CHAPTER 9

HOW WELL WILL THE INTERNATIONAL ATOMIC ENERGY AGENCY BE ABLE TO SAFEGUARD MORE NUCLEAR MATERIALS IN MORE STATES?

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The International Atomic Energy Agency (IAEA) will confront new proliferation risks if its safeguards system must operate in a world with more nuclear facilities in more and riskier places. The usual suggestions for upgrading IAEA safeguards focus on increasing the agency's resources and improving technology. Yet improved technology and more resources for inspections will not help unless the agency can develop standards to gauge the strength of the safeguards system, and unless countries confront the problem of what to do after the IAEA detects a violation.

Nuclear power will likely spread to new countries and new kinds of facilities in the coming years. Even a modest expansion of nuclear power will require more safeguards inspections, which at the very least raises budgeting problems for the agency. Even if money were no obstacle, however, it is not clear that the agency could simply scale up its operations to meet new demands. Scaling up is more complicated than making successful models from the past even larger. Consider one famous example, the RMS *Titanic*. The largest passenger steamship in the world was considered to be the pinnacle of engineering until it sank after striking an iceberg on its maiden voyage.

The IAEA may not be the *Titanic*, but the metaphor raises the question of how one would know

whether the agency is headed for a disaster. After all, the Titanic's engineers never expected their creation to become synonymous with hubris and disaster. To evaluate whether IAEA safeguards can function without a breakdown while monitoring and inspecting more kinds of nuclear facilities in more countries, the agency needs clear and transparent standards. The IAEA has used timeliness detection goals, which are based on calculations about whether the agency can detect the diversion of a significant quantity of nuclear material within the minimum time needed to make a bomb.[1] Timeliness detection goals have the advantage of being clear, but they involve calculations about hundreds of facilities that are very low risk, and the agency does not have the resources to meet these goals for all facilities. As a result, the IAEA is moving toward state-based declarations to evaluate safeguards risk and performance, but these standards are still being developed, and it will be a challenge to apply them to diverse countries in a fair and equitable way.

So far, there is scant evidence for the agency actually having prevented diversion in a timely manner. In the four most prominent cases in recent memory of illicit nuclear activity, the IAEA appeared to formally meet its timeliness detection goals while countries pursued illegal nuclear activities. The agency detected violations in only one of these cases, North Korea. The agency's safeguards division sees promising new tools in new technologies, training, and legal authority in the Additional Protocol (AP), but adopting these tools is sometimes slowed by goal conflict within the agency. The IAEA exists to provide technical assistance in developing nuclear power, prevent military diversions, and enhance safety, but it is not clear which of these should take priority.

Even if the agency is able to improve its detection capabilities through better technology, training, and standards, the safeguards system cannot be relied upon to react quickly enough to a diversion of nuclear materials toward a military program. Finally, there is no consensus on how to handle countries that may be in violation of IAEA and Non-Proliferation Treaty (NPT) agreements. To fulfill the goals of nonproliferation, the IAEA must be able to detect violators, and the world political community, along with the agency, must be able to enact a sufficient penalty for violation.

If the agency does not change what it and the United Nations (UN) Security Council will do after a violation is discovered, then the system of preventing the proliferation of illicit nuclear materials is at risk of collapse. Iran could withdrawal from the NPT without penalty, and other states, including Syria, could continue to deny the IAEA access to suspect locations. Meanwhile, the IAEA's credibility is at risk because it is expected to verify agreements in countries that it can at best only monitor but not truly safeguard.

INCREASING DEMAND FOR NUCLEAR POWER IN PROLIFERATION-RISKY REGIONS

Developing economies demand new energy sources, while North America and Europe are showing a greater resistance to the costs and potential consequences of nuclear power. Therefore, new nuclear reactors will likely be built in regions where the risks of proliferation are the highest.

While there is great uncertainty surrounding the price of energy in the future, it is clear that demand for energy will grow in the coming decades because of modernization and population growth. The Inter-

national Energy Agency, the chief international organization for monitoring energy demands, predicted growth in energy demand in each of its three scenarios from 2008 to 2035. Growth in demand is the only reliable prediction, however. The executive summary for the 2012 *World Energy Outlook* begins with the statement, "The energy world faces unprecedented uncertainty."[2]

Investors do not know the price of fuels in the future or the precise risk of delays in plant construction. Nuclear power requires a high initial investment in the facility and in supporting technical staff, but long-term operational costs are relatively low. (From the perspective of investors, however, it can be difficult to disaggregate initial investments from long-term ones.) New nuclear plant construction often faces unpredictable delays and cost overruns that would decrease returns on investment to equity investors.[3] Furthermore, there are limits to the world's capacity to increase nuclear plant production and technical nuclear training; for example Japan Steel Works is the sole maker of certain reactor parts.[4]

Despite the uncertainty, more than 45 countries are considering embarking upon nuclear power programs, according to a May 2012 report from the World Nuclear Association.[5] It is unlikely that all of these countries will develop nuclear power soon, but some of them likely will. After Fukushima, Japan, nuclear power is likely to hold steady or slightly recede in Europe and the United States, although nuclear power plant construction has been part of climate change and energy legislation discussions in the United States.[6] There are 443 nuclear plants in operation around the world, and 64 new plants are under construction. Demand, however, appears to be shifting from Europe and North

America to Asia and the Middle East, where many countries have expressed interest in building nuclear plants to meet their energy needs.[7] More than half of the reactors currently under construction are in Asia, one-fourth in Eastern Europe, and some in the Middle East. Many of these countries are investigating new kinds of nuclear plants that pose safeguards challenges. IAEA Director General Yukiya Amano expects "more than 20 new states, including many developing countries, [to] bring their first nuclear power plants online within 2 decades."[8]

Fast-paced growth in emerging economies, led by Brazil, China, India, and Indonesia, will drive the bulk of demand.[9] India remains committed to nuclear power even after the Fukushima disaster. "We are determined that our expanded nuclear power programme will follow the highest standards of nuclear safety and security," Indian Prime Minister Manmohan Singh said at a summit on nuclear security in 2012.[10]

Because investment in nuclear power provides such an unpredictable return on investment, it is likely that plants will be built in countries whose political leadership has decided that nuclear power is a strategic goal rather than an economic investment. In 2009, Citigroup concluded that:

> . . . it is extremely unlikely that private sector developers will be willing or able to take on the Construction, Power Price, and Operational risks of new nuclear stations. The returns would need to be underpinned by the government and the risks shared with the taxpayer / consumer. Minimum power prices (perhaps through capacity payments), support for financing, and government backed off-take agreements may all be needed to make new nuclear viable.[11]

The uncertainty in nuclear power investment and the high fixed costs make it more likely that certain kinds of countries will find it worthwhile to invest in nuclear power: large countries with ample resources; countries looking to develop power for political prestige; or countries that factor military uses into the cost of nuclear power investment. It is also more likely that countries that do not factor the high and uncertain cost of waste disposal into the investment calculation will pursue nuclear power more than those that do factor in disposal. All of these considerations make it more likely that countries attentive to military considerations and located in regions at risk of proliferation will invest in nuclear power, rather than countries in regions that are less at risk for proliferation, or countries that rely more on market pricing for energy.

