Nuclear Security Governance for the 21st Century: Assessment and Action Plan

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March 2012

US-KOREA INSTITUTE AT SAIS

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Printed in the United States of America
www.uskoreainstitute.org

This USKI Working Paper Series was made possible by support from the John D. and Catherine T. MacArthur Foundation.

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Kenneth N. Luongo
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THE OPPORTUNITY FOR SEOUL

The upcoming Nuclear Security Summit (NSS) in Seoul, South Korea, will raise the international profile of the threat of nuclear terrorism and focus attention on the need to better secure weapons-usable nuclear materials in all corners of the globe. It follows the first NSS held in March 2010 in Washington, DC. Another summit will be held in the Netherlands in 2014. This sequencing of biennial, high-level international political summits has underscored the global importance of addressing the threat of nuclear terrorism. As a result, the NSS has the potential to become the preeminent international forum where the state of global nuclear material security is evaluated and where new commitments are made to improve the world's defenses against nuclear terrorism. But, to fully realize its potential, the NSS process will need to evolve and participating countries must be willing to accept changes that will strengthen the nuclear material security regime.

It is important to recognize that regularized, high-level, international summits that address important transnational issues are fairly rare, difficult to establish, and raise expectations for effective action. The closest corollary is the G-8 economic summit process, and the recent addition of the G-20 economic summits. But even the G-7 meetings (the forerunner of the G-8) were not regularly established until 1979. And their creation was an outgrowth of the ad hoc sessions initiated by the industrialized countries following the 1973 OPEC oil embargo.

The NSS process has had the foresight to address the clear and dramatic danger posed by nuclear terrorism in advance of any such shocking event. But this strategy of focusing attention on the prevention of nuclear terrorism requires policies and requirements to be stronger than those that the Washington Summit, and likely the Seoul Summit, will require. It requires the development of an international nuclear security regime that emphasizes transparency of action, shared standards, and confirmed performance and accountability by nations.

The upcoming meeting should build on the success of the first NSS by moving beyond the current elements of the regime and creating the foundation for the construction of an improved governance structure for nuclear security—one that is comprehensive, standardized, and accountable. If this policy evolution process can be initiated at the Seoul Summit and can be continued in subsequent summits, it would help significantly strengthen and expand the existing nuclear and radiological material security regime.

THE NEED FOR IMPROVED GOVERNANCE

The 2010 Washington Summit solidified and underscored the key elements of the current nuclear material security regime, including the importance of strong national control and regulation, acceptance of United Nations Security Council (UNSC) resolutions and international agreements, and the continuing role of the International Atomic Energy Agency (IAEA). However, the summit documents did not require countries to take any specific action beyond those that they wanted to take. The most specific actions toward nuclear material security improvements—many important—were declared unilaterally by individual nations in attendance. But, the summit Communiqué and Work Plan only outlined specific actions and policy objectives without making implementation mandatory.[1]

This may have been an acceptable outcome in 2010 at an inaugural summit. But circumstances have changed over the past two years, particularly as a result of the nuclear reactor accident at Fukushima in Japan. While for many nations, including some of those in attendance in Washington, nuclear terrorism remains an abstract and distant threat, Fukushima underscored that nuclear disasters can occur in an extremely technologically advanced country, as a result of an unanticipated event, and have significant economic and social consequences. In addition, the accident at Fukushima made it clear that the global community does not have an adequate system in place to deal with nuclear crises that extend beyond borders.

In fact, in the aftermath of the Fukushima accident a number of high-level international discussions were held, including at the IAEA and the United Nations (UN). As a result of a conference on nuclear safety and security held in September 2011, the UN Secretary General, Ban Ki-moon, declared, "The effects of nuclear accidents respect no borders. To adequately safeguard our people, we must have strong international consensus and action."

The current nuclear material security regime has improved over the past ten years but it still lags behind other regimes including safeguards, safety, and arms control. At the very least, all of these other regimes require some element of transparency and/or verification of commitments. The current nuclear security regime is still very much designed and controlled by national agencies and actors and remains individualized to specific nations. International obligations are largely voluntary with no uniformity of security regulations or procedures. These are major gaps in the regime in comparison to other, related nuclear issues.

What is needed is a confidence building architecture that emphasizes demonstrated performance and accountability. It must be comprehensive and include clear but flexible standards.[2]

THE CURRENT NUCLEAR SECURITY REGIME

The current nuclear material security regime is composed of three major elements. The first is the domestic laws and regulations that govern security on a nation's territory. The second is the international agreements and institutions and United Nations Resolutions that supplement domestic security laws. The third is ad hoc, cooperative measures in which nations voluntarily agree to participate.

Domestic Activities

The first line of defense for the security of nuclear materials resides with the country that manufactured or stores them. These materials are national possessions, and the laws and regulations of individual nations are the most relevant protections. This is one reason why the Washington Summit made clear that each nation possessing nuclear materials has a duty to ensure the highest level of protection. Individual nations are very protective of this sovereign control, and it is a major reason why that summit did not seek to break new ground by introducing new initiatives. The rationale was that security could be significantly improved if all nations took additional steps at home and also adhered to the international conventions and agreements that have been developed over the past 65 years. The 2010 NSS work plan does encourage the sharing of best security practices, in cooperation with industry, the IAEA, and newly created nuclear security training centers to develop effective, robust nuclear security systems and culture, but it does not identify a path forward for this cooperation.

International Conventions, Agreements, and Institutions

There are a handful of major international agreements and conventions that govern nuclear material security, though there are also others that have applicability to terrorist activities using weapons of mass destruction (WMD) more directly. [3]

Convention on the Physical Protection of Nuclear Materials and its Amendment

The Convention on the Physical Protection of Nuclear Materials (CPPNM) is the only legally binding international document on the physical protection of nuclear materials. The convention requires its parties to take appropriate measures to protect civilian nuclear materials while in transit. The CPPNM also criminalizes the theft, misuse, or threat of misuse of nuclear materials and requires each state to designate a point of contact for information if material is stolen or diverted. The CPPNM was signed in March 1980 and entered into force in 1987.[4] As of September 2010, there were 145 parties to the CPPNM.[5]

Because the original CPPNM only applied to the transport of nuclear materials, an amendment was agreed upon in July 2005 to expand its physical protection regime. The 2005 Amendment requires countries to protect domestic nuclear facilities and materials in use, in storage, and during transport. It also strengthens provisions to protect against theft, diversion, or sabotage, and provides for expanded cooperation to rapidly respond to these offenses. The 2005 Amendment, however, has not yet taken effect because not enough nations have ratified it. Two-thirds of the state parties to the CPPNM must ratify the amendment before it can enter into force. As of December 2011, only 52 states have completed ratification.[6] At the 2010 NSS, five states (Argentina, France, Germany, the United Kingdom, and the United States) pledged to ratify the 2005 Amendment.[7] To date, only Argentina, Germany, and the United Kingdom have followed through on that pledge.

