creation of a new machine that can detect attempts to smuggle nuclear material through airports and seaports, even if it has been shielded from giving off radiation.78

§3.6. National Nuclear Security Regulations

3.112 Several countries have strengthened their national regulatory framework and capacity as part of the global efforts to improve nuclear security, from stringent export control laws that incorporate international best practices (for example Armenia in 2009 and Malaysia in 2010), to regulating nuclear and radiological activities in conformity with regional and global norms and treaties (for example Egypt in 2010). Of course, there is a difference between creating the legal framework and implementation in actual practice.

3.113 For example in 2012, on the eve of the Seoul NSS, China released a report listing several points that were implemented between the two nuclear security summits in order to enhance nuclear security in the country. 79 The report said that authorities had already finished assessing security systems at operational nuclear power plants all over the country. Since September 2010, China and the United States had worked together to convert Chinese miniature research reactors, allowing them to substitute HEU with LEU fuel. The two countries were about to establish a radiation detection training centre for Chinese and other Asia–Pacific customs officers in accordance with the January 2011 agreement. They had also jointly implemented a pilot program in Shanghai under the Megaports Initiative. Beijing claimed that it had created several laws and regulations to enhance security for radioactive storage facilities; upgraded security facilities for regional radioactive storage centres and centralized the storage of several dozen hazardous radioactive sources; and developed new high-tech devices to detect explosives and radioactive substances inside vehicles that had already been deployed at major international events, including the Shanghai World Expo and the Guangzhou Asian Games in 2010.

3.114 A number of similar initiatives are occurring elsewhere. For instance, Indonesia has announced plans to install, with IAEA help, new mobile radiation portal monitors that will greatly increase nuclear and radioactive material detection capabilities at the country’s major seaports. It had already been successfully tested at one port, an official said.80

3.115 In this context, UNSCR 1540 has played a significant role in terms of creating a legal obligation for states to implement measures related to nuclear security and to report on the measures they have taken to the 1540 Committee. “[A]t least 140 States have now adopted legislative measures to prohibit proliferation of nuclear, chemical and biological weapons, as compared to 65 States in 2006. The number of countries reporting national legal frameworks regarding the manufacture and production of nuclear materials has risen from 32 in 2006 to 71 in 2009 and to more than 120 in 2011.”81 However, as noted in the 2011 report of the committee, significant work remains to be done in the national implementation of nuclear security measures and many states continue to ask for its assistance.

§3.7. Sensitive Nuclear Materials

3.116 “Sensitive nuclear materials” are HEU and separated plutonium. The bulk of HEU in the world is used for military purposes, but significant amounts are also used in civilian programs and the same is true for separated plutonium. HEU has a threefold attraction for terrorists: it can be used in the simple “gun-type” fission weapon with no need for sophisticated detonation equipment; it is smuggler-friendly because it emits

only faint radiation signals that make it hard to detect; and, being less radiotoxic than plutonium, it is safer to handle. HEU remains “the most accessible fissile material for a terrorist nuclear device.”\textsuperscript{82} Making a successful explosive device from plutonium would present greater challenges for terrorists, compared with using HEU, but the risk is real, especially given the possibility that terrorists might succeed in recruiting one or more experts from a national nuclear weapon program.

\textbf{Table 3.4: Fissile Material Stocks, Military and Civil Material (tonnes, January 2012)}

<table>
<thead>
<tr>
<th>Country</th>
<th>Highly-enriched Uranium</th>
<th>Separated Plutonium Weapon-grade</th>
<th>Reactor-grade</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>737</td>
<td>128</td>
<td>48.4</td>
<td>913.4</td>
</tr>
<tr>
<td>USA</td>
<td>610</td>
<td>80.7</td>
<td>7.1</td>
<td>697.8</td>
</tr>
<tr>
<td>France</td>
<td>30.6</td>
<td>6</td>
<td>56.0</td>
<td>92.6</td>
</tr>
<tr>
<td>China</td>
<td>16</td>
<td>1.8</td>
<td>0.01</td>
<td>17.8</td>
</tr>
<tr>
<td>UK</td>
<td>21.2</td>
<td>3.2</td>
<td>92.1</td>
<td>116.5</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2.75</td>
<td>0.14</td>
<td>0</td>
<td>2.9</td>
</tr>
<tr>
<td>India</td>
<td>2.0</td>
<td>0.52</td>
<td>4.44\textsuperscript{b}</td>
<td>7.0</td>
</tr>
<tr>
<td>Israel</td>
<td>0.3</td>
<td>0.82</td>
<td>–</td>
<td>1.1</td>
</tr>
<tr>
<td>North Korea</td>
<td>0.03</td>
<td>–</td>
<td>–</td>
<td>1.1</td>
</tr>
<tr>
<td>Germany</td>
<td>–</td>
<td>–</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>Japan</td>
<td>–</td>
<td>–</td>
<td>44.9</td>
<td>44.9</td>
</tr>
<tr>
<td>Others</td>
<td>20.0</td>
<td>–</td>
<td>10.7</td>
<td>30.7</td>
</tr>
<tr>
<td><strong>TOTAL (rounded)</strong></td>
<td><strong>1440</strong></td>
<td><strong>221</strong></td>
<td><strong>271</strong></td>
<td><strong>1932</strong></td>
</tr>
</tbody>
</table>

\textsuperscript{a} Includes “fuel-grade,” an intermediate category between weapon-grade and reactor-grade.