WILL MORE INSPECTIONS BE NEEDED?

If there will be an expansion of nuclear power into new countries and new types of facilities, the IAEA will need to perform more inspections. In 2010, the IAEA carried out 1,750 inspections, 423 design information verifications, and 142 complementary accesses.[12] By 2030, the IAEA expects global nuclear electrical generating capacity to grow from between 40 and 120 percent. It also expects between 10 and 25 new countries to attain nuclear power.[13] Facilities in these countries, or expanded facilities in countries already with nuclear power, will require more inspections. This, at the very least, raises budgeting questions because IAEA member states are reluctant to approve budget increases. Former Deputy Director General of the IAEA and head of the Department of Safeguards Olli Heinonen concluded in 2010 that, "We must do

more with less without compromising the necessary safeguards assurances. Smarter and better verification techniques and technologies should be explored."[14]

In 2012, the IAEA had 1,125 facilities under safeguards, and with the expansion of nuclear activity into new states, it may have more. New facilities require more inspections than existing ones where the agency can rely more on accounting procedures for verification. New facilities will require more work because the agency must ensure that they are built according to standards, and it must work with states to develop a method for making initial and then annual declarations of nuclear material. The agency's budgetary growth is limited, however, by UN policies to maintain zero real growth in budgets.[15] An expansion of nuclear power around the world will provide a bigger nuclear haystack of sites to inspect but no more than the current number of inspections given budgetary constraints.

From 1987 to 2010, the amount of significant quantities under IAEA safeguards increased by five times, but the number of inspection days remained roughly constant.[16] A significant quantity is a standardized measure of nuclear material defined as "the approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded."[17] Inspection days refer to the number of days inspectors worked. Therefore, inspectors inspect more material than ever before using the same amount of human resources.

The IAEA's Safeguards Division, one of several such divisions, carries out a number of tasks meant to provide member states with a reasonable assurance that states are accounting for the nuclear material in their possession and that they are not diverting

material or facilities for illicit use. The agency's safeguards are based on assessments of the correctness and completeness of a state's declarations of nuclear material and nuclear-related activities. Verification measures include on-site inspections, visits, and ongoing monitoring and evaluation. Basically, two sets of measures are carried out in accordance with the type of safeguards agreements in force with a state. First, the agency verifies state-issued reports of declared nuclear materials. Nuclear accountants check the record books to monitor consistency, and inspectors perform "material accountancy" by physically installing and observing tamper-proof seals on storage vessels and cameras in sensitive areas. These inspections verify nondiversion, essentially keeping tabs on nuclear material that states use for nuclear power to make sure that none goes missing by being diverted for weapons uses. Second, as of 2012, 115 of 181 countries with IAEA safeguards agreements concluded an agreement with the IAEA known as the Additional Protocol (AP).[18] (Another 23 have signed the protocol but not brought it into effect). This is a legal agreement that permits the agency to perform more intensive supervision to not only verify nondiversion, but also to provide some evidence about the absence of undeclared nuclear material in a state.

Inspections come in several types. For new states and states making changes in their programs, the agency conducts **ad hoc inspections** to verify initial reports of nuclear material or report on changes to the report. Beyond that, the agency conducts **routine inspections** according to a predefined schedule and, occasionally, with very short notice. In either case, the agency technically enters with the permission of the state and, in some cases, there are delays as states at-

tempt to negotiate arrival and travel schedules with their hosts. The agency has the right to conduct routine inspections, but without the Additional Protocol or other agreements in place, it is limited to locations with a declared nuclear facility or declared sites that handle nuclear material. (There is a possibility that a state has nuclear material in undeclared or secret sites about which the agency could gather information but not perform on-site inspections). The agency has the authority to conduct **special inspections** if it believes that the information provided by the state is not adequate for the agency to fulfill its safeguards responsibilities, but this power has rarely been used. Member states are uncomfortable with the agency entering a state without the state's permission because such inspections would appear to infringe upon national sovereignty. In addition, the agency conducts **safeguards visits** to verify that the design, construction, and decommissioning of facilities are conducted according to standards and the information contained in countries' official reports.

ARE SAFEGUARDS INFINITELY EXPANDABLE?

The IAEA has developed a range of safeguards tools, from accounting procedures that date back to the agency's earliest days, to basic tools such as tamper-proof seals and cameras, to more advanced methods for environmental sampling to measure traces of nuclear materials. These tools may provide some efficiency in performing safeguards in new places, particularly environmental sampling, which can be conducted at a distance. Most likely, however, each of these tools and each type of inspection will have to be repeated in new countries and new facilities with the expansion of nuclear power.

This increase raises a question: Are IAEA safeguards infinitely expandable, or do they reach a breaking point at some level of capacity? It is not clear how one would know whether safeguards might reach a breaking point. Some systems are relatively easily scaled up. They can operate at higher levels of capacity, using a larger version of the same structure. Among computer programs, contemporary peer-to-peer fire sharing systems without a central node are easily scaled up because increasing the number of peers does not increase demand on the system beyond the overall carrying capacity.[19] (This is an improvement over the first online peer-to-peer music file sharing systems that fell victim to severe bottlenecks).[20]

In other cases, scaling up is much more complicated than making successful models even larger. In one famous example, the RMS *Titanic*, its scaled-up design failed for a number of reasons, including a lack of sufficient lifeboats. After the accident, new regulations required that there be enough lifeboats on board to carry everyone on the ship. Ocean liners kept communication systems open 24 hours a day (since no one heard the *Titanic*'s distress call), and ships were much more careful about spotting and avoiding icebergs.

Though the *Titanic* became a paradigm for the hubris of engineers, it was not destined to fail on its maiden voyage. It was a victim of a faulty design **and** bad luck. Had the ship not struck an iceberg and sank, people would have concluded that the celebrated scaled-up ocean liner design was a success. Shipbuilders would have built more ships modeled after it, and likely even larger ships.[21] Designers might have added even more luxuries and reduced the number of lifeboats. Scaling up could have continued for years, maybe decades, until there was a catastrophic failure.

