U.S.-RUSSIAN NAVAL SECURITY UPGRADES

Lessons Learned and the Way Ahead

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For a decade, the U.S. Department of Energy has worked cooperatively with Russia to install modern nuclear security systems for weapons-usable material. The effort is known as the Material Protection, Control, and Accounting (MPC&A) program; its mission is to reduce the threat of nuclear proliferation and nuclear terrorism by rapidly improving the security of all weapons-usable nuclear material in forms other than nuclear weapons in Russia, the NIS (newly independent states), and the Baltics.[1] The program has substantially increased security for large amounts of vulnerable nuclear material.[2] Hardening storage facilities against outside but also, even especially, inside threats is a high priority. Site-tailored and integrated enhancements include such features as entry/exit barriers and control measures (such as traps, gates, locks, and portal monitors), personnel access controls, intrusion detection systems, alarm communications, video surveillance, response measures, and computerized systems for nuclear material accounting.[3]

Notwithstanding successes achieved against the threat of nuclear theft, however, the bulk of the proliferation challenge remains; hundreds of metric tons of nuclear material lack improved security systems. As of March 2003, the Department of Energy (DoE) had assisted Russia in protecting about 228 metric tons, or

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38 percent, of its weapons-usable nuclear material.[4] The vast majority of the remaining material is at sites in the nuclear weapons complex where, due to Russian national security concerns, access has been limited and DoE has not been able to initiate work.

The Department of Energy alone now administers in Russia more than a dozen distinct nonproliferation programs designed to reduce the risk of nuclear material or expertise falling into the hands of terrorist organizations and "states of concern."[5] But there has been an unfortunate tendency to view the various nonproliferation programs one by one rather than all together. According to Leonard S. Spector, former Deputy Assistant Secretary of Energy for Arms Control and Nonproliferation, there is a need for an approach that recognizes and addresses cross-program synergy, impacts, and investment opportunities.[6] Indeed, in March 2003 the U.S. General Accounting Office recommended that the DoE reevaluate its plans for securing Russia's nuclear material and, with DoD, develop an integrated plan to ensure coordination of efforts to secure Russia's nuclear warheads.[7]

This article examines the sources of the extraordinary progress of the naval security upgrades for the fresh, unirradiated naval fuel and nuclear weapons, and attempts to balance justified security concerns with the need for openness. The progress made suggests that valuable lessons can be learned from the U.S.-Russian naval security upgrade program, lessons that could improve on the mere formalization of access substitutes and contribute to other security upgrades as well, possibly even to other nuclear nonproliferation activities.

Inherent and legitimate security concerns, however, effectively limit the information that can be made public from the naval MPC&A program. In fact, the progress to date could not have been made had not the American and Russian sides found an effective way to share and at the same time protect sensitive information.

The assessment is based on interactions with key personnel and on the (limited) open-source information available on naval MPC&A upgrades. The article starts with a brief overview and a summary of the historical background and current status; it then proceeds to an evaluation of the pros and cons of the naval MPC&A approach. The final section describes future challenges and steps, and presents recommendations for applying elsewhere the experience of naval Material Protection, Control, and Accounting.

OPPORTUNITIES AND OBSTACLES

From the very beginning, access to Russian nuclear sites has been a significant stumbling block for U.S.-Russian cooperation on fissile-material security and nuclear weapons. There has been a lack of clarity on both sides as to kinds of access needed, when, for whom, and most importantly, for what purposes.[8] As a result, for instance, all new security contracting at the most sensitive nuclear-weapons complexes has been suspended since the fall of 1999, pending decisions and agreements on access.

The Russians have been reluctant to grant the U.S. access to buildings in the nuclear weapon complexes because of national security concerns and domestic laws and regulations. The idea of "substitute" arrangements, or "assurances"—whereby, for instance, photos and video would supplement or substitute for physical access to sensitive facilities—is under investigation and has been applied at some Russian sites.[9] High-level talks and working groups between DoE and the Russian Ministry for Atomic Energy (MinAtom) have been initiated to negotiate overarching and acceptable agreements for the provision of necessary assurances. Such solutions are intended to be a pragmatic way of avoiding the most profound sensitivity issues, but they may not address fully the underlying problems of distrust.

As of January 2003, U.S. teams had obtained or anticipated obtaining access to thirty-five of the estimated 133 buildings with nuclear material in Russia's nuclear weapons complex. At the remaining buildings (74 percent of the total), DoE had no access to design or confirm the installation of security systems.[10] The level of access has thus changed very little since February 2001 (see table 1). In reality, therefore, progress has been limited for much of the most proliferation-attractive material in the nuclear weapons complex. In contrast, the American team working on security upgrades for the Russian navy reports access to *all* sensitive facilities having fresh highly enriched uranium (HEU) fuel (see table 1). DoE has made significant progress protecting buildings at civilian and naval fuel storage sites and is nearing completion of its security upgrades at these sites. As of January 2003, DoE had completed work at 78 percent (eighty-five of 110) of the buildings at these locations.[11]

TABLE 1
ACCESS TO FISSILE MATERIAL SITES
Percentage, as of January 2001

	Russian Civilian Sites	Russian Naval Fuel Sites	Russian Nuclear Weapon Laboratories	Overall
Buildings to Which U.S. Teams Lack Physical Access	12	0	73	41

Source: U.S. General Accounting Office, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed,* GAO-01-312 (Washington, D.C.: February 2001), p. 8.

