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Combatting Fissile Materials Smuggling Workshop #5

3–4 February 1998

Workshop Coordinator: Maj. Vincent Jodoin

Hosted by:
Lawrence Livermore National Laboratory
Proliferation Prevention and Arms Control Program
Center for Global Security Research

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SUMMARY

On 3-4 February 1998, the Air Force Institute for National Security Studies sponsored the fifth in a series of Workshops which focus on the prevention of nuclear smuggling. This Workshop, "Combating Fissile Material Smuggling: Workshop #5," was hosted by Lawrence Livermore National Laboratory, Center for Global Security and the Proliferation Prevention and Arms Control Program. Workshop #5 was held in Dublin, CA. This Workshop was conducted in an unclassified environment, with an opportunity to discuss classified material/presentation at LLNL.

The previous INSS Workshops were held at the United States Air Force Academy (5 June 1995), the National Defense University, Ft. McNair, Washington, DC (5 December 1995), the United States Army War College, Carlisle Barracks, Pennsylvania (25-26 June 1996), and the Ridgway Center for International Security Studies, University of Pittsburgh, Pittsburgh, Pennsylvania (9 July 1997).

This Workshop permitted more than 60 representatives from government, academic, and private industry to exchange information and opinions regarding the status of fissile material smuggling: evaluation of the severity of the threat and apparent lull in activity, discussion of domestic programs designed to prevent or counter fissile material smuggling, technical aspects of the prevention of nuclear smuggling, international cooperation and training to deter nuclear smuggling, and response programs. Unlike the previous workshops, Workshop #5 had a major emphasis on the international aspects of counter nuclear smuggling. Representatives from 8 European and Central Asian countries participated, describing efforts in their countries to prevent/detect /respond to nuclear smuggling threats.

The Workshop was able to capture the wide variety of efforts which have been layered to counter the threat of fissile material smuggling. As befits a problem of such global proportions, a key element in the successful defense against nuclear smuggling is international cooperation. Many examples of international cooperation were discussed: threat definition; physical protection and accounting of fissile material; detection of nuclear and radioactive material at border crossings and custom control points; law enforcement training in counter-smuggling; legal and trade deterrence to smuggling, including dual use controls; new radiation detection and forensic technology; information exchange through data bases; and response capabilities, exercises and procedures. The relative balance between threats resulting from terrorist groups and rogue nations using nuclear weapons vs. biological or chemical weapons was debated, and one conclusion was that sufficient attention has not yet been paid to the biological threat. It is suggested that future workshops might alternate between evaluation of the nuclear threat vs. the chem/bio threat.

STATUS OF THREAT

Sally Mullen
Arms Control and Disarmament Agency
Washington, D.C.

U.S. Assistance Programs for Improving MPC&A in the Former Soviet Union

Jessica E. Stern[1]

Dr. Jessica Stern, formerly with the U. S. National Security Council and Lawrence Livermore National Laboratory, is a Fellow at the Council on Foreign Relations, Carnegie Institute, Washington DC.

Ironically, some of the changes that have allowed us to reduce the world's stockpile of nuclear weapons have made our non-proliferation efforts harder. The breakup of the Soviet Union left nuclear material dispersed throughout the newly independent states. The potential for theft of nuclear materials has increased We face the prospect of organized criminals entering the nuclear smuggling business. Add to this volatile mix the fact that a lump of plutonium the size of a soda can is enough to build a bomb, and the urgency of the effort to stop the spread of nuclear materials should be clear.[2] (President Bill Clinton, March 2, 1995)

From the beginning of the atomic age, the nuclear weapons states assumed that the difficulty of producing or acquiring fissile materials would constrain nuclear proliferation. This assumption is a key premise of the international safeguards system and has shaped the debate on nonproliferation policy. Widespread knowledge of weapons design has increased the relative importance of protecting fissile materials from theft, but experts fear that worldwide safeguards may not be adequate to the task. This problem of inadequate security for fissile materials is particularly acute in the Newly Independent States (NIS) of the former Soviet Union, where social and economic changes have outpaced safeguards reform. Russian officials claim that the potential for insider theft has increased at many nuclear facilities. Kilogram-quantities of stolen weapons-usable highly-enriched uranium (HEU) have been recovered in Russia and in Europe, demonstrating the urgency of improving nuclear safeguards worldwide.