How do we know that the IAEA's safeguards system is not ripe for catastrophic failure? Safeguards could be like a *Titanic* that has been lucky enough not to strike an iceberg.

THE PROBLEM OF STANDARDS

To evaluate whether IAEA safeguards can function adequately with more kinds of nuclear facilities in more countries—or even whether they function adequately now—the agency needs clear and transparent standards. Standards would clarify how well the agency is meeting the obligations found in its statute, which came into force on July 29, 1957, and has been subsequently amended. Its safeguards obligations in particular have been interpreted with almost ecclesiastical attention to nuance. The IAEA's safeguards mission is to verify, "Through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes." Until the discovery that Iraq had a clandestine weapons program, however, the statement was interpreted to read, "to use **declared** nuclear material and facilities. . . ."[22] In other words, the agency read its mandate as to verify only the facilities that member states agreed to have inspected, leaving out other research, industrial, and military sites.[23] The agency took seriously the idea that member states that consented to agency inspections might attempt to conceal facilities only after the discovery of the Iraq program. The agency's mission in a post-Iraq world is more complicated if it cannot assume that countries that consent to inspections are acting in good faith and are attempting to fulfill the obligations of the NPT.

One way to measure how the agency is doing would be to chart its progress relative to clear and transparent standards. The agency has developed quantitative measures of performance such as "timeliness detection" and "risk of early detection," but it is difficult to find data on these. Even how much money the agency spends on particular country inspections remains inaccessible to anyone who is not agency staff or a qualified member state representative. Timeliness detection goals refer to measures specific to facility and material types of how quickly inspectors should be able to identify that a diversion has occurred, and these goals are used to establish the frequency of inspections.[24] Instead of evaluating and measuring primarily at the facility level, the IAEA is now moving toward a system in which it evaluates state declarations for their consistency and thoroughness. At present, state criteria remain rudimentary, and measuring state criteria rather than facilities risks making verification an even more political issue than it is presently. If the agency can develop relatively neutral criteria for evaluating state declaration, however, the state-level criteria could prove useful, especially when combined with other measures such as timeliness detection.

Standards have their virtues. It is difficult to gauge progress and improvement without measureable standards to show where performance is lacking. It is not clear, however, that the standards for IAEA safeguards are accurate performance measures. Unlike the *Titanic* example, what counts as a failure for the IAEA is ambiguous. A nuclear explosion or nuclear war is as much or more a political failure than an administrative one that can be blamed on the IAEA.

However useful the data gathered during safeguards evaluations, their interpretations are not self-

evident. The agency performs careful analysis of state declarations about nuclear material possession and transfers, and sometimes the agency finds that these reports are incomplete. But state-based reports alone do not provide clear standards because their completeness and accuracy depends on factors other than whether a state is engaging in illegal activities. For example, rich countries with well-developed bureaucracies are better able to produce complete reports, as are countries that have produced such reports in the past and merely make routine updates. Countries with less developed bureaucracies may produce incomplete reports out of inexperience and lower capacity, not an intent to deceive.

Timeliness detection goals do provide a clear standard for having met a goal. But it is not clear that these are used as standards any longer, since the agency is moving toward using state-based declarations. Furthermore, the agency's move away from facility-based timeliness detection goals was in part a result of problems with those goals. It was not clear how accurately the goals were being measured, and even so, the agency rarely met the goals and lacked the resources to perform significantly more or longer inspections.[25]

Safeguards are designed to detect the diversion of a significant quantity of nuclear material within a conversion time, which is the minimum time needed to build a bomb using diverted materials. Timeliness detection goals and inspection schedules are created according to the relevant conversion time. (The conversion time is defined as 7-10 days for plutonium or highly enriched uranium [HEU], 1-3 months for plutonium in spent fuel, and about 1 year for low enriched uranium [LEU]). The presence of safeguards and timeliness detection goals suggests that the IAEA aims to

detect military diversions before they result in bombs, and even to prevent an attempt at diversion from occurring undetected.

The agency's performance in preventing diversion in a timely manner is mixed. In the four most prominent cases in recent memory of illicit nuclear activity, the IAEA appeared to formally meet its timeliness detection goals (though detailed such evaluations are not available to the public).[26] Iraq, North Korea, Iran, and Libya all engaged in illegal nuclear activities, and it is generally agreed that all embarked on some stage of an illegal nuclear program. Nevertheless, the IAEA detected violations in only one case, and even there, the evidence is mixed. In Iraq, the United States discovered the country's nuclear program just before the first Gulf War. After the war began and the agency gained access, IAEA inspectors learned that Iraq secretly enriched uranium and carried out reprocessing experiments in buildings at Tuwaitha, which is not covered by IAEA inspections agreements.

In Iran, an opposition group, The National Council of Resistance of Iran, provided initial evidence of illicit activities there. In Libya, the Libyan government announced its nuclear weapons program, though some government intelligence agencies may have known about it previously. In North Korea, however, IAEA inspectors operating under additional legal authority did uncover diversions and illicit activity, and the inspections were supported by U.S. satellite imagery.[27] The IAEA has discovered other cases of materials unaccounted for and various discrepancies in nuclear accounting, but there are no other known cases of the IAEA detecting diversions of nuclear material to an illicit nuclear program. The recent history of the agency's safeguards program leads to a disturbing conclu-

sion. The agency's traditional safeguards of regular inspections and material accountancy failed to detect and deter all known cases of member states' illicit nuclear programs. The North Korean case, however, shows that when given additional legal mandates, technical support, and political support, the agency can verify nuclear programs and make discoveries that qualify as meeting a performance goal—detecting illicit nuclear activity.

Many of the proponents of reform for the IAEA advocate increasing the number of safeguards agreements the IAEA has with member states and expanding the legal and technical tools available to the agency by increasing the number of states covered by the AP. Former Deputy Director General of the IAEA and Head of the Department of Safeguards Pierre Goldschmidt writes that the "Department of Safeguards doesn't have the legal authority it needs to fulfill its mandate and to provide the assurances the international community is expecting from its verification activities."[28] Goldschmidt advocates giving the IAEA greater authority and better technology so that it might more quickly detect violations and with greater certainty.

AFTER DETECTION, WHAT?