\textsuperscript{b} Includes 4.2 tonnes of plutonium in India’s strategic reserve, not under IAEA safeguards.

A number of the figures are IPFM estimates, with varying degrees of uncertainty.

Nineteen countries, plus Taiwan, had eliminated nuclear weapon-useable materials as of January 2012.


3.117 Almost 1,700 tonnes of weapon-grade nuclear materials in the world – enough for around 100,000 bombs additional to present stockpiles of just under 18,000 (see Table 1.2)\textsuperscript{83} – are stored in hundreds of sites in 32 countries. This is in addition to an estimated 111 sites spread across 14 countries in which nuclear weapons are stored.\textsuperscript{84} While some of the sites are well-secured, many are not.\textsuperscript{85} Hence the risk of sabotage and theft by or

\textsuperscript{82} FMWG, Preventing Nuclear Terror in the 21st Century, p. 6.

\textsuperscript{83} As an additional complication, not all the HEU will be weapon-grade. A break-down does not seem to be publicly available.

\textsuperscript{84} Belfer Center, Nuclear Terrorism Fact Sheet.

\textsuperscript{85} Sometimes even a well-secured facility is vulnerable; for an account of what may have been “the biggest security breach in the history of the nation’s atomic complex,” see William J. Broad, “The nun who broke into the nuclear sanctum,” New York Times, 10 August 2012, http://www.nytimes.com/2012/08/11/science/behind-nuclear-breach-a-nuns-bold-terror. html?pagewanted=all&_r=0.
illicit sales to terrorists, criminals and others.\textsuperscript{86} Materials used in the nuclear fuel cycle can be lost, abandoned or removed from decommissioned and inactivated facilities without proper authorization. The risks are multiplied in conditions of fragile and failing states, of fragmented authority structures, of a pervasive culture of corruption among public officials, or when widespread unemployment, underemployment and poverty can weaken resistance to inducements offered by various groups. There are no precise and reliable figures on how much HEU or separated plutonium is missing.

3.118 The elements of a perfect nuclear security storm are the abundant supply of weapon-useable nuclear materials, all of which must be secured to ensure non-availability to unauthorized individuals or groups; the explosion of knowledge and technical expertise, much of it relatively easily accessed through the Internet; the determination of terrorists to get it; and the known ruthlessness of terrorists to use it. For all these reasons, effective nuclear security demands that weapon-useable HEU and plutonium stocks should be eliminated where feasible, and where this is not feasible, they should be minimized and consolidated into fewer sites.

3.119 In order to limit opportunities for theft and sabotage, states must limit access to nuclear material and facilities only to authorized personnel, and to the minimum number of personnel consistent with safe operational requirements; keep material that is not in use in secure vaults; and monitor all storage and access of materials. Physical protection systems should be subject to periodic inspection and testing. Accountability mechanisms include an appropriate legislative and regulatory framework, a competent and independent oversight authority or nuclear regulator, and a clear assignment of responsibilities for nuclear security as well as nuclear safety.

3.120 \textbf{Sensitive Nuclear Materials for Civil Use.} Progress has been made in the global efforts to eliminate excess weapon-grade plutonium and to shift from HEU to LEU. Under the Reduced Enrichment for Research and Test Reactors program initiated by the DOE in 1978, 62 HEU-fuelled research reactors have been converted to LEU fuel, another 17 have been shut down, and 11 Russian reactors have downshifted to a lower level of 36 per cent enrichment (which is still HEU).\textsuperscript{87} The Plutonium Management and Disposition Agreement (PMDA) between Russia and the United States entered into force in July 2011, setting the stage for the United States and Russia to each eliminate 34 tonnes of excess weapon-grade plutonium, enough for 17,000 nuclear weapons (see Chapter 2.10).\textsuperscript{88} In addition, Russia shut down its last plutonium production reactor, in Zheleznogorsk, in 2010, with Kazakhstan, Mexico, the United States and Vietnam also committing either to shut down or to convert reactors that use or produce weapon-grade nuclear materials.

\textsuperscript{86} For an indication of the scale of damage that can be caused by such an eventuality, see \url{http://www-pub.iaea.org/MTCD/publications/PDF/Pub815_web.pdf}, regarding what happened in Goiania, Brazil.