Assisting the NIS to reduce the dangers of nuclear proliferation resulting from the breakup of the Soviet Union has become one of the highest priority tasks on the U.S.-NIS nuclear agenda.[3] This article considers the extent to which U.S.-NIS cooperative programs for fissile material protection, control, and accounting, including joint projects between the U.S. and NIS governments and between U.S. and Russian national laboratories, have achieved this goal.

What would an ideal nuclear security system look like? It would contain three basic elements: 1) physical protection (barriers, sensors, and alarms to prevent intruders from gaining access); 2) material control (including locked vaults for storage of nuclear materials, portal monitors equipped to detect nuclear materials and prevent workers from walking off the site with nuclear material in their pockets, continuous monitoring of nuclear-material storage sites with tamper-proof cameras, tamper-proof seals, prohibition of access to sensitive materials unless scientists enter sites in pairs, known as the "two-man rule"); and 3) material accounting (including a regularly updated measured inventory, based on regular measurements of weapons-usable material arriving, leaving, lost to waste, and within the facility, plus a measurement control program to ensure the accuracy of the measurement equipment). These three elements together are referred to as material protection, control, and accounting or "MPC&A." Other desirable elements of a nuclear security system include a system of personnel reliability (background

checks, training, and reliable salaries for nuclear custodians) and regulation and inspection by an outside agency with real enforcement powers.

In order to make an assessment of MPC&A in the NIS, it is necessary to appreciate the disarray in the NIS nuclear security system. This article begins by analyzing inadequacies in Russia's nuclear security, focusing especially on the inventory system. Similar problems exist at the dozen or so nuclear facilities located elsewhere in the NIS, but this assessment focuses on Russia because many more nuclear facilities, and a far greater quantity of weapons-usable nuclear material, are located there. This study then describes and evaluates the successes and key problems of ongoing joint efforts to increase NIS nuclear security, including U.S.-NIS government-to-government MPC&A programs and the U.S.-Russian Lab-to-Lab program. Of particular concern in this assessment are potential threats to the continued viability of the programs, including bureaucratic issues on both sides.

This study concludes that the MPC&A program is on the right track, but its success will depend on how quickly the projects are completed. As one proponent of the program inside the U.S. government has asked, "We are making good progress, overcoming many bureaucratic obstacles as they arise, but will we succeed soon enough to prevent something terrible from happening?" That is the question, this official commented, "that keeps me awake at night."[4] Ultimately, success will depend on four additional variables: 1) bureaucratic politics (including the ability of both sides to resist taking what is now a highly successful, flexible, but somewhat messy multi-pronged approach and transforming it into a single, comprehensive, and centrally-managed government-to-government MPC&A program); 2) the ability of NIS partners to overcome their suspicions about U.S. motives, which continue to hamper cooperation; 3) the proper long-term implementation, operation, and maintenance of upgraded MPC&A systems by NIS partners, which in turn depends on the development of a safeguards culture in these countries; and 4) the U.S. administration's greater involvement in educating the public and the Congress about the importance of these programs, in order to ensure their continued funding.

INADEQUATE MPC&A FOR NUCLEAR MATERIALS

The Soviet system for protecting nuclear materials, which worked effectively for five decades of Soviet rule, "was not designed for a democratic state," according to an official with the Russian Ministry of Atomic Energy (Minatom).[5] It was designed with two objectives: preventing terrorist attacks and keeping American spies from acquiring nuclear secrets. "Nobody even considered the possibility of workers stealing nuclear materials," this official acknowledged. Another Minatom official, in a recent published account, has described a system based on "regulations and ordinances which either no longer are in place or are not effective, and upon military discipline and a sense of responsibility which no longer exist."[6]

Civilian research facilities, even those that process or store weapons-grade materials, were not considered strategically important targets for potential foreign espionage and thus have only minimal security. Since the principal purpose of the Soviet system was to keep out American spies, and since many of the people who ran that system are still on the job, it is not surprising that American experts are viewed with suspicion. Convincing Minatom officials that Americans touring and inspecting Russian nuclear sites are part of the answer, rather than the problem, "has been a

difficult sell that has required a prolonged period of socialization," in the words of a U.S. government official familiar with this process.