Standards can help gauge the agency's performance, but the real problems for dealing with more facilities in more countries and countries at higher risk of proliferation are structural. The problem with current standards is that the IAEA inspection system cannot be relied upon to react quickly enough to a diversion even once the agency detects a violation. To quote a classic article on arms control and disarmament, "After detection, what?"[29]

Much of the debate over safeguards focuses on how to detect violations. The agency developed verification procedures and measures for effectiveness such as timeliness detection goals, and it is investing in promising new detection measures such as environmental and remote sampling. New investments may increase the agency's ability to detect violations and even to identify nuclear material in unauthorized locations. Technical questions about how to better detect violations dominate discussion about safeguards, as the conference agenda of a recent meeting in Vienna, Austria, shows.[30] Debates over how to improve safeguards usually result in requests for larger budgets, more and better training for inspectors and analysts, and better technology.[31]

The IAEA presents the effort to detect violators as its central safeguards mission, and in public, the agency portrays more effective inspections as the key to detection. In 2002, IAEA Director General Mohamed El Baradei said:

> Inspections by an impartial, credible third party have been a cornerstone of international nuclear arms control agreements for decades. Where the intent exists to develop a clandestine nuclear weapons programme, inspections serve effectively as a means of both detection and deterrence.[32]

Detecting violations is not enough to achieve deterrence, however. Just as important are the consequences of a violation once it has been detected. While it is important that the IAEA be technically capable of detecting a violation, the agency's Board of Governors, the UN, and world governments must be able to react quickly and effectively once a violation has been discovered. Focusing solely on the IAEA's technical

capacity and resources risks neglecting the important political challenges to dealing with a violation.[33] In private and in expert-level discussions, safeguards officials worry that the agency lacks the capacity and authority to address cases of proliferation that are outside its mandate. In a July 2011 speech, IAEA Deputy Director General for Safeguards Herman Nackaerts said that:

> The [safeguards] system was manifestly failing in its primary objective, namely, to detect activities that **did** raise potential compliance issues and proliferation concerns—such as those undertaken, for instance, in Iraq, Libya, Syria and Iran.

The reason Nackaerts thought that the system was "manifestly failing" was that "major proliferation challenges have arisen in States with limited nuclear fuel cycle facilities, and involved previously exempted or undeclared nuclear material."[34] If proliferators were outside the IAEA's authority, according to this logic, then increasing the agency's capacity and legal authority would be the solution.

Technical and legal improvements within the agency will not be sufficient, however. A violator will not be deterred by the IAEA's technical ability to detect a violation alone. The violator will be deterred by a calculation that the consequences of a violation will be too great to risk detection. Even if the agency's standards and technical ability to detect a violation improve, a nation or an entity considering proliferation will not be deterred if it thinks that it can ignore, forestall, or withstand the consequences of detection. The IAEA realized in Iraq and elsewhere that a country could attempt to conceal violations or hide from inspectors. Similarly, a country could attempt to es-

cape the consequences of detection through political strategies. To fulfill the goals of nonproliferation, the IAEA must be able to detect violators, and the world political community, along with the agency, must be able to enact a sufficient penalty for violation.

If a country's violation is clear, then the IAEA has an easier job, and it can more easily refer the matter to the UN and world community. But in most cases, violations are not clear. The evidence is mixed, or the violation is clear to those in the know, but it is discovered through secret intelligence provided by a member state, and it cannot be scrutinized or it does not have the same level of credibility as a violation discovered by IAEA inspections.

The IAEA's inspection system is based on inspecting and auditing declared sites. If a country wants to hide a small nuclear program, it can probably escape detection from the agency, as happened with Libya's nuclear program. Beginning in the 1990s, Libya had traded in uranium and other illicit material without IAEA detection.[35] Former IAEA Director General Mohamed ElBaradei conceded that "the system cannot detect easily concealable small items. Any verification system cannot do that."[36]

The IAEA often relies on state intelligence agencies to provide satellite and other sensitive data. If intelligence is provided in secret, however, the accused state can question the veracity of the information and the motivations of its sources. In 2011, state intelligence agencies provided documents to the IAEA showing that Iran had sought and found foreign help to learn the steps necessary to build a nuclear weapon. The intelligence reports showed how, among other things, a former Soviet nuclear scientist provided sensitive information to Iran while under contract in Tehran in

the 1990s. Because the information was provided in secret without details about the sources and probably by countries hostile to Iran, Iran questioned the credibility of the information. A former nuclear official in Iran, Ali Akbar Salehi, described the controversy following the information as "100 percent political" and explained that the IAEA is "under pressure from foreign powers."[37] Iran's ability to question secret intelligence about its nuclear program delayed international action to impose consequences.

Even if the IAEA does find noncompliance with the NPT and safeguards agreements and evidence of trafficking in illicit materials, a state could blame nonstate actors—legitimately or illegitimately—for the trades. Export controls and safeguards do not easily cover nonstate actors. By blaming nonstate actors, a state could avoid sanctions and other consequences of illicit activity.

In one famous example, A. Q. Kahn was the mastermind behind an illicit nuclear enterprise that sold secrets to Iran, North Korea, and Libya, but the Pakistani government claimed that he was acting without their approval and that Pakistan should not be held responsible. Pakistani authorities apprehended Kahn in 2003, and Pakistani President Pervez Musharraf pardoned him in exchange for a confession. Some investigations speculated that Kahn cooperated with the Pakistani government, while others found that he cooperated with corrupt parts of the government but escaped detection by the rest of the Pakistani authorities.[38]

ADDITIONAL PROTOCOL AS A DETERRENT OR A BURDEN?

The IAEA's safeguards structure assumes that once a violation is detected, the violator will repent, or world opinion will impose consequences on the violator. Sometimes this happens. In 2004, South Korea revealed that it had failed to report nuclear material used in experiments to enrich uranium as recently as 2000. South Korea also revealed other undeclared materials used in enrichment and other experiments as far back as 1979. The revelations came as part of South Korea's declarations in ratifying the AP, which expands the IAEA's authority to investigate both declared and undeclared nuclear facilities. The protocol also requires that countries declare more of their nuclear activities than is required under traditional safeguards. In November 2004, the IAEA Board of Governors noted "serious concern" about Korea's unreported activities, but the board did not refer South Korea to the UN Security Council, though referral is within the agency's rights.[39] The IAEA is required to report findings of a country's noncompliance with safeguards agreements to the Security Council, but what rises to the level of noncompliance that merits reporting is open to interpretation.

In the South Korean case, the system worked as many people hoped it would. The AP served as a deterrent of sorts, leading the country to at least report previously unreported material, sites, and activities and possibly leading the country to stop activity that might have continued otherwise, and to ensure greater accountability in its nuclear programs. (South Korea claimed that nuclear scientists conducted these experiments without telling high-level political officials.)