\textsuperscript{88} US Department of State, “Nuclear Security Summit National Progress Report,” 16 November 2012, \url{http://www.state.gov/j/s/1s/other/200633.htm}. 
3.121 The United States, the first country to enrich uranium, ended all HEU production in 1992. But it continues to use HEU for military and civilian purposes and to engage in HEU commerce.\(^8^9^\) Noting that it had completed the conversion of 20 HEU reactors that can use existing LEU fuels, Washington has pledged to convert its six remaining HEU-fuelled reactors to LEU as soon as suitable fuel can be developed. It is also assisting – sometimes in cooperation with the IAEA – several other countries, among them Kazakhstan, Mexico and Vietnam, to fulfil their NSS pledges and meet their targets.

3.122 The most significant theatre of operations in this area of work is Russia and the former Soviet republics and Eastern Bloc countries. In July 2012, the NNSA announced that it had monitored the elimination of more than 450 tonnes of Russian HEU under the 1993 US–Russia HEU Purchase Agreement, otherwise known as the “Megatons-to-Megawatts” program. This program, which is a government–industry program additional to the CTR and GTRI programs, is now 90 per cent complete and on track for the conversion of the total of 500 tonnes of Russian nuclear weapons HEU to LEU by the end of 2013 (see Chapter 2).\(^9^0^\) As part of monitoring the Megatons-to-Megawatts program, since 1995 NNSA has conducted 335 monitoring visits to Russian HEU processing facilities, and since 2000 the elimination of 30 tonnes of Russian HEU has been monitored each year. By the end of 2013, the NNSA will have monitored the elimination of HEU

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*Note*

The shutting down or conversion of the reactors shown has been pursuant to the NNSA Global Threat Reduction Initiative

*Source*: SIPRI

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equivalent to about 20,000 nuclear weapons. In addition to the Megatons-to-Megawatts program, from the Washington NSS in April 2010 to mid-November 2012, the United States down-blended 10.5 tonnes of its own HEU, supported Russian down-blending of about 2 tonnes of HEU, and supported the removal and elimination of over 400 kg of HEU from ten countries – in aggregate enough for about 500 nuclear weapons.91

3.123 In 2010, Ukraine removed 56 kg of spent HEU fuel to Russia and another 50 kg of fresh HEU fuel to the United States. It completed the elimination of its HEU stock on 25 March 2012, when the final shipment of 19 kg of HEU was sent to Russia.92 Ukraine signed an MOU with the United States on 26 September 2011 for $60 million in assistance for LEU reactor conversion and a new neutron source medical isotope production facility to be operational by 2014. On 22 March 2012, Ukraine announced that it had fulfilled its pledge to remove all HEU material from its territory that was made in advance of the 2010 NSS.93

3.124 Kazakhstan returned more than 70 kg of spent HEU fuel to Russia in 2009 and down-blended 33 kg of fresh HEU fuel in 2011. It also signed an agreement with the United States in November 2010 for a fuel security project to secure three tonnes of weapon-grade plutonium and ten tonnes of HEU. Belarus pledged to return all of its HEU to Russia and had removed approximately 85 kg of HEU.94 However, the project was suspended by Belarus in 2011 in protest at sanctions placed on it by the European Union. Poland worked with the NNSA to remove 450 kg of spent Russian-origin HEU fuel in 2010. In 2012 a further 90 kg of HEU fuel was returned to Russia from Poland’s only operational research reactor.95 The Maria reactor in Poland was converted to LEU as of September 2012.96

3.125 Canada agreed to remove its spent HEU fuel to the United States by 2018 and to provide funding for HEU removals from Mexico and Vietnam. The United States and Canada have been active also in the Americas. The Colombian research reactor IAN-R1 was converted to run on LEU instead of HEU in 1996.97 This was the start of the project to remove US-origin nuclear material from sites and countries where it was considered surplus, an effort that later became part of the Global Threat Reduction Initiative. Since then, 19 countries have removed HEU fuel from research reactors and critical assemblies, and more than 400 kg of HEU has been removed from civilian sites for safe storage in Russia and the United States since the first NSS in 2010.98

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98. Hinderstein, Newman and Reistad, “From HEU minimization to elimination,” p. 84.
3.126 Working with the NNSA, Chile completed the elimination of its stock of 18 kg of HEU and its removal to the United States ahead of the first NSS in 2010. At the 2012 Seoul NSS, Canada, the United States and Mexico announced the successful removal of HEU from Mexico and conversion of the Triga II Research Reactor to LEU. The HEU removal and reactor conversion were completed with IAEA support. The first shipment of LEU took place in December 2011 and the shipment of fuel exchanges was completed in February–March 2012. The HEU removal and upgrades to the Triga II Research Reactor were made possible with more than $5 million in funding from Canada. These upgrades, along with the LEU shipments, will allow Mexico to expand its capability to produce a variety of medical isotopes for domestic use.99