The naval MPC&A team has clearly been better able to overcome distrust and deal with sensitivity issues. It has been given access despite the secrecy and classification of the design and composition of Russian naval reactor fuel. DoE has forged productive working relationships with officials of the Russian navy, overcome security concerns, and negotiated access appropriate to verify installed physical protection and accounting systems.[12] On the basis of this trust, in 1999 the teams moved from protecting fissile material to naval nuclear weapons. By January 2001, security upgrades were initiated at forty-one of forty-two naval weapon sites.[13] As of March 2003, DoE reported that security had been improved at thirty-three of thirty-six naval weapon sites, the needed access having been provided.[14] The United States expects to finish security upgrades for four thousand Russian naval nuclear warheads by 2005.[15] DoE has, however, scaled back its plans to assist operational naval sites that support deployed nuclear weapons, to comply with January 2003 U.S. interagency guidelines that preclude assistance to most operational sites.[16]

HISTORY AND STATUS OF NAVAL MPC&A

Russia may hold as much as eighty to eighty-five metric tons of HEU for submarine fuel.[17] The fuel's enrichment levels make it a proliferation risk, and economical and political turmoil has put fissile material management in the former Soviet Union under unprecedented stress. In the post-Soviet period, the Russian navy has had severe problems providing satisfactory storage and protection for its fresh reactor fuel.[18] Originally, decaying fences and simple padlocks often provided the only security.[19]

After less than a half-decade of work, however, the DoE MPC&A program for fresh Russian naval fuel storage facilities has made good progress in reducing the vulnerability of large amounts of HEU—all at highly sensitive installations—to theft or diversion.[20] According to DoE, all the fresh fuel of the Northern Fleet and at the Pacific Fleet has now been consolidated at two modern storage bunkers, expanded and secured with U.S. assistance.[21] In addition, the United States has assisted in physical protection upgrades for storage ships and auxiliary ships involved in refueling operations.[22] The first fresh fuel–storage security enhancement, at the SevMash submarine production plant in Severodvinsk, was completed in the fall of 2001. In early 2001, a second facility at the plant was added to the list to receive security upgrades.[23] By June 2003, these security upgrades were in their final stages.

The HEU naval fuel reduction line at the Machine Building Plant at Elektrostal, outside Moscow, remains outside the U.S.-Russian cooperative MPC&A scope, though some work has been done on the facility's low-enriched uranium line. From Elektrostal, the fuel is transported by rail to naval storage facilities, where it is stored until needed. The fuel is shipped by truck to refueling locations. Fuel consolidation made transportation security a more pressing issue; security enhancements for truck shipments of fresh naval fuel, including armored trucks, have been completed.[24] Security for rail shipments, on the other hand, is being considered as part of a separate transportation security project with MinAtom.[25]

The foundations for Russian naval MPC&A were laid in March 1995 when the then commander in chief of the navy, Admiral Gromov, requested assistance and cooperation between the Navy, the Moscow-based Kurchatov Institute, and possibly the United States on upgrades for naval fuel storage and handling.[26] (The Kurchatov Institute, which provides a wide range of services for the Russian navy, had by then become a key player in U.S.-Russian security cooperation;[27] the institute operates independently from MinAtom and is free to initiate cooperation and sign contracts and agreements with external parties.) The month before, Admiral Gromov had participated in a MPC&A demonstration and technical discussions at the institute. U.S. cooperation through the separate Russian-American Laboratory-to-Laboratory MPC&A Program was explored over the ensuing months. (It produced the first security upgrades at the institute itself, to Building 116, late in 1994.)[28]

Since July 1993, attempts to steal nuclear fuel had occurred in the Northern Fleet (as of early 1996, five known attempts. Since then, no new thefts have been reported; see table 2). All of these thefts involved “insiders” with direct or indirect access to and knowledge about the material. Cooperation with the DoE through the Kurchatov Institute was a way for the Russian navy to deal with the problem. In September 1995, the first MPC&A discussions between U.S. technical experts and the Russian navy were held at the institute. By the end of the year, all necessary approvals had been obtained to allow the collaboration to go forward.[29] In 1996, this cooperation advanced beyond the talking stage and began to achieve concrete results.[30]

In February 1996 a course in U.S. approaches to vulnerability assessment was conducted through the Kurchatov Institute; it included a demonstration of “Assess” software for the Russian navy. The next month, representatives from the Russian navy visited the United States. In May the same year, representatives from the DoE and U.S. national laboratories, the Kurchatov Institute, and the Russian navy met in Moscow. A protocol establishing the scope and approach of MPC&A work was signed. The American program leader and the Russians agreed that there should be one small, coherent, and experienced U.S. team to handle all projects. The U.S. side therefore put together a four-person team, with highly qualified personnel from four different national laboratories, to work directly with the Russian navy.

TABLE 2
THEFTS OF HIGHLY ENRICHED URANIUM, NORTHERN REGION

Location	Date	Material Stolen	Enrichment	Perpetrators	Remarks
Andreeva Bay	July 1993	Two 4.5 kg fuel elements	36%	2 naval officers (Radiation Protection Dept.)	Charges against 2 others withdrawn
Sevmorput shipyard fuel storage, Murmansk	November 1993	Three 4.3 kg fuel elements	Approx. 20%	Three officers	Recovered, thieves sentenced
SevMash yard, Severodvinsk	July 1994	3.5 kg uranium dioxide	20–40%	4 local businessmen	Trial in progess
SevMash yard, Severodvinsk	October 1994	Fuel element(s)	Highly enriched		Arrests
Zvezdochka yard, Severodvinsk	July 1994	Fuel element(s)		Nor. Fleet Contractors	Suspects seized before removal
Zvezdochka yard, Severodvinsk	January 1996	Fuel element(s)		Nor. Fleet Contractors	Arrests

Source: Rensselaer W. Lee III, "Recent Trends in Nuclear Smuggling," in *Russian Organized Crime: The New Threat?* ed. Phillip G. Williams (London: Frank Cass, 1996), pp. 118–19, with minor additions.

The U.S. side saw and managed the entire "naval sector" as one integrated program. There was a need to move fast and efficiently, as the Russian navy was watching developments closely. Following a visit by Admiral Gromov to the United States in April 1995, American experts had been invited to Site 49, the main storage site for fresh fuel near Murmansk since May 1994.[31] In cooperation with the Kurchatov Institute, the new expert team designed a set of security upgrades for the facility, provided necessary new technologies, and funded construction. In parallel, the U.S. team was working at Murmansk Shipping Company (MSCo) to secure the fresh fuel of the nuclear-propelled icebreaker fleet. Necessary upgrades focused on the auxiliary ship *Imandra*—moored at the Atomflot harbor, north of Murmansk—which carried fresh nuclear fuel; on port perimeter security enhancement; and on access control. The work at MSCo began with a site visit in June 1996, followed in September by the first-ever U.S.-Russian vulnerability assessment. By the end of 1996 the U.S. and Russian teams had a conceptual design ready.