The Russian system of accounting for nuclear material was developed to maximize quality and quantity of the material produced. Inventories were conducted once a year using two forms—one for the Ministry of Finance and one for Minatom. For direct use (weapons-usable) materials, inventories might be taken more frequently, depending on the site, according to officials at Minatom and at the State Committee for Nuclear and Radiation Safety Supervision (known in Russian as Gosatomnadzor, or "GAN"). Russian officials explain that the philosophy of the Soviet inventory system, which stressed production targets rather than security, led to practices that they now believe must be changed in order to bring the system up to international standards. First, as a rule, input materials or feed stocks are not measured—only output is measured. "In this respect we treat HEU no differently from carbon,. a GAN official said in a recent interview.[7] But output is measured very carefully.

A second important distinguishing feature of the inventory method is the system of "allowed losses." Officials at GAN and at Minatom explain that they do not measure "material unaccounted for" or MUF, as long as material unaccounted for is within a certain range. Someone who knows the quantity of allowed losses could steal a significant quantity of HEU or plutonium, provided he did so slowly, staying within that limit over months or years.

To illustrate the "allowed losses" system, one Minatom official describes a similar regime for truck drivers responsible for transporting vodka from the production plant to the store. The Ministry of Finance (MOF) instated a system that allowed truck drivers to arrive at the store with N minus X bottles of vodka (where N is the number of bottles the truck can hold and X is an allowed number of losses, which the MOF set based on average losses per truckload). No one was concerned whether those bottles were broken or stolen, as long as the amount of vodka delivered to the store was at least N minus X. "You can be sure," this official said, "that every truck driver was exceedingly careful and that those [X number of] bottles went straight into the truck drivers' pockets." The analogy illustrates the systemic problems in Russia's nuclear inventory procedures that, unless corrected, could continue to encourage thefts of material. In the words of this same Minatom official:

The system we need to put in place for a proper nuclear materials inventory is one in which the precise amount of missing or extra material is recorded. We cannot use the Ministry of Finance system of allowed losses. We need to bring our system up to the level of international standards. But nobody in this country has any idea of how to conduct a thorough inventory of all nuclear material because we have never done it. There are only a handful of people in Russia who understand the concept of safeguards....They are scientists who have worked for the IAEA.[8]

Several officials have recounted in interviews the case of nuclear material theft in Podol'sk, in which a worker stole one and a half kilograms of HEU over a long period of time. The missing HEU was never detected during inventories because the worker knew to stay within the allowed losses limit.[9] One official from the Russian National Security Council also confirmed in a recent interview what other Russian officials have said in the past: to ensure their ability to meet production quotas under the Soviet system, nuclear facilities often produced extra plutonium to have on hand in case of an inventory shortfall in future years. As much as 10 percent of production

might have been diverted without being entered into the accounting system, this official explained.[10]

This practice of producing excess plutonium was not considered dangerous from the standpoint of theft, since there was no market in Russia for HEU or plutonium. Now, however, there is a growing perception of a lucrative market for nuclear materials. These secret caches of material, likely to be found at many production sites, present a real danger in the current economic environment in Russia.

INADEQUATE MATERIAL CONTROL AND ACCOUNTING (MC&A) AND WARHEAD SAFETY

Many (but not all) Russian and U.S. officials are more sanguine about warhead security than about nuclear materials security.[11] There is a basic "guards, gates, and guns," approach to warhead security. Unlike materials, in the words of one U.S. government official, "you can't use uncertainties in the accounting system to steal warheads, and you can't put them under your overcoat. It's clearly much harder to steal a warhead than to steal the materials to make one."[12]

Nonetheless, Russia's transition from an authoritarian, command economy to a struggling, chaotic democracy is subjecting the warhead security system to stresses it was not designed to withstand. Undisciplined, understaffed, and underpaid, the military is facing a crisis. Troops desperate for hard currency routinely sell conventional weapons to private consumers, often with the "mafiya" as middleman. A new openness in Russia has reduced the distance between personnel with access to nuclear weapons and "those who may hope to profit from the theft of a nuclear weapon," a U.S. intelligence official has testified. Russian security procedures were not designed to counter well-planned insider threats to weapons.[13]

Stanislav Lunev, a former Colonel in Russia's Military Intelligence Agency, the GRU, wrote recently that he believes some tactical weapons were lost in the immediate aftermath of the breakup of the Soviet Union:

Practically all army divisions located in the former Soviet republics and abroad had missile battalions and other military units capable of using tactical nuclear weapons. But nobody knows where these weapons went after the disintegration of the USSR. The Russian government doesn't know either, but still insists that there is nothing to worry about.[14]