3.127 Between 2004 and 2012, 39 research reactors were converted from HEU to LEU fuel, 9 in the United States and 30 in other countries, with NNSA collaboration.100 Overall, the NNSA's Global Threat Reduction Initiative has eliminated all HEU from eight countries: Chile, Libya, Mexico, Romania, Serbia, Taiwan, Turkey and Ukraine. As of February 2012, the United States had removed 400 kg of HEU and plutonium and down-blended 700 kg from civil nuclear programs around the world since the Washington NSS.101

3.128 The reactors yet to be converted may pose the biggest technical challenges. Russia has devoted more effort and resources to converting and shutting down the facilities of others than its own, on the argument that its stockpiles are well secured. Indeed Russia was slated to open a new HEU-fuelled reactor in 2012 near St. Petersburg (now expected to begin operations after 2014),102 and is also scaling up the production of HEU-based medical isotopes.103

3.129 New technologies have enabled the production of reactor fuel and medical isotopes using LEU fuel. More than 700 kg of HEU – or about half the world’s consumption – is used in civilian research reactors annually, of which 40-50 kg is used for civilian isotope production. Just five countries – Belgium, Canada, France, the Netherlands, and South Africa – produce most of the world’s radioactive isotope molybdenum 99 that is the source for more than 20 million diagnostic imaging procedures globally. The Canadian producer has announced the intention to close its business entirely; in December 2010 South Africa switched to LEU-sourced molybdenum 99; and the other producers have promised to follow suit by 2016.104 At the Seoul NSS in 2012, Belgium, France and the Netherlands pledged to convert existing HEU-fuelled facilities by 2014 and to recycle or dispose of accumulated HEU.

101. All the information in this paragraph is from Cann, Davenport and Balza, Nuclear Security Summit, pp. 4–8.
3.130 Although significant progress has been made on reducing the number of and securing fissile materials storage sites, and in conversion of HEU to LEU, states have been reluctant to ban HEU use in civilian applications. Hinderstein, Newman and Reistad have argued that the time has come to move from HEU minimization to elimination.\textsuperscript{105} As part of this, they call for a new global norm that requires LEU to be used in any new facility, process or vessel under development, design or construction, an end to subsidies for HEU production that prices LEU alternatives out of the market, voluntary declarations of HEU holdings, and an assessment of the inventory needs for HEU use in military vessels. The more ambitious steps, including fissile-material-free zones, could follow.

3.131 **Sensitive Nuclear Materials for Non-Civilian Use.** The progress made in reducing the availability of sensitive nuclear materials, and HEU in particular, for civilian use, has not been matched in relation to stocks held for non-civilian purposes. The IAEA safeguards agreements require each state to create a national system for accounting for and control of nuclear material. But most of the world’s weapon-useable nuclear material is in nuclear-armed states. Consequently, only a small fraction of the world’s HEU and less than half of the world’s separated plutonium, is subject to international discipline with respect to nuclear material accountancy. As shown in Table 3.4, 98 per cent of the world’s HEU stock is held by the five NPT nuclear weapon states (NWS), with even the other four nuclear-armed states being only marginal players in this respect. The minimization by non-NWS of the use of HEU, including through the conversion of reactors from HEU to low enriched fuel, is therefore not enough to solve the problem in its totality.

3.132 In order for the international community to have confidence in it, an effective nuclear security regime must be comprehensive. That is, it must cover all weapon-useable nuclear material. As noted earlier, there have been significant reductions in non-civilian HEU stocks under the Russia–US Megatons-to-Megawatts agreement. “Yet today, the vast majority of weapon-useable material is not subject to international standards, guidelines, best practices, or mechanisms for international assurance.”\textsuperscript{106} Bunn points out that between them, Russia and the United States possess over 90 per cent of the world’s HEU stockpile, operate more than half the world’s HEU-fuelled research reactors and about two-thirds of the reactors with the most dangerous material, provide most of the HEU-fuelled reactors and the HEU fuel for them to the rest of the world, and yet co-chair the Global Initiative to Combat Nuclear Terrorism which has identified HEU (and plutonium) minimization as a key priority.\textsuperscript{107}

3.133 A comprehensive, universal and enforceable nuclear materials control system would be invaluable. The national commitments made by states at the Nuclear Security Summits are minimal, not ambitious, and there is no common rigorous methodology to assess progress against agreed benchmarks. In addition to funding problems, lack of technically qualified personnel and technological capabilities, most developing countries simply put higher priority on their more pressing concerns of poverty alleviation and economic development. And they quickly revert to the illegitimacy-of-the-NPT-regime

\textsuperscript{105} Hinderstein, Newman and Reistad, “From HEU minimization to elimination,” pp. 83–95.
\textsuperscript{107} Bunn, “HEU Consolidation: The U.S. and Russian Pictures.”
argument to note that the US emphasis on nuclear security distracts attention from the lack of major progress on nuclear disarmament. Some developing countries fear that this is a trap by the industrialized countries to deny them scientific and technological advances. They provide confidential reporting on HEU stocks under IAEA safeguards agreements. But there is no binding transparency or public declarations regime of HEU holdings, military non-explosive stockpiles, inventories of material resulting from nuclear disarmament, material in excess of defence needs, and material in active and reserve stockpiles for military and naval propulsion.