In July 1996, the Russian navy, the Kurchatov Institute, and DoE issued a joint statement that they would "cooperate to ensure the highest possible standards of control, accounting and physical protection for all storage locations of the Navy of the Russian Federation, containing fresh highly enriched uranium fuels for naval nuclear reactors."[32] The statement solidified cooperation and a protocol achieved in a meeting in Moscow in May the same year.

A comprehensive agreement with the Russian navy for MPC&A at all naval sites was formalized in a high-level protocol signed in December 1997 by a new commander in chief of the Russian navy, Admiral Vladimir Kuroyedov, and the secretary of energy, Federico Pena. On this occasion the Russians again stressed the importance of maintaining a cohesive and highly qualified team, leaving the U.S. side with little choice but to keep the original personnel. The Russian navy deemed the threats to the Northern Fleet the most severe.[33] When, two years later, DoE established a similar, but more limited, set of projects for the Pacific Fleet, it was with the same team.

In January 1999 the scope of nuclear material protection, control, and accounting cooperation with the Russian navy was expanded.[34] New initiatives included further upgrading of nuclear fuel storage facilities, a feasibility study for dismantling aging submarines, and the securing of naval spent fuel that represented a proliferation threat. The program was broadened to include a naval training facility in Obninsk. More importantly, the security upgrades discussed above were to be extended to the Russian navy's nuclear weapon installations as well as fuel sites.[35]

On 31 August 2000 an "umbrella" agreement was signed between the U.S. Department of Energy and the Russian Ministry of Defense solidifying this realm of cooperation and outlining expanded future joint work in nuclear material security. By this agreement the Russian navy formally became the Russian executive agent for implementing the cooperative program.[36]

Other U.S. agencies are far from reaching the level of collaboration with the Russian Ministry of Defense that DoE has achieved. The Russian Ministry of Defense has not provided the U.S. Department of Defense with any access to nuclear weapon installations.[37] However, 34 percent of the fencing paid by the United States has been installed to address external threats at fifty-two Russian nuclear weapon sites. In sum, the progress of the Defense Department's "Weapons PC&A program," with the Twelfth Main Directorate of the Russian Ministry of Defense, has been limited.[38] For the most part, the Defense Department has hardly been able to move beyond testing the MPC&A equipment to be installed.[39] The high-level agreement between the DoE and the Russian defense ministry was thus a very important breakthrough.

An overview of completed and ongoing DoE naval facility security upgrades as of June 2003 is given in tables 3A and 3B.

THE FOUNDATIONS OF SUCCESS IN NAVAL MPC&A

The examination that follows of the reasons for the progress made in U.S.-Russian naval security upgrades is based primarily on interviews with key American personnel. There are essentially five reasons, all of which are likely to play important roles in the final outcome of the program:[40] strategic goals and approaches; organizational structure and work methods; compliance with domestic laws and with licensing and certification requirements; high-level involvement and support; and finally, sustainability.

Strategic Goals and Approaches

For the fresh-fuel security upgrades, the Russian and American sides shared interests and purposes from the beginning. Several thefts of naval HEU fuel prompted the Russian navy to make contact with the United States, and the Americans were eager to limit the diversion of the proliferation-attractive material. The efficiency achieved in implementation was a direct consequence of the work done for the Murmansk Shipping Company at Atomflot and on board the

TABLE 3A
U.S.-SUPPORTED NAVAL MPC&A UPGRADES

Site	Location	Type	MPC&A Activity	Dates	Remarks
49	Severomorsk	Consolidated Nor. Fleet storage	Storage annex[a]	May 96–Sep. 99[b]	Main fuel storage for Northern fleet; possibly already at capacity
34	Near Vladivostok	Fresh fuel storage	Building replaced[c]	Spring 99–Sep. 2000[d]	
32	Colloc. with Sites 34, 86	Irradiated, damaged fuel	Integ. system upgrades[e]		
86	Colloc. with Sites 32, 34[f]	Irradiated fuel	Integ. system upgrades		
PM 63	SevMash, Belomorsk naval base, Severodvinsk	Auxiliary vessel[g]	Shipboard, pierside upgrades	1998–May 2000[h]	First upgraded ship; *PM 12, PM 74* same class
PM 12	Olenya Bay naval base, near Murmansk	Auxiliary vessel	Shipboard, pierside upgrades	Aug. 98–Sep. 2000	
PM 74	Near Vladivostok	Submarine refueling vessel[i]	Shipboard, pierside upgrades	Comp. Sep. 2000	

a. Capacity expansion, physical upgrades, computerized control and accounting. Oleg Bukharin, Matthew Bunn, and Ken N. Luongo, *Renewing the Partnership: Recommendations for Accelerated Action to Secure Nuclear Material in the Former Soviet Union* (Princeton, N.J.: Princeton University, Russian American Nuclear Security Advisory Council, August 2000), p. 60; and David Lambert et al., "Upgrades to the Russian Navy's Consolidated Storage Locations and Fuel Transfer Ships," *Proceedings of the 39th Annual Meeting of the Institute of Nuclear Material Management* (n.p.: 1998).

b. U.S. General Accounting Office, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed,* GAO-01-312 (Washington, D.C.: February 2001), p. 34.

c. New building has same upgrades as Site 49, with hardened entrance portal.

d. DOE Press Release, "Secretary Richardson Hails Completed Security Upgrades at Ceremony in Russian Far East," US R-00-226, 1 September 2000, available at *U.S. Department of Energy,* energy.gov/HQPress/releases00/seppr/pr00226.htm.

e. Detection, communications, intruder delay, response, control, and accountability.

f. GAO, *Nuclear Nonproliferation,* p. 8, n. 6.

g. Large capacity for fresh and spent fuel, liquid radioactive waste.

h. John Brook Wolfsthal, Cristina-Astrid Chuen, and Emily E. Daughty, eds. *Nuclear Status Report 6* (Monterey, Calif.: Monterey Institute of International Affairs; and Washington, D.C.: Carnegie Endowment for International Peace, June 2001), p. 134.

i. Carries submarine fuel from Chzhma ship repair facility to Gornyak shipyard. Ibid., p. 146.