International Convention for the Suppression of Acts of Nuclear Terrorism

The International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT) was adopted by the United Nations General Assembly in April 2005 to ensure that states would have in place legal frameworks criminalizing the illicit possession or use of nuclear material or devices by non-state actors.[8] Under ICSANT, states must put in place domestic laws to investigate possible offenses as well as arrest, prosecute, or extradite offenders.[9] Countries are also called upon to cooperate and share information on

nuclear terrorism investigations and prosecutions, take measures to protect radioactive materials within their territories, and be instructed on how to proceed if an illicit device or material is recovered from non-state actors. Unlike the CPPNM, ICSANT applies to civilian and military materials. At the 2010 NSS, Armenia, Argentina, Australia, Georgia, the United Kingdom, and the United States committed to moving toward the convention's ratification.[10] To date, Armenia, Georgia, and the United Kingdom have ratified the arrangement.[11]

United Nations Security Council Resolutions (UNSCR): 1373, 1540, & 1887

In the weeks following the terrorist attacks of September 11, 2001, the UNSC unanimously passed UNSCR 1373. Though it focused on general counterterrorism mechanisms and enforcement measures, it specifically cites "the threat posed by the possession of weapons of mass destruction by terrorist groups" and "illegal movement of nuclear, chemical, biological and other deadly materials."[12] Because the resolution was passed under the UNSC's Chapter VII authority, action is not voluntary. It requires members to take measures to combat terrorism.

Despite its mandate for action, the resolution has loopholes, and its shortcomings were highlighted by the discovery of an international nuclear proliferation network run by the Pakistani scientist A.Q. Khan. To supplement the resolution, the UNSC unanimously passed UNSCR 1540 (also under Chapter VII) in April 2004.[13] This resolution was primarily aimed at preventing WMD terrorism by non-state actors and for the first time bound UN member states to take and enforce measures against WMD proliferation. These included creating and implementing strict national export controls and security over all sensitive materials as well as prohibiting financial or other assistance to non-state actors seeking WMD or related materials. It also requires nations to submit reports on their efforts, though the actual reporting has been very uneven.

In September 2009, US President Barack Obama chaired a session of the UNSC, during which UNSCR 1887 was unanimously adopted. UNSCR 1887 reaffirmed the threat of nuclear proliferation to global security and the need for multilateral actions to prevent it.[14] The resolution highlighted the need for improving the security of nuclear materials to prevent nuclear terrorism and expressed support for the April 2010 NSS, the goal announced at that meeting of securing all vulnerable nuclear materials around the world within four years, minimizing the civil use of HEU, and multilateral initiatives such as the G-8 Global Partnership and the Global Initiative to Combat Nuclear Terrorism (GICNT).

International Atomic Energy Agency

The IAEA has several key roles to play in supporting effective nuclear material security. The Agency's activities in this area are separate and distinct from the roles that it plays in ensuring nuclear material is safeguarded so that it cannot be transferred for weapons uses and in supporting nuclear safety. However, the IAEA is only allowed to encourage and incentivize states on nuclear security matters and has no mandate to evaluate state performance in applying or complying with its recommendations.

The most developed set of recommendations and guidance that the IAEA offers on the physical protection of nuclear materials and facilities can be found in Information Circular (INFCIRC) 225/Revision 5.[15] State authorities are encouraged to apply the IAEA's recommendations to nuclear materials in use, transit, and storage to minimize the possibilities of unauthorized material removals and sabotage. The fifth revision of INFCIRC 225 was released in early 2011. It addresses the post-9/11 threat environment and includes guidance to help countries comply with obligations under the amended CPPNM and UNSCR

1540. The previous revisions were completed in 1999. The most recent revision updates categorizations of nuclear material and clarifies site access and control areas. Other changes involve new licensing requirements, prevention of sabotage, interface with safety, interface with material accounting and control systems, and response to malicious acts.

The IAEA also has an Office of Nuclear Security with several responsibilities. It plays the leading role in planning, implementing, and evaluating the agency's nuclear security activities, including those carried out under the *Nuclear Security Plan for 2010-2013*.[16]

The plan focuses on protection, detection and response, and information coordination and analysis. A second role is producing Nuclear Security Guidelines documents, 15 of which have been published to date.[17] Third, the office is responsible for the management and expenditure of the Nuclear Security Fund,[18] which is used to prevent, detect, and respond to nuclear terrorism. This fund is largely reliant upon extra-budgetary contributions from member states, though it does receive some small funding from the regular IAEA budget.

In addition to the documents that the IAEA produces, member-states can augment their domestic security protections by seeking in-country assistance. The IAEA's nuclear security advisory services include: International Nuclear Security Advisory Service (INSServ) missions which help identify a country's broad nuclear security requirements and measures for meeting them; International Physical Protection Advisory Service (IPPAS) missions which evaluate a country's existing physical protection arrangements; and IAEA State Systems for Accountancy and Control Advisory Services (ISSAS) which provides recommendations for improving a country's nuclear material accountancy and control systems.[19]

Ad Hoc, Cooperative, and Nongovernmental Activities

With the collapse of the Soviet Union and concerns about "loose nukes," the nuclear nonproliferation regime in the 1990s expanded from consisting primarily of arms control treaties to also include new, non-treaty based (ad-hoc) initiatives. The first of these initiatives was developed between the United States and Russia, but other multilateral initiatives were then developed as well.