![Figure 3.7: Categories of Weapon-Useable Nuclear Materials Globally (2012)](image)


3.134 The challenge is to devise systems and procedures that secure non-civilian nuclear materials and facilities to international standards and best practices while maintaining the necessary confidentiality for commercial or national security reasons. In the global stockpile of weapon-useable materials comprising 1,440 tonnes of HEU and 492 tonnes of separated plutonium, almost all HEU (1,400 tonnes) and about half of the plutonium remain outside civilian programs. No nuclear security system will be effective, therefore, "without somehow ensuring that these large quantities of materials are under effective security." 108 A modest and cautious start could be made by voluntarily bringing some of the non-civilian nuclear material that is not being used in nuclear weapons under international standards and best practices, for example through UNSCR 1540 reporting, certifications, and unilateral declarations.

3.135 It could be argued that military-relevant material, like nuclear weapons themselves, already has a much higher level of protection: hence the point of the earlier comment that HEU and plutonium stocks for civilian purposes must have weapon-standard protection in order for them to be secure. But while non-civilian nuclear material under military protection is generally better protected than civilian material, not all material – even weapons themselves – and facilities under military protection can be assumed to be totally safe, as exemplified in the unauthorized transfer of six nuclear weapons across the United States in 2007.

3.136 Moreover, not all nuclear material for non-civilian use is under military protection. Warhead components, warheads undergoing maintenance, warheads awaiting dismantlement, and the large stockpiles of US legacy materials, for example, are in the custody of the DOE and under the protection of civilian contractors. On 28 July 2012 three activists – including an 82-year old nun – breached for a few minutes a heavily guarded section of the Y-12 National Security Complex in Oak Ridge, Tennessee that houses several hundred tonnes of weapon-grade HEU and had been assumed to be secure against armed terrorists. This is a government but not a military facility.\footnote{“Options for Strengthening the Global Nuclear Security System,” p. 10.}

3.137 A remaining particular challenge is HEU-fuel use in the navies of the world for powering submarines and aircraft carriers. France finished converting to LEU for its small submarine fleet in 2008. But the naval giants Russia and the United States have declined so far even to publicly assess the feasibility of conversion to LEU-fuelled naval reactors for their fleets and they require about one and two tonnes respectively of HEU each year for this purpose.\footnote{Hinderstein, Newman and Reistad, “From HEU minimisation to elimination,” p. 89.}

§3.8. Nuclear Forensics

3.138 Nuclear forensic analysis is a key technical capability that utilizes signatures inherent to nuclear or other radioactive material to provide information on its source, production and history. It can prove to be useful both before and after a nuclear security event, and also has the potential to be useful in certain contexts in tracing breaches of the non-proliferation regime. As one would expect, the technical capability to detect current, and just as importantly past, suspect activity continues to develop and advance in sophistication.

3.139 When nuclear or radioactive material is found outside and beyond any regulatory control, nuclear forensics becomes relevant. The first task for nuclear forensic experts is to determine the location of the material and make sure that it is secured against loss or theft. Subsequent but just as vital requirements are to identify the source and place of origin of the material, plug the vulnerabilities that allowed it to escape regulatory control, and assist the lax or negligent authorities to enact and enforce laws to prevent recurrence of such incidents.

3.140 Experts in the IAEA Office of Nuclear Security trace the “signatures” of each of the production processes in the manufacture of the nuclear material by examining the
isotope content, chemical constituents and physical shape to determine the geological features of the place from which the uranium ore might have been extracted, or the process by which the ore was concentrated into yellowcake, made into nuclear fuel pellets and burned in a reactor. With the help of such specialized forensic techniques, the investigators can usually tell the story of where the material came from, or at least narrow it down to a few places, and retrace its manufacture and use.

3.141 The nuclear forensic analysis of signatures introduced into the material by specific production processes can in some cases determine if the material has been removed from sites or facilities previously deemed secure. By doing so, nuclear forensics can help identify previously unknown nuclear security gaps, deficiencies in materials accounting, control and physical protection systems, at the level of individual facilities as well as states. By determining that an intercepted material originates from a particular state, nuclear forensics can help to highlight the need to improve the nuclear security regime in that state. Identification of a particular facility or state being the source of material in multiple illicit trafficking cases would emphasize issues with existing nuclear security even more.