Imandra. The Russian navy appreciated the demonstrated U.S. interest and commitment, and as a result, for the first time the Department of Energy had an opportunity to work directly with the Russian Ministry of Defense.

At the outset of the cooperation with the Russian navy, a step-by-step approach was chosen, in which the Russians decided upon each next step. Every project thus depended on the success of the previous one, and progress was closely watched. As one of the American project members stated, "There was zero tolerance for failure." Later, urgent improvements (generally finished within six months) were pursued in parallel with preliminary design work on comprehensive security upgrades at the same locations. The comprehensive projects would be negotiated and then implemented according to the agreed plans.[41] As the upgrades proceeded, it became more and more apparent to each party that its counterpart was committed to make the program work.

Organizational Structure and Work Methods

The initial organization chosen for the naval upgrades was "flat," a pragmatic, highly efficient structure. Communication was free among all parties involved. U.S. team members could personally contact high-level Russian navy counterparts. This drastically increased interaction and allowed for quick problem solving when needed.

The naval MPC&A program was thus a true child of the teamwork spirit of the early days of U.S.-Russian cooperation.[42] The new MPC&A approach included willingness to use Russian equipment and contractors.[43] The program also offered a more flexible approach to verification. Instead of a strict on-site inspection regime, a more cooperative and less adversarial approach was chosen. American and Russian MPC&A experts would sit down together and jointly assess the situation before and after the security upgrades. What the U.S. team might lose in terms of insight through formal inspections it was likely to gain through a voluntary and informal flow of information.

Cooperation between DoE and the Russian navy is governed by confidentiality agreements. Information shared within the joint working group that has not previously been published in the public domain can be released only by consent of all parties involved. This effectively precluded external assessment or supervision, but it probably helped increase significantly the information flow within the group.

The naval MPC&A upgrades are supported by formal documents on all levels and at all stages of the work. Everything from working plans to protocols and agreements had (and has) to be approved by all parties. This arrangement allows formalized delegation of responsibilities and a transparent working environment. Some overarching agreements have, however, been put in place after the

TABLE 3B
U.S.-SUPPORTED NAVAL MPC&A UPGRADES (cont'd)

Site	Location	Type	MPC&A Activity	Dates	Remarks
Navy 2d (Nor. Flt. storage)		Nor. Fleet storage			Planned before consol. at Site 49; not started
SevMash shipyard	Severodvinsk	New upgrades	New and integrated upgrades[a]	1st phrase started 1998, complete. 2d phase started 2001, near completion June 2003	2d phase upgrades Bldg. 438 at sub-marine assembly facility
Murmansk Shipping Co.	Atomflot, north of Murmansk	Auxiliary *Imandra*	Physical barriers, port security	July 96–Sep. 99[b]	Icebreaker upgraded by Norway, Sweden
Murmansk Shipping Co.	Atomflot, north of Murmansk	Nuclear-propelled civilian icebreakers	Security upgrades onboard the ships	Work initiated 1999[c]	Funds for the up-grades provided by Norwegian, Swedish, and Brit-ish authorities
Navy nuc. wpn. sites[d]	42 sites[e]	Nuclear weapon storage	As for fresh fuel	Planned; to be finalized by 2005	Locations classified

a. Upgrades for detection, intruder delay, response, and material accounting.

b. U.S. General Accounting Office, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed,* GAO-01-312 (Washington, D.C.: February 2001), p. 34.

c. Upgrades completed on three *(Sovjetsky Soyuz, Vaigach, Yamal)* out of eight ships as of summer 2003.

d. U.S. General Accounting Office, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed,* GAO-01-312 (Washington, D.C.: February 2001).

e. Northwestern Russia and Far East, locations unknown. All are inside operational naval bases. Total 260 metric tons of nuclear material, number of warheads unknown.

projects were well advanced, either to boost or expand ongoing activities or for corrective reasons.[44]

The Russian side identifies facilities in need of upgrading. In the design of optimal security solutions, however, the two sides work together. A joint vulnerability assessment is performed with the Assess computer model, after discussions on the input data. Design consensus is not only sought but essential before implementation of individual upgrades. For example, one facility lacked a sufficient guard force. No money was released nor further work authorized before the Russians increased the guards there. (It was this experience, moreover, that made the Russians realize the need to consolidate the fuel at fewer sites, as no upgrades would be made at other facilities without similar guard force improvements.)

The Kurchatov Institute serves as a general contractor and an agent for the Russian navy, as the navy itself is not allowed to sign contracts with U.S. laboratories. In addition, the institute often executes work tasks. Vulnerability assessment and preliminary designs are typically assigned to Kurchatov, as is the establishment of training programs. The institute can subcontract negotiated tasks; it is the parent company of Atomservice (AS), which performs all types of civil engineering and construction work. Other security subcontractors are Eleron and Escort Center; the American team can go directly to these firms if the Kurchatov Institute is not involved.

The United States pays only for work completed, and not for overhead costs to the Russian participants. Completed security upgrades are certified in writing by the Russian navy and are generally inspected by American representatives. All work performed must be documented and results demonstrated prior to payment. Every contract is negotiated separately. U.S. laboratories now sign contracts directly with their Russian counterparts, after approval by Department of Energy headquarters. However, attempts have been made to centralize these contracts on the U.S. side, as part of an attempt to track negotiations more closely and to streamline and expedite contacts.

Compliance with Domestic Laws and Regulations

Security systems are designed in accordance with vulnerability assessments and technical specifications jointly agreed upon. Russian contractors then build the systems to the agreed design. The systems typically consist of a wide range of components, including foreign equipment bought in Russia. However, as long as these components are precertified by relevant Russian authorities, final designs and systems are regarded as Russian. This eases often-complex issues related to certification, taxation, and maintenance.