Cooperative Threat Reduction and Related US Programs

One of the most important developments was the creation of US Cooperative Threat Reduction (CTR) program by Congress in 1991.[20] CTR was designed to address the potential leakage of WMD from the collapse of the Soviet Union. CTR and related programs focus on protecting and eliminating nuclear, chemical, and biological stockpiles; securing nuclear weapons-usable materials; and eliminating delivery systems. The core of the nuclear material security initiatives is run by the National Nuclear Security Administration (NNSA), a semi-autonomous arm of the Department of Energy. In recent years, programs within the Department of Homeland Security (DHS) have also begun contributing to these efforts, including the Domestic Nuclear Detection Office (DNDO) which is charged with creating a global nuclear detection architecture.

Historically, most of the nuclear material security funds have been spent in Russia and the former Soviet Union (FSU). However, programs are slowly trending toward more global targets. In 2004, NNSA created the Global Threat Reduction Initiative (GTRI) and the International Nuclear Materials Protection and Control (INMPC) program that work with other countries outside the FSU to assist with material

security. However, a 2009 National Academy of Sciences report suggested that the overall effort needs to be updated from "CTR 1.0" to "CTR 2.0,"[21] and the programs must evolve to be more agile, flexible, and globally responsive while retaining their cooperative, results-focused core.

By concentrating on joint problem solving and cooperative approaches to mitigating dangers, CTR has achieved nuclear material security improvements that would not have been possible otherwise, validating the importance of ad hoc approaches.

G-8 Global Partnership

The G-8 Global Partnership against the Spread of Weapons and Materials of Mass Destruction (Global Partnership) was established in 2002 as a multilateral corollary to the CTR effort. G-8 countries pledged $20 billion over ten years to support this work.[22] Under this agreement the United States would provide $10 billion with the rest of the G-8 countries contributing the remaining $10 billion. In practice, however, the US' annual contribution to the Global Partnership is now approximately $1.5 billion, $500 million more than originally expected. Approximately $1 billion per year is spent in Russia and the former Soviet states with the rest directed to other regions of the world.[23] While beginning as a G-8 initiative, the Global Partnership has grown to include 23 partners: Australia, Belgium, Canada, Czech Republic, Denmark, European Union, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Republic of Korea, Russia, Sweden, Switzerland, Ukraine (recipient only), United Kingdom, and United States.[24] Most of the non-US funding supports nuclear safety work, submarine dismantlement, and chemical weapon destruction.

In 2008, the Global Partnership's geographical focus was expanded beyond Russia to allow the multilateral effort to operate anywhere in the world where terrorism and proliferation risks existed.[25] But the G-8 nations have had difficulty managing the transition away from a focus on Russia, and the majority of the funds are still spent there. The Global Partnership was set to expire in 2012, but at the 2010 NSS, President Obama called for a 10-year extension, an expansion of its scope and mission, and another $10 billion in funding for new projects.[26] However, just weeks after the Washington Summit, in July, the G-8 decided not to take action on the extension of the Global Partnership and instead to evaluate the program before deciding how to proceed.[27] The next year, at the May 2011 G-8 Summit, leaders extended the Global Partnership, but did not include any new funding targets.[28] They did elect to enlarge its scope of activities and expressed their objective of expanding the number of participants.

Global Initiative to Combat Nuclear Terrorism

In October 2006, Russia and the US created GICNT, a non-binding forum for sharing nonproliferation expertise and information as well as for preventing nuclear terrorism. In the four years since its creation, GICNT has grown from 13 to 82 member nations.[29] There are also four official observers: the IAEA, European Union, INTERPOL, and the United Nations Office on Drugs and Crime. In 2009, members agreed to strengthen the group by promoting greater civil society and private sector involvement. GICNT has conducted over 30 multilateral activities and five senior-level meetings in support of the initiatives objectives.[30] In President Obama's April 2009 speech in Prague, he called for GICNT to be transformed into a formal institution, though it has yet to move in that direction. However, at the 2010 and 2011 Plenary sessions, GICNT took steps to strengthen its activities by adopting three priority function areas that will be led by member states: nuclear detection (Netherlands), nuclear forensics (Australia), and response and mitigation (Morocco).[31] These issues have more to do with reaction to a nuclear terrorist event rather than the prevention of it.

Proliferation Security Initiative

The Proliferation Security Initiative (PSI) is a US-led multilateral initiative that was launched in May 2003 to interdict WMD and related materials in transit. PSI has grown from 11 participating states to 99 (as of September 2010).[32] Participating nations endorse the PSI Statement of Interdiction Principles and participate in meetings, workshops, and other exercises to improve their capacities for breaking up black markets as well as for detecting and intercepting materials. PSI members rely on existing national and international legal authorities to impede WMD trafficking. In President Obama's April 2009 speech in Prague, he called for PSI to be transformed into a formal institution, though no steps have yet been taken to do so.

World Institute for Nuclear Security

The Vienna-based World Institute for Nuclear Security (WINS)[33] was launched in 2008 to provide an international forum for promoting the implementation of best practices by all those accountable for nuclear security, but with a particular focus on the nuclear industry. WINS publishes best practices guides (e.g., Nuclear Security Culture, Security Equipment Maintenance, and Security Governance) in multiple languages that are informed by the expertise of its members. It also regularly brings together experts from industry, government, and international organizations at workshops with the objective of helping to strengthen the security of nuclear and radioactive materials and facilities around the world.

CHALLENGES TO CURRENT REGIME EFFECTIVENESS

The list of the current elements of the nuclear material security regime is long, and in many ways impressive. The problem is that it is not comprehensive, cohesive, and current given the evolution of nuclear threats and challenges in the 21st century. That threat has gone through many evolutions from the superpower arms race, to rogue regimes, to loose nukes, to nuclear terrorism. Today, the threat is all of those issues as well as the expansion of fissile material stockpiles and nuclear reactors in volatile regions. While the response to most of the traditional threats has been fairly robust, such as the nonproliferation regime, arms control treaties, and nuclear suppliers guidelines, it is least developed on the loose nukes-nuclear material security issue. This problem exists in large part because of the voluntary, sovereign, and non-transparent nature of the regime.

The Threat

The 2010 US Nuclear Posture Review and National Security Strategy identified nuclear terrorism as the greatest and most urgent threat facing the United States.[34] One reason is that Osama bin Laden had stated that he considers it to be a religious duty to obtain nuclear weapons, and there is some evidence that al-Qaeda has pursued such a capability.[35] However, not all countries accept the priority of the danger posed by nuclear terrorism. Some consider it to be an obsession of developed nations and a problem primarily for the nuclear weapons states. But this is an incorrect reading of the danger. The larger amounts of nuclear material in weapons states may increase security vulnerabilities, but they also have the most developed security systems and guard forces. It is important to recognize that even small amounts of material in any country, if not adequately protected, are a danger. Some developing countries also see the

intensified international political focus on nuclear material security and the NSS process as a potential means of impeding their access to nuclear technology for peaceful purposes and as a result remain skeptical.