3.142 Nuclear forensics can also be used before a nuclear security event has taken place, to help prevent unauthorized removal of nuclear or other radioactive material. It can exercise a deterrent function on states as well as individuals. At the state level, the credible attribution potential of nuclear forensics combined with credible assurance of measured response can deter national authorities from actively supporting or contributing in any way to illicit trafficking. The same combination of factors is also likely to encourage governments to introduce improvements into the existing nuclear security regime in their own states, as well as to contribute better to international regulatory and policy measures aimed at advancing nuclear security. The individuals working within states in areas with access to nuclear or other radioactive material may be dissuaded from diverting it if they are made aware that the likelihood of attribution and prosecution is increased by an advanced nuclear forensic capability.

3.143 In order to function as a deterrent for states or individuals, the discipline of nuclear forensic analysis, working in concert with other means of investigation, has to demonstrate the potential to attribute material outside regulatory control to the specific source, and possibly to collect information on a history of unauthorized removal. The success of the deterrent function will depend on the credibility and speed of the attribution process, as well as the degree of certainty of the threatened response measures. Since the nuclear forensic evidence might be less than unequivocal, the investigation process must be at least as accurate, reliable and transparent as deemed acceptable by involved states or stakeholders to justify an appropriate response. The current lack of pre-established clarity concerning certainty and form of response may undermine international and local cooperation required for successful attribution. A number of unresolved technical, legal and policy issues in this area are addressed by international mechanisms such as the Global Initiative to Combat Nuclear Terrorism and the Nuclear Forensics International Technical Working Group; as well as by activities within the NSS framework.
3.144 An IAEA Nuclear Security Series publication on nuclear forensics in 2006 brought together for the first time a concise but comprehensive description of the various tools and procedures of nuclear forensics investigations from the existing scientific literature. It also incorporated the experience accumulated over the preceding decade by law enforcement agencies and nuclear forensics laboratories confronted with cases of illicit events involving nuclear or other radioactive materials.111

3.145 In addition, the IAEA helps to build capacity in member states by coordinating research and development, training experts in nuclear forensic methodologies, and providing guidance on the design of a nuclear forensic library. In March 2012, the US NNSA teamed up with the IAEA to organize a workshop in the United States with 24 participants from 12 countries.112 Another IAEA regional training course on introductory nuclear forensics for 24 participants from 10 Asian countries was hosted by the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security in Tokai, Japan. In the three-day (22–24 May 2012) course, the participants were given short overviews of nuclear security threats, the role of nuclear forensics, the IAEA’s ITDB resource, nuclear forensics core and advanced capabilities, national nuclear forensics libraries, requirements of a nuclear forensic investigation and legal considerations, and international cooperation in nuclear forensics as well as national response plans for nuclear security events.113

§3.9. Role of Nuclear Industry

3.146 As with global governance in general, global nuclear governance is being increasingly shared between state, intergovernmental (for example the IAEA) and non-state (for example WANO and WINS, already mentioned earlier in this chapter) actors. This is especially true of the nuclear industry, where there exists significant public–private cross-ownership, not just partnership. Commercial, non-proliferation and nuclear security interests can overlap or collide between industry and government stakeholders, and accountabilities in managing nuclear risks have to be shared between parliaments and boardrooms. Just as nuclear security events will add to the financial and commercial costs of the nuclear industry, so industry can help governments to raise the costs of proliferation.

3.147 Providing nuclear security must be a shared responsibility between state authorities and the nuclear industry. Industry’s “comparative advantage includes its knowledge of increasingly complex supply chains for hardware and technology exports and its ability to deploy such knowledge to prevent proliferation.”114 In the changing global nuclear energy landscape, the integrated nature of the nuclear industry both vertically (across the different levels of the global supply chain) and horizontally (across

the different political jurisdictions) puts a premium on active government–industry collaboration to manage the risks and dangers of the three nuclear “Ss” of safety, safeguards and security.

3.148 The cooperation between state authorities and the operators is probably the main determining factor in the effectiveness of a nuclear security system, because legislation and regulations cannot compensate if industry fails to implement the necessary measures. While the state authorities can identify current and anticipated threats, it is the industry that must translate those assessments into practical measures at facility level. The operator understands the vulnerabilities of a facility, knows the vital areas that need to be protected and probably owns the equipment and employs the manpower needed to perform security tasks. If an incident does occur, it will first and foremost be the operators in charge of nuclear facilities who will have to deal with nuclear and radiological risks associated with it. This was the case, for example, with TEPCO in Fukushima in March 2011. At the same time, confidentiality must be maintained of any information that is sensitive from a commercial competition point of view, or the industry sector will withhold cooperation.