In parallel with the upgrades, a documentation project has been initiated to assess the current MPC&A regulatory status of the Russian naval nuclear materials and to determine what the governing regulations and guidelines are.[45] While the United States recognizes the relevance of Russian laws and regulations, it is not likely to pay for measures not indicated by vulnerability assessments even if they are required by Russian law. The Russians are, however, free to include such features themselves. One example is radiation monitors; Russian law calls for them, but because they do not directly improve security, they are not normally installed at U.S. expense.

High-Level Involvement and Support

The Russian navy's Inspectorate for Nuclear and Radiation Safety and Security plays an essential role in this collaboration. The inspectorate is led by Admiral Nikolai Yurasov. The admiral is well regarded within the Navy, and his interest in and promotion of these security upgrades have been instrumental in the success and progress of the program. Russian high-level support extends to the head of the Northern Fleet, a fact that has eased interactions with headquarters-level bureaucrats and military opponents of this collaboration. It has, moreover, created an important vehicle for communication with other Russian agencies, like the forces of the Ministry of Interior, which protects facilities of the Russian Economic Ministry, and the Federal Security Service (FSB).[46]

The fact that the Navy quite early acknowledged an internal security problem and declared a genuine interest in fixing it has been important for the support it has received. MinAtom, in contrast, has tended to put less emphasis on the inside threat and to regard MPC&A deficiencies as primarily an economic problem. International expertise and cooperation thus easily become secondary in MinAtom's eyes to obtaining domestic funding for upgrades. Cultural and organizational differences in the two organizations are also likely to have played a role. A naval chain of command seems to have eased communication of and reinforced directives from Moscow to the facilities where installations were to take place, limiting the effect of any local intransigence.

On the American side, however, if the naval MPC&A program had top-level support in DoE, it may have lacked high-level *interest*. In the beginning, the small program was not perceived as very important and was more or less "left alone." This may have actually, if paradoxically, helped in the initial stages of the program, as it gave the U.S. side discretion to build the strong foundation its Russian counterpart was looking for. The American team was not afflicted by personnel replacements, and all participants soon knew each other. Internal rules establishing a well defined process, mode of cooperation, and working structure were quickly put in place. That experience of building up working groups contrasts, to some degree, with DoE collaborations with MinAtom. There, in an attempt to manage the program and prevent personnel "burnout," the U.S. side has changed personnel and administrative procedures quite frequently, probably to the detriment of the long-term effort.

The role of the U.S. Navy in the early stages of the naval MPC&A cooperation has been given little or no attention. The initial hope was to get the U.S. Navy "on board" and initiate reciprocal visits and activities for Russian counterparts to American naval bases. This, however, has been unacceptable to the U.S. Navy, so much so that the American MPC&A community is concerned that the whole collaboration would fail if the Russians asked for such visits. (They have never demanded or requested any such reciprocity.) Further, to limit the risk to sensitive nuclear information, the U.S. Navy has insisted that only personnel unfamiliar with its activities be involved in cooperation with the Russian navy. (The American team members, handpicked from national laboratories, had indeed little knowledge of U.S. naval secrets.) These initial objections having been met, the U.S. Navy backed the program. Its endorsement was of great importance in terms of domestic political and bureaucratic support for the program. Throughout the project, the U.S. Navy has been regularly updated as to progress.

Until recently, and while DoE has always dealt with overall policy issues and provided oversight, the American team has continued to enjoy a fairly free and open environment with respect to discussions with Russian counterparts on technical issues. However, as the naval MPC&A program has grown and matured, so also has high-level interest on both sides, and with it requirements for oversight and control. The recent expansion of MPC&A upgrades to naval nuclear-weapons installations has also produced closer follow-up and tighter reins. Further, on the American side, increasing interagency and congressional interest has required closer project management and an increase in staff at the federal level. The result has been more complicated and lengthy procedural approaches, and in turn slower processes and prolonged negotiations, all of which create frustration at the working level. It has, moreover, limited the interaction and communication among technical project participants on both sides, reducing the possibility of quick problem solving when needed.

Sustainability

The training of Russian naval personnel is an integral part of the MPC&A program, vital to its long-term operation. A goal of the training program is to instill in managers a culture of sustainable commitment to MPC&A activities.[47] A series of two courses has been developed and presented at the Kurchatov Institute. An MPC&A fundamentals class consists of class lectures and practical training at various facilities. The objective of the second training course is to prepare naval personnel to work independently in their particular areas at naval facilities.

In addition, to validate the long-term performance of the installed systems, a program has been initiated to deal with their life-cycle management. The Kurchatov Institute has been given this task under a separate contract. The program provides a structured way of ensuring the performance and integrity of all components (including the guard force) of an upgraded system, through regular (annual) testing, and the program has been the preferred approach of the Russian Ministry of Transportation. The program reveals whether everything is in place and identifies special needs, like additional training, maintenance, or spare parts, as well as problems with software, hardware, or procedures. Life-cycle management is a quantifiable way of addressing long-term risk reduction and sustainability of measures put in place. Moreover, structured follow-up reinforces the sincerity and commitment to the joint cooperation of all involved.

FUTURE CHALLENGES AND THE WAY AHEAD

The naval MPC&A program now having been successfully implemented, and in view of the remaining challenges in fissile material security, the theme for the future must be *expansion*. Specifically, the scope of the naval MPC&A cooperation could be extended, and the naval approach could be extended to U.S.-Russian MPC&A cooperation as a whole.

Expanding the Scope of Naval MPC&A Cooperation

Notwithstanding the accomplishments of naval MPC&A, there is unfinished business, as well as room for further improvement in the cooperation with the Russian navy. As Russian naval facilities are not subject to any form of independent supervision or licensing, the long-term quality and sustainability of the measures now in place are hard to evaluate and protect. Thus, an independent review of the overall integrity of the integrated systems put in place would be highly desirable.