Lunev also claims that the Russian government is depending on custodians who are paid inadequately and whose role models are "corrupt senior officers" to protect the warheads from theft. Russian officials have repeatedly denied that any warheads are missing. U.S. officials also doubt the veracity of Lunev's claims, but, as one knowledgeable analyst has admitted, "we really don't know what to believe."[15]

In a November 1995 interview, General Evgeniy Maslin, Head of Strategic Forces of the Main Directorate of the Russian MOD, repeated his assurances that an inventory of all Russian warheads, in which seals are removed and the warheads are physically inspected, takes place two times every year. However, a Minatom official who requested anonymity has claimed that the seals are removed only to assess the electronic equipment inside the warhead, not to verify the presence of nuclear material. One could easily replace a warhead with an "imitator," and the substitution would not be noticed for many months because the seals are of poor quality and can be falsified. In

the view of this official, the MOD does not understand the requirements for a high-confidence inventory and instead uses a paper-based system prone to human error, in which warheads are counted *na pal 'tsakh* (by fingers).[16] Moreover, the system is not designed to deter insider threats. Like the system for materials, it was designed with two principal objectives: to keep out Western spies and to prevent intruders from obtaining access to the weapons.

With rare exceptions, the Russian government has officially denied that nuclear warheads are vulnerable to terrorist attack or to theft. Nonetheless, the government has taken steps to remove nuclear weapons from the volatile Caucasus region and to consolidate nuclear warheads in storage—from over 600 sites in 1989, to 200 sites in 1991, to fewer than 100 in 1995.[17] Moreover, General Maslin and other officials have admitted concerns about the security of the warheads in transit. For example, in a 1995 account, General Maslin is reported to have observed:

What is theoretically possible and [for] what we must always be prepared is train robbery, attempts to seize nuclear weapons in transit. We ran some modeling exercises at our facilities [to test our warhead security system].... And I must tell you frankly that as a result of those exercises, I became greatly concerned about a question that we had never even thought of before: What if such acts were to be undertaken by people who have worked with nuclear weapons in the past? For example, by people dismissed from our structures, social malcontents embittered individuals?[18]

The troubled economy, the government's inability to pay custodians of both nuclear materials and warheads adequately, the rise of organized crime and corruption, the KGB's loss of absolute power, and the absence of a "safeguards culture" have led to a dangerous situation vis-a-vis protection of nuclear materials and, perhaps to a lesser extent, of warheads.

THE PROBLEM OF NUCLEAR THEFT: DISTINGUISHING RUMOR FROM FACT

As early as 1991, Kurt Campbell, Ashton Carter, Steven Miller, and Charles Zraket warned:

Economic disorder within the Soviet nuclear weapons complex...creates a potential source of nuclear proliferation outside the Soviet Union unlike any ever faced by the non-proliferation regime. Nuclear materials, sensitive non-nuclear components of nuclear weapons, the talents of skilled bombbuilders, and even entire nuclear weapons might find their way onto world markets.[19]

Since the dissolution of the Soviet Union, increasing U.S. and international attention has focused on the question of clandestine transfers of fissile or other nuclear materials from poorly guarded nuclear facilities in former Soviet republics to foreign states or terrorist groups. A key analytical dilemma, however, has been to determine the real dimensions of the nuclear smuggling problem. As two recent analysts of confirmed and alleged smuggling incidents have observed, there are several difficulties in determining the scale and severity of the problem:

First, nuclear trafficking is sufficiently serious that intelligence agencies are rarely willing to confirm more than the broadest outlines.... Second, Russian sensitivities and the belief in some quarters in Moscow that the danger is being artificially exaggerated in order to put Russia's nuclear weapons under international control have added another element of uncertainty.... Compounding these difficulties is the prevalence of numerous 'con men' and "scam artists" in the market. A high profile black market provides many opportunities for fraud.[20]

Most reports of alleged smuggling of nuclear weapons or weapons-usable components have been unreliable.[21] Nonetheless, a number of reported smuggling cases warrant concern. The most serious cases are those few that have involved fissile materials that could be used to make nuclear devices.[22] While no single known case has involved enough material to manufacture a bomb, kilogram quantities of stolen weapons-usable HEU have been seized both inside and outside the Russian Federation. Examples include:

- One and a half kilograms of 90 percent enriched HEU, stolen from the Luch production facility at Podol'sk in October 1992;
- Nearly two kilograms of 36 percent enriched HEU, stolen from a naval base in Andreeva Guba in July 1993;
- Four and a half kilograms of 20 percent enriched HEU naval fuel, stolen from the Murmansk shipyard in late 1993;
- Three separate caches of weapons-usable HEU and plutonium, ranging in size from less than a gram to 350 grams, seized in Germany in the summer of 1994;
- Nearly three kilograms of 87.7 percent enriched HEU, seized in Prague in December, 1994.[23]

Western officials believe that some of the materials seized abroad may also have come from Russia, although Russian officials deny this. The technical distinction between "weapons-grade" and "weapons-usable" nuclear materials has been an important issue in U.S.-Russian discussions about the smuggling problem. Russian officials have repeatedly denied that any smuggling case has involved "weapons-grade" uranium, which according to the strict definition, is uranium enriched to greater than 90 percent or plutonium with less than seven percent Pu-240. However, all the cases cited above involved nuclear materials which, in fact, could have been used in a nuclear weapon, albeit with a less efficient yield than weapons-grade material.

Are There Consumers for Stolen Nuclear Materials?

U.S. and Russian government officials claim that there is little evidence to suggest that countries or terrorist groups are actively seeking black market nuclear materials.[24]

This lack of evidence notwithstanding, the prospect that terrorists or irresponsible leaders could acquire nuclear material from poorly protected facilities in the NIS is cause for serious alarm. One Russian official has privately expressed grave concerns on this issue:

I (like many nuclear custodians) would know exactly how to go about stealing nuclear materials. I am very afraid about the future—that a terrorist group—either inside or outside Russia—will learn details about our poor level of MPC&A, the terrible economic situation...[and] that a group will find a way to pay off the relevant officials. Business in Russia is actually legalized stealing. Nearly everyone is corrupt, nearly anyone can be bought.[25]

There have been cases that appear to link buyers with sellers. Reports began to surface shortly after the dissolution of the Soviet Union that Iran had purchased nuclear weapons components, and even intact warheads, from Kazakhstan. The U.S. government looked into the reports and concluded that they had no basis in fact.[26] Subsequently, reports emerged that Iran had approached Kazakhstan in connection with enriched uranium located at the Ulbinsky (Ulba) Metallurgy Plant, a nuclear reactor fuel fabrication facility near Ust-Kamenogorsk in northeast Kazakhstan.[27]

However, the veracity of these claims, made by a number of U.S. government officials, including Secretary of State Warren Christopher, has been the subject of some dispute. U.S. government experts, in confidential interviews, have recounted claims by Kazakhstani officials that Iran had approached the Ulba plant about a possible purchase of low-enriched uranium (LEU) but *not* HEU. In another reported case, Turkish police apprehended a professor in the act of selling two and a half kilograms of uranium of uncertain enrichment to three Iranians, reportedly agents for the Iranian secret service. According to Turkish police, the uranium was brought to Turkey by visiting Russians.[28] The accuracy of this case also has been questioned, however. Konrad Porzner, Head of Germany's BND Intelligence Service, told a German parliamentary committee that he has definitive proof that Iran and Iraq have been seeking materials on the black market. Of 32 cases of interested buyers registered by German intelligence in 1995, 16 involved states, he claimed. The Iranian government denied the charge.[29]

Although it remains unclear whether any transfers of fissile or other nuclear materials from former Soviet facilities have actually taken place, the risk of such transfers clearly exists. The consequences of this problem are sufficiently grave to warrant immediate action. With this in mind, it is worth examining recent and ongoing cooperative efforts to address this threat.[30]

U.S.-NIS JOINT EFFORTS TO ADDRESS INADEQUATE NUCLEAR SECURITY

The Nunn-Lugar Cooperative Threat Reduction (CTR) program has been the Clinton administration's principal tool for working with the NIS to improve nuclear security. The original Nunn-Lugar legislation authorized the DOD to help former Soviet States to: 1) destroy weapons of mass destruction; 2) store and transport weapons slated for destruction; and 3) reduce the dangers of proliferation. The MPC&A projects, originally funded under the Nunn-Lugar program, are the most important instrument for reducing the dangers of proliferation associated with weapons dismantlement and inadequate nuclear safeguards.[31]

Since 1992, the original Nunn-Lugar MPC&A program has evolved and expanded into several independent initiatives: the Government-to-Government MPC&A program (originally funded from DOD's Nunn-Lugar budget); the Lab-to-Lab program (principally funded from DOE's budget but also receiving some funds from DOD); the DOE-GAN program (a new program funded under DOE's budget); and the warhead security program (funded from DOD's Nunn-Lugar budget). As a background to these various activities, let us first consider the White House's involvement in the MPC&A initiative and then examine in greater detail each of the four components of the program.