3.149 Some survey work was done by the Lowy Institute in Sydney on behalf of ICNND. Overall, the nuclear industry took the view that nuclear non-proliferation and security were primarily the responsibility of governments and not of the nuclear energy industry. That said, they subscribed to the same broad goals, believed it to be part of their social responsibility and were prepared to work with governments to prevent, limit or place conditions on the spread of developing dual-use technology to stop it from being abused by rogue regimes and associated networks. While only governments can put in place regulatory regimes, industry can play a critical role in reporting suspicious activities or patterns. But there is some industry scepticism on the value of more restrictive measures.115 Sharing information on best practice among industry can be done while respecting the confidentiality surrounding the specific aspects of security measures at facility level.

3.150 The importance of the industry was recognized in the Nuclear Security Summits, where special events and sessions were devoted to exploring how state authorities and industry can work more effectively together. Yet, at the Seoul NSS, even though Australia’s Prime Minister Julia Gillard noted that “we should find mechanisms to foster cooperation between governments and the private sector,” industry was given only a side-event.116 The Nuclear Security Summit initiated the discussion of how to ensure that operators are using the highest standards while taking these issues into account. This issue will be explored more fully at the 2014 NSS in the Netherlands.

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116. Quoted in Letts,  "Nuclear security: Partner with industry."
§3.10. Nuclear Security and Safety Interface

3.151 Both nuclear safety and security are concerned with public safety and health, but they differ with respect to the events that are to be prevented. Nuclear safety aims at unintended events, such as natural disasters, human mistakes or interruptions; and nuclear security aims to prevent intended malicious acts. In contrast to the definition of nuclear security given at the start of this chapter, the IAEA defines nuclear safety as “The achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards.”

3.152 Useful progress has now been made in recognizing the synergy between the two concepts. Meeting shortly after the anniversary of the nuclear meltdown in Fukushima, the Seoul NSS highlighted “the nexus between nuclear security and nuclear safety,” and it did so with a starkness that was absent in Washington:

7. Acknowledging that safety measures and security measures have in common the aim of protecting human life and health and the environment, we affirm that nuclear security and nuclear safety measures should be designed, implemented and managed in nuclear facilities in a coherent and synergistic manner. We also affirm the need to maintain effective emergency preparedness, response and mitigation capabilities in a manner that addresses both nuclear security and nuclear safety. In this regard, we welcome the efforts of the IAEA to organize meetings to provide relevant recommendations on the interface between nuclear security and nuclear safety so that neither security nor safety is compromised.

3.153 The common goal of the interface between nuclear safety and security is the protection of people, society and the environment by preventing any large release of radioactive material. The threshold of unacceptable risk may be presumed to be the same for both and both adopt the strategy of defence in depth based on layers of protection that begin with prevention and move to detection and response. Accordingly, many elements and actions enhance both security and safety simultaneously. For example, the containment structure at a nuclear power plant not only prevents the significant release of nuclear material in case of an accident, but also provides a robust shield in the event of a terrorist attack.

3.154 It appears to be generally recognized now that safety-security overlaps are to be found in:

- Regulation. It is a good idea to have a single site licence that incorporates safety and security issues rather than two separate licensing systems, one each for safety and security.

- Design. The planning of a nuclear facility should be done with both safety and security as integral elements, rather than a focus on the safety aspect with security “bolted on” later.

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Risk assessment. It is better to have an integrated approach to risk assessment, rather than two separate assessments, one for safety and one for security.

Training. Personnel should be sensitized to both safety and security issues as part of their training.

§3.11. Nuclear Security Culture

There are six groups of actors responsible for the proper development of security culture. States, organizations, managers in organizations, personnel, public and the international community fulfil the different tasks relevant for the realization of nuclear security culture through dialogue and coordination.\(^{121}\) The role played by WINS, as already mentioned earlier in this chapter, is especially important in this regard. There are also additional bilateral and other collaborative arrangements and practices. In a report released during the Seoul 2012 NSS, for example, China said that in the two years since the first NSS in April 2010, it had cooperated with the IAEA, the United States and other countries in conducting 20 training courses and seminars for more than 500 nuclear security workers. The IAEA, United States, Canada and “several other countries” had partnered with China to construct a Centre of Excellence on Nuclear Security in Beijing that will in time provide security training to other Asia–Pacific countries.\(^{122}\)

Similarly, the approach taken by India’s Global Centre for Nuclear Energy Partnership – like the Gulf Nuclear Energy Infrastructure Institute (GNEII), and the European Project to offer nuclear security courses at the European Nuclear Safety Training and Tutoring Institute in France – recognizes the importance of an integrated approach to security, safety, and safeguards in the design of these “centres of excellence.” Other existing and proposed centres “should develop appropriate links and collaborations with nuclear safety organizations to foster close working relations and the sharing of best practices and lessons learned, especially in the field of human resource development and threat assessment exercises.”\(^{123}\) There should also be a standardization of training at the different centres to common norms and benchmarks. All such efforts will help to instil a culture of nuclear security among all stakeholders.