The life-cycle management program now introduced is a step in the right direction, but there is a risk that the highly pragmatic U.S. approach taken has neglected Russian laws and regulations—and in a way that may undermine the long-term security goals of all parties. Certainly, due to budgetary constraints and the necessity for speed, none of the security systems installed are likely to meet domestic American standards. The installed accounting systems for fresh fuel were developed without access to classified Russian fuel information, making their value somewhat uncertain.[48] Moreover, the guard force is an integral component in the MPC&A system, yet its mode of employment is novel for Russian security forces and still poorly understood.

Further, spent naval fuel may contain both plutonium and highly enriched uranium, and therefore may constitute a proliferation risk; in particular, naval fuel with low burn-up and extended cooling periods is potentially attractive to would-be proliferators, both states and subnational groups.[49] Currently, the U.S. MPC&A mandate excludes all of this material. Irradiated Russian naval nuclear fuel in fact remains highly enriched;[50] taking into account its cooling time, it does indeed pose a threat from a proliferation standpoint.[51] This threat will only increase with time.

Moreover, while the Russian navy has declared that all its fresh fuel in the northern region has been consolidated into one building, Site 49, where it is protected, there has been no independent verification. As recently as 1996 the number of storage facilities to be covered was not known; anecdotal reports indicate that fresh fuel dumps had been established on the Kola Peninsula as backups for crises.[52] Thus, there is a risk that the Russian navy has not included all depots needing upgrading—and Site 49, though newly expanded, is reportedly already full. No U.S. teams have visited even the known old facilities to verify that nothing was left behind in consolidation. Again, therefore, an independent review analysis would be highly desirable, to increase confidence in system performance and coverage. Such an overall, independent assessment should also be of interest to the Russian navy, as it would boost security and possibly strengthen the prospects of expanded American funding.

The inclusion of nuclear weapon sites in the naval MPC&A program is an important and particularly gratifying development. Russia has indicated that it would like improved security systems installed at additional weapons locations. However, as of March 2003, Russia has provided only limited information about new nuclear weapon locations and security conditions.[53] The needed information ought to be presented as soon as possible, again to secure future funds and allow prudent long-term planning.

Finally, the naval program's establishment of close working relations and consolidation of fuel at centralized storage facilities has created a sound basis for an overall Russian HEU accounting exercise. The naval MPC&A may therefore act as a springboard to increased transparency and possibly future nonintrusive verification measures for highly sensitive fuel cycles—that is, material with classified parameters, like the fuel used for naval propulsion or excess fissile material from dismantled nuclear weapons.[54]

Extending the Naval Approach

Russia and the United States have come a long way in their nuclear security cooperation. Yet, as mentioned, the majority, and probably the most challenging, of the needed MPC&A upgrades in the Russian Federation lie in other cooperative programs for protection of weapon-usable material. Several calls have thus been made for the need to revitalize U.S.-Russian nonproliferation cooperation.[55] In this regard, there is a particular need for a comprehensive review of cooperative security programs to assess strengths, weaknesses, successes, and failures. The focus should be on identifying lessons and determining how to use them to solve current and future problems.[56]

The pragmatic, coherent, and flexible stepwise approach of the initial naval MPC&A upgrades has pointed to a highly efficient way of solving access problems and achieving results at sensitive facilities. Naval MPC&A would be a useful "case study," a source of working methods that might be fruitful at other sensitive facilities in the Russian nuclear-weapon complex. Currently, however, such unusual program approaches are not held up to broad scrutiny, except on a piecemeal or even accidental basis, since there is no regular discussion of policy implementation standards.[57]

Ideally, the naval MPC&A experiences could be shared in the forum of a joint, overarching U.S.-Russian technical committee overseeing the MPC&A program, and then distributed to other MPC&A personnel through seminars or guidelines on achieving program objectives. Policy makers and bureaucrats could be invited to workshops and briefed on different MPC&A working approaches. This not only would help them identify best practices and pertinent differences in national safety and security cultures but could create a foundation for extended and coordinated threat-reduction support from a wider range of contributors, such as Western Europeans, who have a self-interest in seeing all MPC&A programs sustained and strengthened. Naval MPC&A experience could, moreover, be fed into ongoing access discussions and negotiations between the Russian and American parties, to help them better determine what kinds of access are needed, to what, and to what ends.

In the early stages of the U.S.-Russian MPC&A cooperation, a joint steering group dealt with overall planning and discussions, and developed a joint plan (including a section on the flexible-assurances approach). This coordinating group was eliminated in the fall of 1995, after internal disagreements on the Russian side about who should be in charge of the group. One option would be to revive this group, making sure that its composition met the criteria of all parties. A twofold approach could be considered. A U.S.-Russian MPC&A steering group could deal with the policy aspects and coordination of MPC&A activities. An equivalent joint technical coordinating group could, on the basis of the naval approach, identify and refine technical approaches that have been valuable.

Sustainability is typically seen as a "Russian" issue, one of merely overcoming deterioration due to organizational, structural, technological, and cultural factors.[58] However, there seems to be a need to address the sustainability of sound MPC&A policy and practice as well. It may be hard to rebuild the collaboration if it is somehow destroyed; the benefits of maintaining the novel U.S.-Russian working relationships achieved seem obvious. In recent years, bureaucratic factors have hampered the effective implementation of U.S. nonproliferation policies in Russia.[59]

With the expansion of security upgrades to the area of naval nuclear weapons, and with increased U.S. and Russian federal interest in the project, further changes of the "rules of the game" may be deemed necessary to allow high-level authorities on both sides to follow the developments more closely. If so, much care should be given to avoiding new procedural difficulties. The future of U.S.-Russian naval security upgrades, and the MPC&A program in general, may strongly depend on how well trade-offs are chosen between progress and strict oversight.

The results of the naval upgrades confirm that U.S. and Russian experts working together in a spirit of partnership and mutual respect can significantly reduce the risks of nuclear proliferation by improving systems of nuclear material protection, control, and accounting.[60] As evidenced by the naval MPC&A program, a flexible and nonadversarial cooperative approach is likely to avoid many of the problems other parts of the MPC&A program are facing and thus to achieve the shared long-term goals of sustained nuclear security.