The major concern about nuclear terrorism is the potential access of terrorists to fissile and high intensity radiological material. There is a very large stockpile of fissile material around the globe—rough estimates put it at 1,440 tons of HEU and 495 tons of plutonium.[36] About half the world's fissile material is in military stockpiles and the rest in civilian stockpiles. But the exact amount of this material is not known with any precision and the error on the estimates is +/- 125 tons for HEU and +/- 10 tons for plutonium.[37]

There is particular concern about HEU because it is used in a number of applications outside of military programs, and a crude HEU gun-type device is considered to be the most accessible nuclear terrorist weapon.[38] It is estimated that 50-60 kilograms of HEU would be needed to make a crude gun-type nuclear device.[39] But, such a device would likely be large and heavy and terrorists would need some basic infrastructure support, such as a machining capability, to create it.

A plutonium device is much harder to develop without a more sophisticated technical infrastructure and experts, and terrorists likely would need more assistance in building this type of a weapon.

The largest fissile material stockpiles are in the United States and Russia.[40] But much also exists in Britain, France, China, and Japan. And the security for nuclear materials around the globe is uneven, particularly in the civilian sector. This security vulnerability becomes even more acute when the material and security problems are in dangerous neighborhoods of the world, where nations possessing the material do not have strong governance. For example, 10 tons of HEU is used in civilian applications in non-nuclear weapon states with the largest stockpiles in Belarus, Ukraine, and South Africa.[41]

Nuclear smuggling is one window into the threat and it is a reality. According to the IAEA, there have been 1,600 cases of illicit nuclear trafficking since 1993.[42] There have been 18 cases of the theft or loss of HEU or plutonium.[43] None of the HEU that was recovered was reported missing from the facility from which it disappeared.[44] There have also been at least three cases of holding radiological sources for ransom.[45]

In addition, two teams of armed men attacked a South African site that contained hundreds of kilograms of HEU.[46] Terrorists have been seen on reconnaissance missions near a Russian nuclear weapon storage site.[47] In January 2010, peace activists penetrated a Belgian air base where US nuclear weapons are believed to be stored.[48]And, in December 2011, Greenpeace activists infiltrated two separate French nuclear power plants on the same day.[49]

Radiological terrorism is a related threat and is considered to be a higher probability event than a nuclear attack.[50] But, the issue of high intensity radiological source security is inadequately prioritized in the nuclear material security regime. A radiological device can be created by wrapping an explosive around a radiological source and detonating it, though there are a variety of other methods that can be used. Radiological devices do not result in nuclear explosions, but do spread toxic radioactive materials. A radiological attack is much less sophisticated and would cause much less physical damage than a nuclear attack, but its impact on the global economy would be significant depending on the location.[51] There is a serious problem with the security of radiological sources around the world. The IAEA estimates that there are 100,000 to 1 million radiological sources around the globe, but no country has a completely accurate accounting.[52]

Nuclear Expansion

Compounding the danger posed by the existing stockpiles of fissile materials is the anticipated growth of nuclear facilities and power around the globe—but in particular in historically unstable regions. This expansion cannot be ignored and needs to be addressed in a clear and creative way. The growth of nuclear power is a global reality and the regime for protecting these materials and facilities needs to evolve with this reality. The accident at Fukushima, in addition to highlighting the global impact of an accident at a nuclear power plant, has distorted the once clear line between nuclear safety and nuclear security. Although the accident was caused by nature, the radiation release and the way in which the reactors were affected were indistinguishable from an act of terrorism.

Nuclear Power Growth

Today, there are 433 nuclear reactors in operation around the world and the IAEA projects that an additional 90 will come online by 2030.[53] The Fukushima accident is expected to potentially slow nuclear power growth, but not stop it. [54] One area of significant growth is expected to be in countries that already have operating nuclear plants, particularly in the Far East.[55] The IAEA's low projection estimates nuclear power capacity to grow from 81 GWe in 2010 to 180 GWe by 2030 in this region, with its high growth model predicting upwards of 255 GWe.

In January 2012, China was generating 1.8 percent of its electricity from 15 nuclear reactors.[56] An additional 26 reactors are currently under construction out of a total of 51 that are planned. Japan typically generates 29.2 percent of its electricity from more than 50 nuclear reactors.[57] Two of 10 planned reactors have been under construction, but Japan's nuclear future is being reconsidered in the aftermath of the Fukushima accident in March 2010. Currently, only two of its reactors are in service.[58] In the Republic of Korea (ROK), 32.2 percent of its electricity is generated by 21 reactors.[59] At the start of 2012, five of six planned reactors were under construction.

The ROK wants to become one of the world's top three nuclear reactor exporters by 2030 through securing $400 billion worth of nuclear energy-related contracts and exporting 80 reactors. In 2009, 67 percent of South Korea's plant building deals were in the Middle East.[60]

The Middle East is a region with very little nuclear infrastructure but potentially significant future growth in nuclear power. At least half a dozen nations are contemplating nuclear reactor construction with several already moving forward. The United Arab Emirates (UAE) has completed a civilian nuclear cooperation agreement with the United States, and the US is in the process of negotiating similar agreements with Jordan and Saudi Arabia. In December 2009, South Korea secured a contract to supply the UAE with four light water reactors (LWR) by 2030. South Korea also won a contract to supply Jordan with its first 5 MW nuclear research reactor in December 2009.[61] Jordan has signed Memorandums of Understanding (MOU) with more than 10 countries in preparation for purchasing its first nuclear power reactor that it wants to be operational by 2020. Iran's Bushehr (915 MWe) reactor became operational in May 2011, was connected to the grid in September 2011, and began commercial operation in January 2012.[62] Turkey is also interested in building nuclear power reactors, and the ROK has offered to build them.[63] An MOU was signed by Turkey and the ROK in June 2010. In May 2008, a civil nuclear cooperation agreement between the US and Turkey entered force.