In January 1994, Presidents Clinton and Yeltsin agreed that reducing the risk of nuclear theft should be a "high priority," and agreed to expand cooperation to include fissile materials at both civilian and military facilities. In September 1994, they endorsed expanded cooperation, and in May 1995, they directed U.S. Vice President Gore and Russian Prime Minister Chernomyrdin to provide a status report on progress in U.S.-Russian MPC&A cooperation. After START entered into force in December 1994, President Clinton began to focus surprisingly intensively on fissile material security issues. He raised the issue repeatedly in conversations with President Yeltsin and other foreign leaders, as well as in formal summit meetings. President Yeltsin responded by proposing a G-7 plus one (P-8) conference on nuclear safety and security, now scheduled for April 1996. The White House also established a Nuclear Smuggling Response Group, overseen by the

Department of State, to coordinate U.S. government responses to significant smuggling incidents. On September 28, 1995, the president signed a decision directive that called for an acceleration of joint U.S.-NIS programs to enhance security and accounting of nuclear materials and weapons, and an expansion in diplomatic, law enforcement, and intelligence efforts aimed at stopping nuclear smuggling.

The Government-to-Government MPC&A Program

On September 2, 1993, the United States and Russia signed a Nunn-Lugar implementing agreement that included up to $10 million for MPC&A activities. This agreement became known as the "Government-to-Government" MPC&A agreement to distinguish it from the less formal "Lab-to-Lab" agreements that were negotiated in separate fora, described below. Other Government-to-Government MPC&A cooperation agreements were subsequently signed with Belarus, Kazakhstan, Lithuania, Latvia, Ukraine, and Uzbekistan.

The purpose of the Government-to-Government program is to strengthen, in a timely manner, NIS national systems of MPC&A. MPC&A systems provide the capability to deter, detect, delay, and respond to possible adversarial acts or other unauthorized use of nuclear material and, if necessary, aid in recovering nuclear materials.[32]

Initially Russian government officials were highly suspicious of U.S. motives and reluctant to allow the U.S. side access to sensitive sites. The two sides had fairly different expectations. According to one DOE official familiar with the process, the U.S. side had hoped "to begin work right away and finish as soon as possible." The United States was forced to moderate its hopes, especially about the pace of the program, in the months and years that followed.

Russia at first agreed to allow MPC&A cooperation only at civilian sites; military sites were to be off limits. Moreover, Russia initially objected to cooperation with the United States at any sites, civilian or military, involving weapons-usable materials (plutonium or HEU that can be used to make nuclear weapons). Russia first suggested two demonstration MPC&A systems at the LEU lines at Elektrostal and at Novosibirsk. LEU does not pose a significant proliferation threat, however, and the U.S. side was determined to achieve more, insisting that security be improved at sites where weapons-usable materials were most susceptible to theft or diversion. However, the Russians were understandably reluctant to allow U.S. experts to inspect security vulnerabilities at these sites; many of the sites had broken down fences and wholly inadequate controls. The suspicion that the United States had ulterior motives—to collect intelligence about Russian nuclear weapons programs—was extremely strong then and persists even now. After further discussions, the two sides agreed to an interim arrangement that included a single demonstration system at Elektrostal, as well as reciprocal visits to plutonium storage facilities at Hanford and Mayak as first steps toward greater cooperation. In January 1995, after extensive negotiations, the MPC&A Agreement was amended to include an additional $20 million in Nunn-Lugar funds, and an agreement by Russia to allow access to sites housing weapons-usable nuclear materials. Eventually the two sides agreed to cooperate at Obninsk, Dmitrovgrad, Podol'sk, Mayak, and the HEU line at Elektrostal. However, delays and broken promises continued even through the first six months of 1995. The most frustrating problem was that, despite the January agreement, U.S. experts were repeatedly denied permission to carry out site surveys at agreed facilities, a necessary first step for putting MPC&A upgrades in place. Out of $30 million allocated to MPC&A between 1992 and

1994, the administration had spent only about $1.5 million as late as June 1995. The Government-to-Government MPC&A program appeared to be in serious trouble.