Nuclear security culture is discussed in the IAEA Nuclear Security Series No. 7 Implementing Guide, and described there as the “assembly of characteristics, attitudes and behaviour of individuals, organizations and institutions which serves as a means to support and enhance nuclear security.”\(^{124}\) Each characteristic is made up of various components, including beliefs and management systems, which together contribute to greater nuclear security. The publication consists of four main chapters: an introduction to the topic, nuclear security and nuclear security culture, roles and responsibilities of institutions and individuals, and characteristics of the nuclear security culture.

\(^{121}\) IAEA, Nuclear Security Culture, p. 7.
3.158 The IAEA organizes a variety of training activities and workshops that are based on findings from the work of advisory missions. One of the IAEA programs relevant to security culture is the International Physical Protection Advisory Service (IPPAS) whose objective is to support states to develop and improve their national nuclear security. Four countries – France, Netherlands, Sweden and the United Kingdom – have received a review mission of the IAEA’s IPPAS since the Washington Summit, and Australia, Finland, the Republic of Korea, Romania and the United States have presented plans in this regard.

3.159 "International assurances" refer to activities undertaken, information shared, or measures implemented voluntarily by one party to provide confidence to others of the effectiveness of nuclear security within the jurisdiction of the first party. They can include “conformity assessments,” as used for example by the International Organization for Standardization (ISO) to show that a product, service or system meets the requirements specified in an ISO standard; information sharing and annual reports on nuclear security regulations and issues; physical protection assessments; certification of nuclear security personnel to agreed baseline qualifications and training; bilateral cooperation programs; and peer review mechanisms.

3.160 IAEA IPPAS missions offer one example of a peer review mechanism that helps to provide international assurance. Since the first such mission in 1996, 56 IPPAS missions in 37 countries have been performed. The IAEA IPPAS checks if a country’s laws and regulations conform to IAEA guidance, but not the effectiveness of the implementation of the guidelines. Others gain confidence from the very fact that a state agrees to host an

Figure 3.8: Characteristics of Nuclear Security Culture


IPPAS mission, as Australia will in 2013, for it indicates a national commitment to evaluate and strengthen nuclear security. But the state has no obligation to implement the recommendations and report on them. According to the NTI Nuclear Materials Security Index, 17 countries published either regulations or an annual report, and 13 countries published both, on nuclear security issues as of 2011.127

3.161 In addition to acknowledging the nuclear security and safety interface, it is worth noting also that there is a close relationship between nuclear non-proliferation and nuclear security. While the non-proliferation regime was designed to defend against state level proliferation it also provides an important, if by itself insufficient, line of defence against terrorists acquiring nuclear materials, equipment and technologies. Application of safeguards [particularly an effective state system of accounting for and control of nuclear material (SSAC)], export controls and the like are all fundamental to the security of nuclear material, technology and equipment and to preventing illicit trafficking. Similarly, agreement on measures to limit the spread of uranium enrichment and reprocessing would reduce the risk of both state and non-state misuse of these materials. All of this also can be described as developing a robust nuclear security culture.

3.162 If a robust nuclear security culture is to be created, some existing gaps will have to be filled. The catalogue of incidents listed in Box 3.1 is suggestive of gaps in the existing national and multilateral machinery of nuclear security. These include lack of universality, binding standards, transparency and accountability mechanisms, compulsory IAEA oversight, and insufficient attention to nuclear weapons. The measures adopted by the Washington and Seoul Nuclear Security Summits in 2010 and 2012 are said to suffer from three serious flaws: they are recommendations for voluntary action by states; they are uneven and inconsistent between different states; and they lack built-in accountability requirements and mechanisms. Given the gravity of the threat, a credible and effective nuclear security regime requires the opposite three attributes: mandatory, legally binding, and globally uniform standards and monitoring-cum-verification systems. It is not enough to “encourage” states to share best practices and to cooperate with the IAEA in securing the essential and disposing of surplus nuclear material. A nuclear terrorist attack would unleash profound security, political, economic and social consequences.

3.163 That said, the international community must weigh in the balance whether an instrument capable of attracting strong political support like the Code of Conduct on Radioactive Sources is, for the present, a better outcome than a poorly supported legally binding instrument. David Santoro recommends the cultivation of “nuclear security champions” with in-depth understanding of the political, legal, economic, social and technological aspects of the subject as an effective means of fostering a culture of nuclear security at the state level.128 This would add to the current efforts, for example of the IAEA with its International Nuclear Security Education Network,129 and of the MacArthur Foundation’s initiative on support for graduate and post-doctoral interdisciplinary training in nuclear security.130

Revision of the State's physical protection

Comments by State

IAEA expert team outlines the conduct of mission IPPAS and government and facility personnel meeting

Draft Report Exit Meeting

Results
- Good Practices
- Recommendations and suggestions for improvement

Comments by State

Final Report

6–9 months

Follow-Up Activities

IPPAS Follow-Up Mission

2–3 years