The expansion of nuclear infrastructure and materials in historically volatile regions like the Middle East in an age of radical terrorism heightens the need to construct higher and more robust protective

barriers. This will require governments to think more creatively about the evolution of the governance structures for nuclear safety and security. But, it also requires the nuclear energy industry to accept more responsibility for the protection of its products. In this regard, a significant portion of the nuclear energy industry has taken an important voluntary step in accepting the Nuclear Power Plant Exporters' Principles of Conduct. This is a common set of guidelines that major nuclear exporters have agreed to apply when considering sales of reactors and other technologies. The principles create common standards of practice including committing suppliers to ensure that purchasers of nuclear technologies have adequate security procedures in place.[64]

Fissile Material Production

While the protection of nuclear infrastructure is an important objective, the most obvious path to the creation of a terrorist improvised nuclear device (IND) is through the acquisition of fissile material. Most of the NSS process has focused on preventing this scenario by encouraging improved protection of these materials, the consolidation and down-blending of excess materials, and the conversion of civil reactors that use HEU to non-weapons-grade fuel. Also, while virtually all the declared weapons states have ended their production of fissile materials for weapons, HEU and plutonium production for both civil and military purposes continues in some key countries and some volatile regions, particularly South Asia.

Pakistan and India are the only states still known to be producing HEU. India's HEU stockpile is estimated to be 2 tons (+/- 0.8 tons). It is intended for the country's submarine propulsion program and thought only to be enriched to 30-45 percent. India's enrichment capacity has been rapidly expanding in recent years, including new generations of centrifuges and (possible) expansion of its current enrichment site. India's second enrichment complex, the Special Materials Enrichment Facility, is being planned and will not be safeguarded to keep "options open for using it for multiple roles."[65]

Pakistan's HEU stockpile is estimated to be 2.75 tons (+/- 1 ton). It is intended for the country's nuclear weapons program and enriched to 90 percent. Uncertainty surrounds Pakistan's enrichment capacity, including the operating history at Kahuta and the possible existence of centrifuges at Gadwal.[66]

India, Pakistan, and possibly Israel, also are the only countries that continue to produce plutonium for weapons. India's stockpile of plutonium is estimated to be 0.52 tons (+/- 0.17 tons). Weapons plutonium was originally produced in India's CIRUS (40 MWt) and Dhruva (100 MWt) reactors in Mumbai, but CIRUS was shut down in December 2010. A new "multipurpose high flux reactor" similar to the Dhruva reactor is being planned for operation in 2017-2018 to replace CIRUS.[67]

Pakistan's plutonium stockpile is estimated to be 135 kg (+/- 45 kg) and its plutonium production capacity is expanding. Khushab-I (40-50 MWt) has been operating since 1998; a Khushab-II began operation around the end of 2009/beginning of 2010; and a third reactor site is nearly complete. Satellite images indicate a fourth plutonium production reactor is also being built. All reactors are estimated to be of similar size.[68]

Certainly the challenges of adequately protecting today's global fissile material stockpile are going to be further compounded by the continued production of these materials in India and Pakistan, and perhaps in other nations, including Iran and North Korea. This raises questions about the adequacy of the current regime and whether it is sufficiently adaptable to these evolving circumstances as well as adequately effective in the face of new challenges.

Inadequate Cohesion and Transparency

The nuclear material security regime lacks cohesion and focus because many of its elements were developed in response to crises or opportunity, not as part of a rational regime development process. For example, a number of the ad hoc programs were originally designed to deal with Russia and the former Soviet states, but are now being adapted for more global missions. The UNSCRs and new IAEA initiatives were a reaction to the terrorist attacks on 9/11. However, in the current global political and economic environment, there is not much appetite for dramatically remaking the current regime and creating new institutions. But, the elements of the regime should be carefully analyzed and rationalized so that overlaps, duplications, and inefficiencies can be eliminated. Then the gaps can be filled.

The most significant challenge to improving nuclear material security worldwide is that the security of nuclear materials is not uniform across borders. Moreover, security systems are not transparent, creating real and perceived vulnerabilities about the security of nuclear materials in each nation.[69] This does not mean that every nation has to do exactly the same thing. Each state has its own internal and cultural considerations, and this will inevitably lead to differences in implementation. But, the voluntary and sovereign nature of the regime means that there is no forcing mechanism to move all nations toward a common set of objectives and practices. Lack of transparency means that the security situation in suspected weak link countries can only be improved if that nation decides it wants assistance with its security. But, this is an inadequate approach when the cross-border implications of a nuclear material theft or use of an RDD or IND are significant and not adequately accounted for in the current regime.

In general, the security of military-related fissile materials will always remain highly sensitive and little transparency should be expected soon. But, gradual transparency and trust building is possible with political will. The United States, Russia, and former Soviet states have proven for over 15 years that fissile material security can be a subject of discussion among former adversaries if there is sufficient will and adequate protections for confidentiality. Significant improvements in nuclear security in these countries have been made as a result of this collaboration.

The international community needs to define for the future a cohesive security architecture based on the concept of confirmed performance and to generate international expert and political support for it in order to persuade governments (some will be quite reluctant) to accept a new global order for nuclear material security.

ACTION PLAN FOR EVOLVING NUCLEAR SECURITY GOVERNANCE

Moving the nuclear materials security regime beyond its current envelope will not be an easy task, and is likely to engender opposition and obstruction from a number of countries and experts. But, the current system is too fragmented, too ineffective, and not well suited for future challenges.

The NSS process, which is a short term effort to coalesce key nations around the priority of protecting nuclear materials, has focused on generating greater global adherence and implementation of key international conventions and legal instruments. These include the CPPNM and its amendment and the UNSCRs. This is an important objective and contributes to the creation of a stronger foundation for regime improvements, but these agreements represent the status quo, not the innovation in governance that is required.

The NSS process has also helped to generate growth in the supporting infrastructure for nuclear security through the creation of new centers of excellence.[70] At the Washington Summit, Japan, China, India, and South Korea pledged to create these centers. The European Union (EU) has also launched a Chemical, Biological, Radiological, and Nuclear (CBRN) Center of Excellence Initiative to help countries and regions maintain the institutional capacity needed to fight these threats.[71] It aims to establish centers of excellence in five regions of concern: South Caucasus/Ukraine/South East Europe, North Africa, West Africa, the Middle East, and South East Asia.[72] Japan opened its center of excellence in December 2010, India launched its center with a regional training course in November 2011, and the EU established a Secretariat for the Middle East center in Amman, Jordan in December 2011. China has signed an MOU to cooperate with the US and is constructing a new facility. The South Korean center is scheduled to open in 2013. This infrastructure development will make use of the capabilities of the IAEA, which is attempting to coordinate among them, and that of WINS as well as individual nations.