While South Korea is a possible example of the AP's deterrent ability, the AP may lead to additional burdens on the agency in the future. Some experts claim that adoption and implementation of the AP by additional countries will improve the effectiveness of safeguards. The AP is a legal document that enables the IAEA not only to verify the nondiversion of declared nuclear material but also to provide assurances as to the absence of undeclared nuclear material and activities in a state. In short, the AP gives the IAEA increased access to sites and information in a state. For the AP to be effective, and for safeguards generally, timeliness is everything. Safeguards are designed to detect the diversion of a significant quantity of nuclear material (defined as enough to make one crude bomb) within a conversion time, which is the minimum time needed to build a bomb using diverted materials. The expansion of the AP to new states, combined with the need for timeliness and budget constraints, produces a worrisome new safeguards equation. Member states expect the AP not to cost more than current safeguards, but an increased number of facilities under the protocol multiplied by the cost of increased data analysis and environmental sampling per facility that comes with the AP, divided by a constant safeguards budget, equals a reduced number and intensity of inspections. The AP will likely lead (and has led) to countries covered by the AP being subject to fewer inspections, even as the IAEA obtains greater authority to provide assurances about declaring undeclared sites.

Despite the potential for the AP to increase expectations of the IAEA beyond what the agency can accomplish, the adoption and implementation of the AP has been an article of faith among proponents of the

IAEA's safeguards program. In 2005, Director General Mohamed ElBaradei wrote that:

> I believe that, for the Agency to be able to fulfill its verification responsibilities in a credible manner, the Additional Protocol must become the standard for all countries that are party to the Treaty on the Non-Proliferation of Nuclear Weapons.[40]

Similar calls for wider adherence to APs came from the UN General Assembly, by member states at the 2000 and 2010 NPT Review Conferences, and by states at IAEA General Conferences. Yet if the IAEA expands verification activities under the AP without increasing its budget at a greater rate than in the past, it will have to seek new efficiencies, likely by reducing the number and intensity of inspections or decreasing inspections in countries not considered to be proliferation risks, a practice that opens the Agency to charges of unfairly applying its standards.[41] Reducing inspections by increasing randomization may make sense from a cost-benefit standpoint, but it opens a window for diversion, especially if the inspections do not occur within the timeliness window.[42]

The AP confers a preferred traveler status to a country, allowing the IAEA to reduce inspections once it has reached a finding of "nondiversion." A clever state, terrorist, or criminal (perhaps without state knowledge) may seek to attain the activation of the AP and then engage in diversion activities. Given the intensive background work required to implement the AP and inspect new nuclear facilities, the IAEA will likely reduce inspections for its "preferred travelers" because of resource constraints. Despite its advantages, the AP provides an increased possibility for diversion.

With more nuclear facilities in more countries, whether under the AP or not, the IAEA faces a tough decision about whether to lower the false alarm rate and potentially increase the possibility for diversion. The IAEA has an acceptable false alarm rate of approximately 5 percent.[43] In other words, the agency tolerates the inspectorate alleging that materials are unaccounted for when, in fact, there exists a good explanation about 5 percent of the time. The 5 percent rate, multiplied by an increasing number of inspections, leads to two options. First, the agency could pursue a politically unacceptable high number of false alarm reports and confront member states, who will demand that the agency lower the false alarm rate. Governments do not like the agency to give them negative publicity, give excessive attention to sensitive nuclear and industrial processes that are secret, or insult national pride. Second, the agency could allow more nuclear material to remain unaccounted and make a security case to member states and the Board of Governors for the IAEA to increase its permissible false alarm rate. It is not clear which of these will happen, but the agency's leadership will have to make a choice. While technical constraints shape the process of material accountancy, the greatest challenges are political.

THE LIMITS OF LEGAL TOOLS

Former IAEA officials agree that the legal framework of the IAEA needs revision. The NPT prohibits non-nuclear weapons states from making weapons, but it allows states to get extremely close to making weapons. The treaty has been interpreted as providing an inalienable right to peaceful use, which overlaps

with much of what is needed for military purposes.[44] Much of the delay in imposing penalties on Iran for its nuclear activities comes from disagreement about whether and to what degree Iran is in violation of the NPT. Iran maintains that it is fulfilling its obligations under the treaty and that hostile powers are unfairly seeking to deny its right to peaceful use of nuclear materials.[45]

The current safeguards legal framework relies on member states' voluntary cooperation with the inspection process. IAEA inspectors are more like door-to-door salesmen asking for permission to enter a home than they are like police investigators demanding access. The IAEA also lacks the legal tools to gather information in case of noncompliance, and the international system has no regular sanction available if a country forbids or delays IAEA access, and no pre-established penalty if a country withdraws from the NPT. Without enforcement, detection risks lead to nothing more than empty threats. Alternatively, detection could lead to ad hoc penalties imposed by the UN Security Council or by coalitions of interested countries that risk being criticized as unfair. The agency will be in a better position if governments can agree on penalties for violation that apply to all countries and are agreed upon before any particular country is in violation. Without reform of the legal processes governing IAEA inspections, the IAEA will have more of the same—more evasion, as in the cases of Iran and Syria, and perhaps many more cases if nuclear power expands around the world.

Former safeguards officials agree that the IAEA and the UN need to have more authority for inspections and a standard procedure for dealing with evidence of diversion. The international system also

needs agreement on what to do about countries that leave the NPT. Without standard measures for what counts as a violation and standard procedures for dealing with it, the IAEA risks a loss of credibility as a neutral arbiter when a crisis occurs and the agency does not have an impartial procedure to address these crises. For the IAEA to fulfill its obligation under the statute—and to maintain credibility with the world, fairly or unfairly—the agency must be able to detect violations of safeguards agreements and the NPT and be clear about the consequences if countries do not cooperate in addressing violations.

PROSPECTS FOR REFORM

Goal conflict within the IAEA will not make resolving these challenges easy. The agency has at least three major goal conflicts. First, member states are unclear about whether the agency should privilege promoting nuclear power, preventing military diversions, or maximizing safety. Article II of the Agency's statute provides for the first two missions simultaneously:

> The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.[46]

The goals of promoting peaceful use and preventing diversion are in conflict if nuclear power expansion makes identifying diversion more difficult because inspectors look for the "needles" of diversion in a bigger nuclear haystack, with more nuclear facilities, materials, transfers, and knowledge around the world. Furthermore, if, after Fukushima, the agency

devotes more of its budget to safety and less to other aims, then the agency's missions are locked in a zero sum game.