NOTES

1. See *MPC&A Program Guidelines,* www.nap.edu/html/nwm_russia/appendices .html#e.
2. Oleg Bukharin, Matthew Bunn, and Ken N. Luongo, *Renewing the Partnership: Recommendations for Accelerated Action to Secure Nuclear Material in the Former Soviet Union* (Princeton, N.J.: Princeton University, Russian American Nuclear Security Advisory Council, August 2000).
3. Vladimir Sukhoruchkin et al., "United States–Russian Laboratory-to-Laboratory Cooperation on Protection, Control, and Accounting for Naval Nuclear Materials," *Proceedings of the Institute of Nuclear Material Management,* Naples, Florida, 1996.
4. U.S. General Accounting Office [hereafter GAO], *Weapons of Mass Destruction: Additional Russian Cooperation Needed to Facilitate U.S. Efforts to Improve Security at Russian Sites,* Report to the Ranking Minority Member Subcommittee on Financial Management, the Budget, and International Security, Committee on Governmental Affairs, U.S. Senate, 2003, p. 25.
5. For an overview of the programs, see William Hoehn and Christopher Fieck, "U.S.-Former Soviet Union Cooperative Security Programs," *Arms Control Today* (January/February 2001). For a discussion about the programs, see Leonard S. Spector, "Strategic Planning for U.S. Nonproliferation Activities in Russia," in *WMD Threats 2001: Critical Choices for the Bush Administration,* ed. Michael Baretta, Monterey Nonproliferation Strategy Group Occasional Paper 6 (Monterey, Calif.: Center for Nonproliferation Studies, Monterey Institute of International Affairs), p. 38.
6. Leonard S. Spector, "Missing the Forest for the Trees: U.S. Non-Proliferation Programs for Russia," *Arms Control Today* (June 2001), p. 6.
7. GAO, *Weapons of Mass Destruction.*
8. Laura Holgate, "From Islands to Continents: Filling the Ocean in U.S.-Russian Cooperative Programs" (paper presented at the 11th Annual International Arms Control Conference, 20–22 April 2001, Albuquerque, New Mexico).
9. The idea of assurances is not new but dates back to mid-1994, in the U.S.-Russian Lab-to-Lab program. DoE has, for instance, used video and photographs instead of physical access at Snezhinsk; GAO, *Weapons of Mass Destruction,* p. 30.
10. U.S. Dept. of Energy [hereafter DoE] has determined that 243 buildings at forty sites in Russia (including central alarm stations) require improved security systems to protect weapons-usable nuclear material from theft more effectively. DoE plans to complete its work at naval fuel storage sites in 2006, at civilian sites in 2007, and at the nuclear weapons complex in 2008. Ibid., pp. 24–25, 29.
11. Ibid., p. 26.
12. Due to current Russian economic hardship, the Russian nuclear fleet is at an all-time low in terms of operation and readiness. Nonetheless, to increase security the Russian navy has taken steps that have resulted in increased transparency of its nuclear propulsion programs.
13. GAO, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further*

Enhancements Needed, GAO-01-312 (Washington, D.C.: February 2001), p. 32.

14. GAO, *Weapons of Mass Destruction,* p. 32.

15. Secretary of Energy Spencer Abrams, remarks delivered to the Carnegie International Non-Proliferation Conference, Washington D.C., 14–15 November 2002.

16. GAO, *Weapons of Mass Destruction,* p. 32.

17. Mark Hibbs, "Czech Find May Be Re-Enriched to Naval Fuel or Research Reactors," *Nuclear Fuel* 20, no. 1 (1995), p. 12.

18. Jill Tatko and Tamara Robinson, "Russia: Northern Fleet Overview," cns.miis.edu/cns/projects/nisnp/naval/nucflt/norflt/norflovr.htm (created April 1998, updated February 1999). See www.nti.org/db/nisprofs/russia/naval/nucflt/norflt/norflovr.htm.

19. Oleg Bukharin and William Potter, "Potatoes Were Guarded Better," *Bulletin of the Atomic Scientists* (May–June 1995), p. 50.

20. Bukharin, Bunn, and Luongo, p. 60.

21. Under this program, Russian fresh naval fuel is consolidated into two central facilities, one for the Northern Fleet (Site 49, at Severomorsk) and one for the Pacific Fleet (Site 34, at Primorye).

22. Clay J. Moltz and Tamara C. Robinson, "Dismantling Russia's Nuclear Subs: New Challenges to Non-Proliferation," *Arms Control Today* (June 1999), www.armscontrol.org/ACT/jun99/subjun99.htm.

23. Gary Tittemore et al., "Cooperative MPC&A Enhancements at Russian Navy Sites," *Proceedings of the Institute of Nuclear Material Management,* Indian Wells, California, 16 July 2001.

24. Transportation systems were to be delivered to the Northern Fleet in October 1998 and to the Pacific Fleet in February/March 1999. David Lambert et al., "Upgrades to the Russian Navy's Consolidated Storage Locations and Fuel Transfer Ships," *Proceedings of the Institute of Nuclear Material Management,* Naples, Florida, 1998.

25. Sukhoruchkin et al.

26. Vladimir M. Shmelev et al., "Russian Navy Fresh Fuel MPC&A Training," *Proceedings of the Institute of Nuclear Materials Management,* Naples, Florida, 1998.

27. The Russian navy's nuclear program originated at the Department of Ship Propulsion Reactors at the Kurchatov Institute. Ties to naval reactor propulsion continue to be strong, through, for instance, criticality calculations, naval reactor research and development, and training of sailors in reactor physics.

28. Building 116, which contains HEU, served both as a test and a demonstration site for U.S.-Russian cooperative security upgrades.

29. DoE, *United States/Former Soviet Union: Program of Cooperation on Nuclear Material Protection, Control and Accounting* (Washington, D.C.: Nuclear Material Security Task Force, December 1996), p. L-L-7.

30. Sukhoruchkin et al.

31. The Russian Federation Navy's commander in chief, Admiral Feliks Nikolaevich Gromov, visited Washington, D.C., 4–8 April 1995 and met with Secretary of Defense William Perry, Chairman of the Joint Chiefs of Staff General John Shalikashvili, Commandant of the Marine Corps General Carl Mundy, and other senior U.S. naval officers and Defense officials. See *Navy Office of Information,* www.chinfo.navy.mil/navpalib/news/navnews/nns95/nns95017.txt.