The role of these centers is envisioned to be as repositories and disseminators of nuclear material security best practices. But they also can become advocates for improvements in the governance structure and actually work on some of the key questions that need to be addressed, including how to facilitate transparency to generate international confidence without revealing sensitive information, to better secure high intensity radiological sources, and to improve the independence of regulatory authorities. Moreover, there are lessons that can be learned about securing sensitive materials and at highly classified facilities while ensuring confidentiality from the original center—the Russian Methodological and Training Center (RMTC) located in Obninsk, Russia, which was formed as a joint project with the United States.

While the NSS process has taken the important step of establishing global fissile material security as a top-level international objective, this mission will require actions beyond the current mechanisms and international consensus. The question remains what will happen to the momentum for improvement of the global regime if this process were to end after the next meeting in 2014. There needs to be a more permanent, cohesive and comprehensive international instrument that will harmonize and supplement the existing regime. The objective should be to create a more robust, effective, and flexible 21st century nuclear material security architecture to effectively protect fissile and radiological materials.

A Framework Agreement

A Nuclear Material Security Framework Agreement is one approach that could address this challenge. It would identify threats from vulnerable nuclear materials, especially those posed by terrorists, and list the actions required to mitigate them. A framework agreement would allow the subject to be acknowledged at a very high political level as a global priority and then require the adherents to take specific steps to achieve its objectives either in the text or through subsequent protocols.[73]

The framework could include a number of items and usefully package them so that its norms are unified, clear, and cohesive. For example, it could:

- Include a comprehensive and convincing assessment of the nuclear terrorist threat, including the global economic consequences of a nuclear or radiological terrorist event. It must be clear that security systems have to evolve to meet the changing threats.
- Recognize all the relevant existing conventions, agreements, and UNSCRs, and state that universal acceptance of these agreements and their rigorous implementation are fundamental for

effective and sustainable nuclear security.[74]

- Recognize the importance of the IAEA in the area of nuclear and radiological security, and request greater international political and financial support for its activities.
- Clearly establish the legitimacy of ad hoc mechanisms such as the CTR program, the G-8 Global Partnership, and the GICNT while proposing that these initiatives be streamlined and folded together, where appropriate, to increase efficiency. It could encourage all nations that can contribute to the objective of these efforts, or benefit from them, to become participants.
- Make clear the need for continued, robust, multilateral funding over the long term for those nations and institutions in need of assistance to improve nuclear material security, including through the IAEA, and to fulfill international obligations, such as UNSCR 1540.
- Recognize that the production and use of HEU for civil purposes should be limited and eventually eliminated, that excess fissile materials should be permanently disposed of, and that storage of all nuclear materials should be consolidated to the degree possible, consistent with safety requirements.
- In the near term, encourage implementation of the highest possible security standards through an intensive process of global best-practices and security culture engagement utilizing contributions from individual nations, the IAEA, WINS, and the centers of excellence, while underscoring the need for a better balance between voluntary and mandatory security commitments, standards, and practices. It could identify the eventual need for a baseline standard for nuclear and radiological material security to supplement the current voluntary requirements and guidelines. It also could underscore the need for some form of measurable and transparent implementation of security measures without compromising sensitive information.
- Encourage public-private partnerships in support of nuclear security and recognize the important role that the nuclear industry and civil society play in this area.
- Allow for the negotiation of supplementary protocols that require more detailed actions. The protocols could specify actions to be taken by individual nations, identify standards for security through the creation of a scientific council, detail means of sharing information for peer review on a confidential basis, identify dates for completion of specific security actions and improvements, and establish enhanced authority for the IAEA.[75] It also should include an amendment process and a regularized review conference.
- Include an annex with individual national commitments that will be undertaken to improve nuclear material security, similar to the "house gifts" provided at the Washington Summit, but with the ability to continually supplement the list, rather than waiting every two years.

This agreement should eventually be universal, but its development could begin with support from a coalition of committed nations. However, its legitimacy would be strengthened if it had political support in the developing as well as in the developed world.

General Principles for the 21st Century

The policy objectives of the framework agreement should also be supplemented with clear principles that frame the development of the new agreement and its architecture. These principles could include recognition that:[76]

- Nuclear power and technology are vital energy and human resources and the benefits of nuclear power, medicine, and other peaceful uses of atomic energy must be protected.
- Nuclear safety and security should be continuously reviewed and improved on a national and international basis.
- All necessary steps to prevent nuclear terrorism using fissile materials and high intensity radiological sources should be taken by all nations possessing them.
- All necessary steps should be taken to prevent the unauthorized, non-remedial release of radiation from nuclear reactors and other nuclear facilities by all nations possessing them.
- The stakeholder communities—governments, regulators, industry, international organizations, and civil society—should be treated equally in ensuring the safety and security of nuclear facilities and materials.
- Nuclear safety and security are interrelated endeavors and all elements of these regimes should be reviewed and improved on a regular basis on both the national and international levels.
- Any improvement in the nuclear material security regime will have to balance the principles of sovereignty with international responsibilities and obligations.
- The governance system should embrace a culture of confirmed performance.

Framework Agreement Precedents

Framework agreements addressing transnational challenges, like nuclear material security, have precedent, particularly in the environmental area. Legally, framework agreements are designed to unify a "special regime" that consists of elements that are binding but fragmentary. They also give international obligations a rooting in international law.[77] Models for the framework agreement on nuclear material security include the Vienna Convention and Montreal Protocol, the UN Framework Convention on Climate Change (UNFCCC), and the Convention on Nuclear Safety (CNS).

Vienna Convention and Montreal Protocol[78]

In 1977, due to a growing consensus in the scientific community on the harm chlorofluorocarbon gases (CFCs) were causing to the ozone layer, the United Nations Environment Program (UNEP) concluded the *World Plan of Action on the Ozone Layer*. This plan called for international research and monitoring of the ozone layer.