Second, the agency's responsibilities for inspection and verification conflict with member states' desire for control and secrecy in nuclear energy. The agency wants unfettered access to facilities for safety and safeguards inspections and verification, but member states want their companies to protect proprietary information and want IAEA inspectors to have as little interference as possible with industrial routines. As the nuclear facilities under safeguards expand beyond light-water reactors, new safeguards demands may make reconciling these conflicts more difficult. Third, the agency's conflicts over budget growth will force a choice as the number of states and kinds of facilities under safeguards expands. The agency can choose to constrain budget growth to near 0 percent a year and keep staff and financial burdens on member states to a minimum, or it can expand budget obligations on member states and expand its responsibilities and capacities. Each of these three goal conflicts will force the agency and its member states to make choices at higher levels of operations.

The potential for goal conflicts prompts a question: Can the IAEA reasonably be expected to safeguard much larger nuclear programs throughout the world, including in many more countries than at present? Scaling up the agency's operations, human capital, and technology at the same rate as has been done in the past is not sufficient, but the IAEA's Secretariat can develop workarounds to improve performance. The agency can engage in selective scaling up, purchasing new surveillance equipment, better laboratory facilities, and training for inspectors. These efforts

alone, however, are not sufficient, and the agency is not likely to dramatically increase its budget through the current financing structure. To reduce goal conflict and improve performance, the agency could reorganize according to mission, separating elements of the agency that promote nuclear power from those that conduct safeguards. The IAEA already has separate divisions, but the separation could go further, perhaps providing separate reports to the Board of Governors and to the director general, leaving it to the director general to find the appropriate balance among organizational goals and not to bureaucrats further down the organizational chart. This might resemble the competing intelligence analysis given to the President of the United States after intelligence reorganization following September 2001.[47]

Simply grafting a new branch onto an organization may not prove to be sufficient separation among divisions. To incorporate additional perspectives in the decisionmaking process, the IAEA could seek new sources of funding based not just on membership but on use.[48] The current safeguards funding structure has a free rider problem in that those who benefit from nuclear power do not always pay more for safeguards, and those who do not benefit sometimes pay an amount disproportionate to their use. The excessive payers are especially reluctant to increase safeguards funding. Nevertheless, countries that benefit more from nuclear power could ante up for safeguards. Industry, too, could contribute to safeguards based on use either through member states or through other bodies. Some IAEA officials balk at the idea of anyone other than member states contributing to the agency's work since it is a creature of member states. Yet nongovernmental organizations (NGOs) have made con-

tributions to safeguards before, and Taiwan pays a safeguards fee even though it is not a member state.

While the agency can seek new sources of funding to meet new challenges, the agency could also be honest about its limits. If governments and NGOs were more aware of the technical and political limits of the agency's capacity, then they may not be so quick to give the agency new missions or to spread nuclear materials around the globe, both of which would make the agency's job easier than it would be otherwise. Former Secretary General Mohamed ElBaradei's memoir presents an expansive portrayal of the agency's powers, which may undermine the agency's authority in the long term if it is shown to be perpetually underperforming compared to expectations.[49] For instance, ElBaradei asserts that the agency can, with the AP, declare that a state has no undeclared material. But proving the negative is impossible. The UN Monitoring, Verification and Inspection Commission conducted inspections in Iraq and did not find weapons of mass destruction (WMD), but it could not prevent the March 2003 invasion of Iraq, which was justified on the grounds that Iraq had WMD.

Better transparency about performance goals could help the agency be more clear about its limits. Agencies resist establishing and publicizing data for a host of reasons: outcomes are difficult to measure; inequalities breed envy; and publicity could spawn a media blame-game. Nevertheless, performance metrics could help improve performance or secure more resources, even if the agency falls short. If the agency perpetually underperforms, it could make a case that member states expect far too much. The agency has developed quantitative measures of performance such as "timeliness detection" and "risk of early detection,"

but it is difficult to find data on these measures. Traditionally, on-site verification efforts concentrated on the states with the largest nuclear programs, not on the programs that necessarily posed the greatest proliferation risks. Under traditional safeguards, "60 percent of the agency's verification efforts was expended in just three states," according to IAEA Deputy Director General for Safeguards Herman Nackaerts.[50] Thus, the more materials and sites a state declared, the more it was inspected, independent of any analysis of the proliferation risk in a state or the state's history of cooperation. The IAEA is moving toward a system in which it evaluates state declarations for their consistency and thoroughness, and away from evaluating and measuring facilities. If the agency can develop relatively neutral criteria for evaluating state declaration, however, the state-level criteria could prove useful, especially when combined with other measures, such as timeliness detection.[51]

Perhaps because of the agency's exceptional professionalism among international organizations, and because of successes in the cases of North and South Korea, some politicians and the IAEA's own leaders overstate the capabilities of the agency. Yet the safeguards system is fragile, and, without reform, more countries will advance to the brink of building weapons, even as they maintain their legal obligations under the NPT's right to peaceful use.

Some reformers advocate improving the IAEA's technical abilities and giving more discretion to the agency's Secretariat.[52] Not doing so, they argue, would risk further politicizing issues in the UN Security Council, where countries would pander to their most powerful constituencies. The UN Security Council lacks neutral dispute resolution procedures unlike, for

example, the World Trade Organization. Meanwhile, the IAEA has more legal authority than it uses. The agency's statute allows for it to suspend technical cooperation to problematic member states who value the agency's expertise, and the agency could ask for the international Court of Justice or other litigation bodies to intervene in disputes. In short, working around the UN Security Council gives the agency the best chance at deterring violators.

Another school of thought advocates reform in cooperation with the UN Security Council and the UN as the best path forward for the IAEA. The UN Security Council and UN are the most effective bodies for aggregating world opinion and for legitimate enforcement action, the argument goes, and their participation is essential in an equitable system of nonproliferation that imposes consequences for violations. Not all consequences should be punitive, however. Studies of regulation enforcement show that different kinds of violators respond to different kinds of consequences.[53] For example, regulators should be reasonable toward more cooperative organizations, harsh with chronic evaders, and conciliatory with repentant organizations.