32. Shmelev et al.

33. Moltz and Robinson, p. 80.

34. Kenneth B. Sheely, "New Strategic Directions in the MPC&A Program," *Proceedings of the 40th Annual Meeting of the Institute of Nuclear Materials Management,* Phoenix, Arizona, 1999, available at www.nn.doe.gov/mpca/text/t-broch/t-ksbpaper.htm.

35. Generally, the same approaches and tools for security upgrades are used at weapons installations as for fuel sites, though in a somewhat more stringent manner. A vulnerability assessment is performed, and on the basis of the result a system is designed with the necessary integrated security components: alarms, detectors, barriers, and communications.

36. Under the agreement, technical assistance may be rendered for "improving physical protection at nuclear fuel storage facilities of the Russian Navy Pacific and Northern Fleets ashore and afloat" and for "creating systems of accounting, control and physical protection of nuclear materials at nuclear

submarine bases as well as Russian Federation Navy enterprises.” An English version of the agreement may be found at cns.miis.edu/db/nisprofs/russia/fulltext/doe_mpca/doe2000/mpca00en.htm.

37. GAO, *Weapons of Mass Destruction,* p. 32.

38. This program (like the DoE MPC&A) grew out of the Cooperative Threat Reduction (CTR) program. The implementing arm on the U.S. side is the Defense Threat Reduction Agency, DTRA.

39. With some exceptions, the U.S. Defense Department tests all its equipment at designated sites in Russia prior to putting them in service.

40. A related set of assessment criteria can be found in John M. Shields and William C. Potter, “Cooperative Assistance: Lessons Learned and Directions for the Future,” in *Dismantling the Cold War: U.S. and NIS Perspectives on the Nunn-Lugar Cooperative Threat Reduction Program,* CSIA Studies in International Security (Cambridge, Mass.: MIT Press, 1997), pp. 386–405.

41. Vladimir Sukhoruchkin (presentation to the 42nd Annual Meeting of the Institute of Nuclear Material Management, Indian Wells, California, 16 July 2001).

42. The director of the Los Alamos National Laboratory from 1986 to 1997, Siegfried S. Hecker, emphasized that much of the success of the initial Lab-to-Lab program was due to the trust and friendship developed with Russian nuclear scientists. “Russian-American Collaborations to Reduce the Nuclear Danger,” *Los Alamos Science,* no. 24 (1996), p. 3.

43. In the early days of the cooperation, it was all “Buy American,” and all tasks were assigned to U.S. laboratories.

44. One example is the August 2000 agreement. An “umbrella agreement,” it is the strongest so far, covering past cooperative actions and security upgrades at naval nuclear-weapon facilities.

45. Including documents on a federal level (e.g., laws, orders, and requirements) and on the navy level (including MPC&A regulatory rules). DoE, *Partnership for Nuclear Security: United States/Former Soviet Union Program of Cooperation on Nuclear Material Protection, Control, and Accounting* (Washington, D.C.: Nuclear Material Security Task Force, September 1998).

46. The ministry owns the SevMash production facility, where most Russian nuclear submarines are built. The Russian navy protects its own bases. All contact with the FSB is through the Russian navy; there has been no direct interaction with the FSB in the program.

47. Shmelev et al. The paper includes an overview of the course curricula.

48. Russians provided the inputs themselves, and the parties agreed only upon the structure of the database. The Kurchatov Institute served as a main contractor for the project.

49. Due to residual heat and highly radioactive fission products, spent naval fuel needs cooling. The radiation from the fission product creates for decades a self-protecting barrier against theft and diversion. This barrier, however, will diminish over time, potentially making the fuel—and thus the highly enriched uranium and plutonium—accessible to intruders. For proliferators, see Ole Reistad and Knut Gussgard, “Russian Spent Marine Fuel as a Global Security Risk” (paper presented at the International Conference on Security of Material Measures to Prevent, Intercept and Respond to Illicit Uses of Nuclear Material and Radioactive Sources, International Atomic Energy Agency [IAEA], Stockholm, Sweden, 7–11 May 2001).

50. Nikolai Yurasov [Rear Adm., RF Navy], “Modernization of Navy Nuclear Fuel Storage Protection,” *Proceedings of the Institute of Nuclear Material Management,* Naples, Florida, 1999.

51. Lambert et al.

52. Sukhoruchkin et al.

53. GAO, *Weapons of Mass Destruction,* p. 32.

54. For example, nuclear material containers could be equipped with computerized bar codes and tamper-resistant seals that would allow site personnel to perform quick inventories and would raise confidence that none of the containers were tampered with. GAO, *Nuclear Nonproliferation,* p. 12. For other nonintrusive transparency options on naval fuel, see Morten Bremer Maerli, “Transparency Technologies and the Naval Nuclear Fuel Cycle,” *Proceedings of the Institute of*

Nuclear Material Management, Naples, Florida, 2001.

55. William Potter and Sergei Batsanov, "U.S-Russian Relations: Practical Measures to Restore Nuclear Non-Proliferation Cooperation," in *WMD Threats 2001,* ed. Baretta, pp. 13–16, and Kenneth N. Luongo, "The Uncertain Future of U.S.-Russian Cooperative Security," *Arms Control Today,* January/February 2001.

56. Kenneth N. Luongo, "The Uncertain Future of U.S.-Russian Cooperative Security," *Arms Control Today* (January/February 2001).

57. Rose Gottemoeller, "Bureaucratic Balkanization: The Need for a Functioning Interagency Process," in *WMD Threats 2001,* ed. Baretta, p. 32.

58. See, for example, Galya Balatsky, *Sustainability Issues: Russian Aspects,* Report LA-UR-01-1683 (Los Alamos, N.Mex.: Los Alamos National Laboratory, 2001).

59. Gottemoeller, p. 31.

60. Based on the early prospects of the U.S.-Russian cooperation presented in Sukhoruchkin et al.