In 1981, UNEP's Governing Council authorized the body to draft a global framework convention on stratospheric ozone protection. In March 1985, UNEP opened the resulting Vienna Convention for signature. This is a framework agreement under which states agree to cooperate on research and scientific assessments, exchange information, and adopt "appropriate measures" to prevent activities that harm the ozone layer. All obligations are general and contain no specific actions or limits on chemicals. It did not include any implementing protocols. In addition, the convention was not universal. It was initially ratified by a smaller number of nations than have signed it today.

This approach broke with previous practice. Earlier UNEP regional seas agreements had established the precedent of negotiating a framework convention together with at least one protocol that contained binding obligations. States were required to ratify at least one binding protocol when they joined a

framework convention. While negotiators of the Vienna Convention discussed adding a protocol that would give specific targets for certain chemicals, they could not reach consensus and so the framework convention was negotiated without binding protocols.

A UNEP working group began working on a binding protocol to the Vienna Convention in December 1986. Their work resulted in the Montreal Protocol, which was concluded in September 1987 and went into effect on January 1, 1989. Like the Vienna Convention, the Montreal Protocol was not accepted initially by all nations and its membership grew over time.

Ozone agreements were the first to address a long term transnational problem in which the damage caused in the short term might not be evident for decades. This approach requires flexibility and adaptable agreements capable of accommodating new realities over time. Indeed, special provisions were included in the Montreal Protocol for this purpose.

For example, Technology and Economic Assessment Panels were created to provide regularized expert assessments. An adjustment process was developed to create targets and timetables for phasing out chemicals listed in the protocol. And, an amendment process allowed new chemicals to be added to the list of controlled substances. The parties to the convention must ratify any new amendment to be bound by it. New countries that join the Protocol are bound by all amendments made to it as of that date, but they must individually ratify any future amendments. There have been four amendments to the Protocol: London (1990), Copenhagen (1992), Montreal (1997), and Beijing (1999).

An Implementation Committee also was created to facilitate compliance with the protocol. It reviews annual reports submitted by countries and has a suite of measures to help address issues of noncompliance and implementation assistance. This precedent has been used in a number of subsequent environmental agreements, including: the Kyoto Protocol to the UNFCCC; the UN Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution and its Protocols; and the UNECE Aarhus Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters.

Framework Convention on Climate Change

The Vienna Convention and Montreal Protocol formula also has been applied to the UNFCCC agreement that was followed by the Kyoto Protocol and the Convention on Biological Diversity with its Cartagena Protocol on Biosafety. The Montreal Protocol's formula of targets and timetables has been subsequently employed in international agreements controlling air pollution and the Kyoto Protocol.

The UNFCCC also includes a high-level international scientific advisory panel, the Body for Scientific and Technological Advice, which could serve as a model for a similar group supporting the nuclear material security framework.[79] The mandate of this body is to provide advice on scientific and technical issues that are relevant to the substance of the convention. While the climate change convention limits participants on the panel to governmental representatives, the nuclear material security version could include nongovernmental and private sector experts who could provide alternative perspectives.

There are several interesting aspects of the mandate of the climate change scientific panel that could be relevant in the nuclear framework. For example, it allows the panel of scientific experts to assess the effectiveness of measures taken to implement the convention and respond to technical questions that parties may put to it. While that may not be an unusual charge, it also requires experts to identify innovative and state of the art technologies that can be utilized as well as ways of promoting and

transferring them to other nations. In addition, it provides a mandate for promoting international research and development cooperation and supporting capacity building in developing countries.[80]

All of these activities conducted by the climate change scientific panel could be directly relevant to the nuclear material security area and it is a mandate that fits very well with the proposed best practices and centers of excellence concepts. It also could perform the assessments of the more technologically adventurous ideas such as the baseline standard and the means of protecting, while sharing, sensitive information.

No other elements of the existing security regime require this type of expert body or international scientific scrutiny. In fact, there are multiple sources of technical expertise that are provided by governments, national laboratories, the IAEA, and nongovernmental and private sector experts. But, a scientific advisory body would not need to be imbued with overriding authority. It could be used to harness the technical talent that already exists around the globe.

Nuclear Safety Convention[81]

The nuclear safety regime has significantly improved over time in response to the accidents at Three Mile Island and Chernobyl. The challenge for the nuclear security regime is to prevent an event and not act forcefully only after a terrorist attack has occurred. There are four major elements embodied in the Convention on Nuclear Safety that have been critical to the improvement of nuclear safety over time—regularized assessments, information sharing, peer review, and reviews of the implementation of relevant international conventions.

Neither of the nuclear security regime's key international conventions—the CPPNM and its amendment, nor ICSANT—includes provisions for assessment, information sharing, or peer review. A single CPPNM review conference was held in October 1992, five years after it entered into force as required by Article 16, during which unanimous support for the CPPNM was expressed by the 35 states in attendance. CPPNM parties came together again in the late 1990s and early 2000s to strengthen and expand the scope of the convention by amending it to better address threats of nuclear terrorism, smuggling, and sabotage. Amendments were adopted in 2005, but will not come into effect until two-thirds of the state parties ratify the changes. The ICSANT has a provision for an amendment conference but not a review conference.

Because the nuclear safety regime is so familiar to many in the nuclear business, and because it is considered to be more developed and robust than the nuclear materials security regime, it could offer a useful platform from which to begin the evolution of nuclear security governance.

ACTION PLAN (2012-2020)

The 2012 Seoul Nuclear Security Summit offers a very useful pivot point for a future focus on the evolution and improvement of the nuclear materials security regime for several reasons. First, there is broad understanding, as a result of Fukushima, about the transnational implications of an unauthorized release of radiation and the inability of the international system to adequately address these implications. Second, the Seoul Summit needs to build on the foundation created by the Washington Summit, offer something more creative than just the pursuit of the universality of adherence to the existing conventions, and create momentum for policy evolution leading up to the summit in the Netherlands—which could

be the last one. At the very least, the inclusion of several new issues on the Seoul agenda, including radiological security and the interface between nuclear safety and security, open up new avenues for initiatives and creative policy development. Third, the experts' symposium that will be held in Seoul before the summit has as its theme, "Innovating Nuclear Security Governance," that can be carried forward to the next summit, and even beyond. It is a theme that the South Koreans can own and nurture because no other nation has claimed the issue.