Mohamed ElBaradei has been a leading proponent of comprehensive reform, recommending that the IAEA and the UN Security Council work together to, "effectively deter, detect, and respond to possible proliferation cheats."[54] Former Head of the Department of Safeguards Pierre Goldschmidt warns that if reform is not adopted, "we will see more of the same and we should not be surprised if one day Iran withdraws from the NPT and other states like Syria continue to deny the IAEA access to suspect locations."[55] In other words, he predicts a breakdown of the nonprolifera-

tion system. Goldschmidt offers a series of thoughtful international-level reforms. These include:

> imposing penalties for withdrawal from the NPT; announcing that safeguards agreements and the IAEA's power of special inspection will outlast withdrawal; giving the agency new tools for monitoring the nuclear trade; and being clear and objective about when a violation occurs and the steps a country must take to address the violation; and, in some cases, imposing penalties for violations that would ultimately improve the agency's effectiveness and credibility.[56]

When asked about these proposals, experts in the nonproliferation community provided few solid arguments against them except that they will be difficult to achieve. Enacting these reforms will require that enough interested governments take the matter to the international community, specifically the UN and the UN Security Council. In the meantime, the IAEA can do its part by sounding the alarm for reform and calling attention to the limits to what it can safeguard, especially if nuclear power expands.

ENDNOTES - CHAPTER 9

1. Safeguards Glossary, 2001 Edition," International Atomic Energy Agency, Vienna, Austria, p. 23, available from *www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_prn.pdf.* Inspection intervals are based on the time required to divert a significant quantity for non-peaceful uses, but a significant quantity could be more than enough to make a bomb. The IAEA safeguards glossary defines significant quantity as: "the approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded."

2. "World Energy Outlook for 2010," *International Energy Agency*, Paris, France, 2010, p. 1.

3. Citigroup Global Markets finds recent delays in construction in several new nuclear power plants reduce the likelihood that nuclear power will be considered a viable investment by the market. Citigroup finds that nuclear power investments are economically viable only when governments intervene in the market to provide explicit assurances of a minimum return on investment. Peter Atherton *et al*., "New Nuclear: The Economics Say No," *Citigroup*, November 2009, p. 4-6, available from *npolicy.org/article_file/New_Nuclear-The_Economics_Say_No.pdf*.

4. *Ibid*, p. 8.

5. "Emerging Nuclear Energy Countries," *World Nuclear Association,* London, UK, May 2012, available from *www.world-nuclear.org/info/inf102.html.*

6. Ryan Lizza, "As the World Burns," *New Yorker*, October 11, 2010.

7. Heather Timmons, "Emerging Economies Move Ahead With Nuclear Plans," *The New York Times*, March 14, 2011; Trevor Findlay, "The Future of Nuclear Energy to 2030 and its Implications for Safety, Security and Nonproliferation: Overview," *The Centre for International Governance Innovation*, Waterloo, Ontario, Canada, 2010; Jaeyeon Woo, "Seoul's U.A.E. Deal Caps Big Sales Push," *The Wall Street Journal*, December 29, 2009.

8. Yukiya Amano, "International Cooperation Vital for Nuclear Renaissance," *Le Monde*, March 7, 2010.

9. "World Energy Outlook 2011," *International Energy Agency,* Paris, France, p. 2.

10. "India Needs Nuclear Energy, Says PM Manmohan Singh," *BBC News India,* March 27, 2012, available from *www.bbc.co.uk/news/world-asia-india-17520589*.

11. Atherton *et al*., p. 3.

12. "Safeguards Statement for 2010," *International Atomic Energy Agency,* Vienna, Austria, available from *www.iaea.org/OurWork/SV/Safeguards/es/es2010.html.*

13. Herman Nackaerts, "A Changing Nuclear Landscape: Preparing for Future Verification Challenges," *International Forum on Peaceful Use of Nuclear Energy and Nuclear Non-Proliferation*, Vienna, Austria, February 2, 2011, available from *www.iaea.org/newscenter/statements/ddgs/2011/nackaerts020211.html.* The IAEA's 2009 projections high growth scenario forecast that nuclear power production could double by 2030, and its low-growth scenario has nuclear power production increasing by about 40 percent. See IAEA, *Energy Electricity and Nuclear Power Estimates for the Period up to 2030,* Vienna, Austria, 2009.

14. Olli Heinonen, "Belfer Center Release," Cambridge, MA: Harvard University, October 12, 2010, available from *www.iaea.org/Publications/Reports/Anrep2009/table_a5.pdf.*

15. "The Agency's Programme and Budget, 2010-11," *International Atomic Energy Agency,* Vienna, Austria, August 2009, available from *www.iaea.org/About/Policy/GC/GC53/GC53Documents/English/gc53-5_en.pdf.*

16. "Annual Reports, 1987-2010," *International Atomic Energy Agency,* Vienna, Austria.

17. "Safeguards Glossary, 2001 Edition," *International Atomic Energy Agency,* Vienna, Austria, p. 23, available from *www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_prn.pdf.*

18. Mark Hibbs, "The Unspectacular Future of the IAEA Additional Protocol," *Carnegie Proliferation Analysis*, April 26, 2012.

19. Lucia D'Acunto, Tamas Vinko, and Johan Pouwelse, "Do BitTorrent-like VoD Systems Scale under Flash-Crowds?" IEEE Communications Society P2P 2010 Proceedings Paper, 2010.

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21. Henry Petroski, *Success through Failure: The Paradox of Design,* Princeton, NJ: Princeton University Press, 2006, pp. 95-96.

22. "IAEA Mission Statement," available from *www.iaea.org/About/mission.html*. On the relationship of declared to undeclared sites, see IAEA, *The IAEA's Safeguards System, Ready for the 21st Century*, Vienna, Austria, undated, available from *www.iaea.org/Publications/Booklets/Safeguards2/part5.html.*

23. This authority is in accord with non-nuclear weapons states who are members of the NPT under the Model Safeguards Agreement pursuant to IAEA INFCIRC 153. For more on how the agency interpreted its safeguards mission in the past, see Herman Nackaerts, "IAEA Safeguards Cooperation as the Key to Change," talk to the INMM 52nd Annual Meeting, July 18, 2011, available from *www.iaea.org/safeguards/documents/IAEA_Safeguards_Cooperation_as_the_Key_to_Change.pdf.*

24. "Safeguards Glossary," available from *www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_prn.pdf.*

25. See *Falling Behind: International Scrutiny of the Peaceful Atom*, Henry Sokolski, ed., Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2008.

26. Performance according to timeliness detection goals is reported in the Safeguards Implementation Report. Annual and facilities-specific data is not available to the public, but occasionally the agency reveals performance data as an illustration in various reports. In the United States, relevant bureaucrats and congressional committees have access to this data.

27. For a chronology of the IAEA's discoveries in North Korea, see the agency's fact sheet available from *www.iaea.org/newscenter/focus/iaeadprk/fact_sheet_may2003.shtml.*

28. Pierre Goldschmidt, "Looking Beyond Iran and North Korea for Safeguarding the Foundations of Nuclear Nonproliferation," see Chap. 11 in this volume, p. 1.

29. Fred Charles Iklé, "After Detection: What?" *Foreign Affairs*, Vol. 39, No. 2, January 1961, pp. 208-220.

30. See the *Symposium on International Safeguards: Preparing for Future Verification Challenges*, Vienna, Austria, November 1-5, 2010, available from *www-pub.iaea.org/iaeameetings/38095/Symposium-on-International-Safeguards-Preparing-for-Future-Verification-Challenges.*

31. Pierre Goldschmidt, "Identifying the Right Skills and Expertise for the Challenges of the 21st Century: Where to Find Them? How to Retain Them?" IAEA Safeguards Symposium, Vienna, Austria, November 1, 2010.

32. *IAEA Safeguards: Stemming the Spread of Nuclear Weapons*, Vienna, Austria, 2002, p. 1, available from *www.iaea.org/Publications/Factsheets/English/S1_Safeguards.pdf.*

33. The IAEA often makes statements such as, "With wider access, broader information and better use of technology, the Agency's capability to detect and deter undeclared nuclear material or activities is significantly improved." While this is probably true, better technology and more information is only half the battle. What to do after detection is the other half. See "IAEA Safeguards: Stemming the Spread of Nuclear Weapons," *International Atomic Energy Agency Information Series Division of Public Information Factsheet,* 2002.

34. Herman Nackaerts, "IAEA Safeguards: Cooperation as the Key to Change," Keynote Address to the INMM 52nd Annual Meeting, July 18, 2011.

35. Borzou Daragahi, "Details Told of Libya's Nuclear Bid," *The Los Angeles Times*, September 13, 2008.

36. Elbaradei, "Coming Clean Background," *PBS NewHour*, December 30, 2003.

37. Joby Warrick, "IAEA Says Foreign Expertise Has Brought Iran to Threshold of Nuclear Capability," *The Washington Post*, November 6, 2011.

38. Douglas Frantz and Catherine Collins, *The Nuclear Jihadist: The True Story of the Man Who Sold the World's Most Dangerous Secrets . . . And How We Could Have Stopped Him,* New York: Twelve Books, 2007; Adrian Levy and Catherine Scott-Clark, *Deception: Pakistan, the United States and the Global Nuclear Weapons Conspiracy,* New York: Walker & Company, 2005.

39. Paul Kerr, "IAEA: Seoul's Nuclear Sins in the Past," *Arms Control Today*, December 2004.

40. IAEA, *Non-Proliferation of Nuclear Weapons and Nuclear Security*, Vienna, Austria, May 2005, p. 2, available from *www.iaea.org/Publications/Booklets/nuke.pdf.*

41. Dapo Odulaja, "Broader Use of Statistical Techniques in the Design of Advanced Safeguards Approaches," *2010 Safeguards Symposium: Preparing for Future Verification Challenges,* Vienna, Austria, November 2010, p. 3.

42. It is difficult, if not impossible, to obtain actual data on the relationship between the probability that random inspections will take place within the timeframe of detection goals. The IAEA does make some theoretical models for random inspections and timeliness goals available, but these models do not necessarily reflect practice.

43. U.S. Congress, Office of Technology Assessment, *Nuclear Safeguards and the International Atomic Energy Agency,* OTA-ISS-615, Washington, DC: U.S. Government Printing Office, June 1995, p. 45; Marvin M. Miller, "Are IAEA Safeguards on Plutonium Bulk-Handling Facilities Effective?" Washington, DC: Nuclear Control Institute, August 1990, available from *www.nci.org/k-m/mmsgrds.htm.*

44. The first clause of article IV of the NPT reads: "Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty."

45. Peter Crall, "Iran's Nuclear Program: An Interview with Iranian Ambassador to the IAEA Ali Asghar Soltanieh," *Arms Control Today*, October 2011.

46. IAEA, Article II.

47. Richard A. Posner, *Uncertain Shield: The U.S. Intelligence System in the Throes of Reform*, Lanham, MD: Rowman & Littlefield Publishing, 2006, pp. 55-86; John Diamond and Judy Keen, "Bush's Daily Intel Briefing Revamped," *USA Today*, August 25, 2005, p. A1; Douglas Jehl, "Intelligence Briefing for Bush is Overhauled," *The New York Times*, July 20, 2005, p. A18.

48. Tom Shea and Henry Sokolski have suggested this idea. See *Falling Behind*, pp. 13, 36.

49. Mohamed ElBaradei, *The Age of Deception: Nuclear Diplomacy in Treacherous Times*, New York: Metropolitan Books, 2011. For example, the agency said that it is not yet "in a position to conclude that there are no undeclared nuclear materials or activities in Iran." This assumes that the agency could potentially be in such a position. See the "Report on the Implementation of Safeguards in the Islamic Republic of Iran," GOV/2006/15, *International Atomic Energy Agency,* February 27, 2006.

50. Herman Nackaerts, "IAEA Safeguards Cooperation as the Key to Change," talk to the INMM 52nd Annual Meeting, July 18, 2011, available from *www.iaea.org/safeguards/documents/IAEA_Safeguards_Cooperation_as_the_Key_to_Change.pdf.*

51. In "IAEA Safeguards Cooperation as the Key to Change," Nackaerts describes the new safeguards thusly:

> This means moving away from such a heavy reliance on routine quantitative measurements and the mechanistic application of generic criteria. Instead, it requires taking into account a wide range of factors—qualitative and quantitative, reaching an informed judgment based upon a detailed analysis and evaluation of all the information available to the Agency, and then deciding to act accordingly. To do

this, our focus needs to be on each State as a whole, rather than solely on the nuclear material and particular facilities within that State.

52. Sebastian Harnish, "Minilateral Cooperation and Transatlantic Coalition-Building: The E3/EU-3 Iran Initiative," *European Security*, Vol. 16, No. 1, March 2007, pp. 1-27.

53. John T. Scholz, "Voluntary Compliance and Regulatory Enforcement," *Law & Policy,* Vol. 6, Issue 4, October 1984, pp. 385-404.

54. Mohamed ElBaradei, "A Recipe for Survival," *The New York Times*, February 16, 2009, available from *www.nytimes.com/2009/02/16/opinion/16iht-edelbaradei.1.20216338.html?_r=1&pagewanted=all.*

55. Pierre Goldschmidt, E-mail Interview with author, December 4, 2011.

56. "Looking Beyond Iran and North Korea for Safeguarding the Foundations of Nuclear Nonproliferation."