The approach to building a modernized governance regime should be careful and deliberate so as not to raise suspicions about hidden agendas or ulterior motives. It should also include a nongovernmental track that can supplement governmental action, or more likely precede it by identifying paths forward and strategies that governments can then consider.

The two-track approach can include formal negotiations on binding requirements (a long term effort) and an expert-academic process to identify binding and voluntary measures beyond current requirements.

The expert process should be led by an independent group of professional and knowledgeable individuals from a cross section of countries. They should be committed to the evolution of nuclear governance, have the professional experience that allows their opinion to carry weight in the global community, and be creative in their thinking.

The formal negotiation approach does not need to be universal but can utilize the Vienna Convention and even the NSS precedent of selective multilateralism. For example it could begin with discussions among CPPNM members.[82]

The process should be broken down into two phases that culminate in 2020. The first phase should be interim goals for 2012 through 2016. And the second phase should be from 2017 through 2020.

In the first phase, the official process should:

- Continue the NSS process with meetings every 2 or 3 years.
- Seek near universal ascension and implementation of the key international conventions (CPPNM and amendment and ICSANT).
- Seek agreement by a selective and committed group of nations that improvement in nuclear security governance and relevant regimes is necessary, including: 1) the creation of a working group to develop and review new proposals; and 2) the initiation of a review of the overlap among existing nuclear material security regime elements and recommendations for the best path forward for streamlining them.
- Initiate limited steps toward the implementation of key elements of the safety regime in the nuclear security area. For example, this might entail encouraging interaction among regulators from different nations; facilitating discussion among nuclear operators on security issues while protecting sensitive information; and increasing cooperation and information sharing between key stakeholder groups, such as through some regularized meeting process.
- Take steps to ensure that the new centers of excellence are developed and effective with minimal duplication.
- Assist with the strengthening of WINS and related industry-focused organizations.

During this phase, the expert process should:

- Create an independent Global Nuclear Governance Experts Group that can assess the current state of nuclear security governance and make recommendations for changes and improvements. The group should be geographically diverse and cross disciplinary as well as selected for its commitment to creative solutions to the current challenges. The development of these recommendations is completely consistent with statements that have been made by the UN Secretary General, the IAEA, and the NSS.
- Continue outreach to governments, international organizations, and industry to find consensus on the mix of binding and voluntary measures for nuclear security that builds upon the current system.
- Develop the draft text of a new Framework Agreement for Nuclear Security based on either or both, a UNSCR 1887-like resolution that could include a check list of the actions a nation must take in order to be considered a good global nuclear material security citizen and/or global goals similar to those outlined in the Vienna Convention and UN Framework Convention on Climate Change.
- Submit the draft framework agreement to the NSS nations for review and response.
- Begin to work on implementation protocols to the framework convention.

In the longer term through 2020, the objectives should be to establish a new nuclear governance performance-based architecture that:

- Confirms the importance of national responsibility and recognizes the need for protection of people and the environment outside of national borders in the event of a crisis, accident, or terrorist event.
- Calls for regularized information sharing and international peer reviews of security practices and performance, with confidentiality provisions.
- Better integrates operators, regulators, governments, international organizations, and civil society as well as identifies their responsibilities.
- Mandates international nuclear security standards that reflect a minimum performance criteria that is comprehensive, effective, succinct, and clear.
- Establishes effective response and communication methods in the event of a crisis, accident, or terrorist event.
- Establishes long term technical, bureaucratic, and financial support for the new system.
- Results in the approval of the new Framework Agreement for Nuclear Security.
- Provides the IAEA with the responsibility for helping all nations meet the new governance requirements.

CONCLUSION

The NSS process has created a new and unique channel for the improvement of nuclear material security and the prevention of nuclear terrorism. It has created a very important, high level political process

that did not exist before. It offers the opportunity for making progress on a scale that otherwise would not exist and would have had to be done country-by-country. But, the consensus-based approach of the process is not well suited to the development of dynamic new policies, the policy objectives are not binding on any nation, and the national commitments are completely voluntary.

As a result, additional steps beyond what the NSS likely can deliver, and in support of the continued improvement in the security regime if the summits are ended, are required to build a stronger security regime for this new century. The Washington Summit was an important watershed event; it both highlighted the importance of universalizing the current regime commitments, improving the infrastructure around the regime, and generating national commitments to take action. The decision to extend the summit process to South Korea and now the Netherlands creates the opportunity to significantly build on this foundation by pivoting and beginning to focus on more forward-looking policy options that reflect new and changing threats and requirements.

The upcoming summit and its corollary events, including the expert symposium that will focus on innovating nuclear security governance, provide a window of opportunity to begin to reframe the nuclear material security debate and develop new strategies and policies.

Most important among these objectives should be the development of a Nuclear Material Security Framework Convention and subsequent actionable protocols. The precedents of the Vienna Convention and the Montreal Protocol and the UNFCCC and its protocols have made clear that this approach is neither radical nor uncommon. The nuclear material security regime is at present fragmented and incomplete. A framework convention can unify it and fill the policy voids. It can begin by taking advantage of the elements that exist in the nuclear safety regime—including regular assessments, information exchange while protecting confidentiality, transparency to generate international confidence, and limited peer review—since most specialists are familiar with this regime and because it has been operational and effective for many years.

In addition, the stakeholder community engaged in the details of nuclear materials security—governments, international organizations, facility owners and operators, regulators, and international experts—needs to work more closely together to improve the governance structure. This process can move along dual tracks and the objective should be to deliver concrete progress at the 2014 NSS.

South Korea is an important choice for the second summit because of its unique position in the nuclear spectrum. It is a significant domestic consumer of nuclear energy, a rising exporter of nuclear technology (especially in the volatile Middle East), and a non-nuclear weapons state with a nuclear armed neighbor on its border. These circumstances provide the ROK with both the opportunity and the imperative to seize international leadership in improving the security of nuclear and radiological materials. It should use the Seoul Summit as the opportunity to launch an initiative to build a regime for nuclear security governance that meets the realities of the 21st century.

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- *Well-developed plans but commitment pending*: Thailand, Indonesia, Egypt, Kazakhstan, Poland, Lithuania, Chile; or commitment stalled: Italy.
- *Developing plans*: Saudi Arabia, Israel, Nigeria, Malaysia, Morocco, Kuwait.
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