A long awaited breakthrough was reached at a meeting of the Gore-Chernomyrdin Commission in June 1995. By the end of that session, DOE Secretary Hazel O'Leary and Minatom Minister Viktor Mikhailov signed an agreement calling for site surveys at all five of the agreed Government-to-Government program sites, thereby shifting the program into much higher gear. Background discussions between U.S. and Russian officials revealed that the delay in the first half of 1995 had been due, in part, to a bureaucratic battle within Minatom over responsibility for MPC&A, which had been largely resolved. Within two months, surveys were completed at all five Russian sites.[33] Since that time, a number of MPC&A activities have been ongoing at these facilities:

- At the Dmitrovgrad Scientific Research Institute of Atomic Reactors, U.S. and Russian MPC&A experts are upgrading physical protection systems at several key sites. These upgrades are expected to be complete by the end of 1996. U.S. and Russian negotiators have also discussed improvements to additional facilities at Dmitrovgrad that process HEU and plutonium.
- At the Production Association Machine Building Plant at Elektrostal, DOE has provided upgraded MPC&A equipment and MPC&A training at the LEU facility. Agreement has been reached to begin upgrading MPC&A at the HEU fuel fabrication line as well. A joint working group agreed to strive to complete the upgrades by the end of 1996.
- At the Institute of Physics and Power Engineering at Obninsk, the two sides agreed to establish a Russian Safeguards Training and Methodology Center to train Russian MPC&A specialists. This is arguably the most important element of the entire MPC&A program in that it will help establish a safeguards culture in Russia. U.S. and Russian experts have also developed a plan to expand MPC&A cooperation at Obninsk, focusing on physical protection and access control.
- At the Luch Scientific Production Association in Podol'sk, the two sides are upgrading MPC&A at two facility sites that house HEU. These upgrades are expected to be completed by the end of 1996.
- At the Mayak Chemical Metallurgical Combine at Chelyabinsk65, experts have begun planning MPC&A upgrades for plutonium reprocessing sites. The two sides agreed to install MC&A equipment and physical protection system upgrades by the end of 1996.

By 2002, DOE hopes to have cooperative programs in place for nuclear materials in each of four sectors in Russia: the Minatom civil complex; the Minatom weapons complex; facilities processing fresh naval fuel; and non-Minatom civil nuclear facilities, such as research reactors. DOE officials explain that the MPC&A program is designed to help Russia through a difficult transition until its nascent safeguards culture is more fully developed. These officials are hopeful that, by 2002, the two sides together will have put in place MPC&A upgrades at all of the most vulnerable nuclear sites, and that the program will then move on to a second phase, characterized by joint experiments, some of which are likely to be related to nonproliferation.

Non-Russian NIS

In general, Government-to-Government MPC&A projects have run more smoothly in the NIS outside Russia. Compared to Russia, there are fewer nuclear facilities in these states, housing less nuclear material, and with fewer bureaucratic obstacles to overcome. DOE has encountered some problems, however. In Ukraine and Kazakhstan, some difficulty was encountered with state licensing of MPC&A technologies to be installed at nuclear facilities. Other problems experienced throughout the NIS include customs duties, taxes, and protection of proprietary information.

As discussed below, MPC&A programs are underway at four sites in Ukraine, four sites in Kazakhstan, and one site in Belarus. DOE is also cooperating with other International Atomic Energy Agency (IAEA) members to upgrade MPC&A at sites in Latvia (Salaspils Institute of Physics), Lithuania (Ignalina Nuclear Power Plant), and Uzbekistan (Tashkent Institute of Nuclear Physics). There has been substantial progress at the site in Belarus, and the project in Latvia is expected to be completed soon. DOE conducted an initial site survey at a facility in Tbilisi, Georgia, in early January 1996 and hopes to begin cooperative work on physical protection soon. The programs for Ukraine, Kazakhstan, and Belarus, unlike the programs for Latvia, Lithuania, Uzbekistan, and Georgia, have been funded principally under DOD's Nunn-Lugar program, but future work will be carried out mostly with DOE funding.[34] When the agreement with Georgia is implemented, DOE will have joint MPC&A programs in place at all sites known to house weapons-usable material in the non-Russian NIS.

Ukraine

An MPC&A implementing agreement was signed with Ukraine in December 1993. Work is proceeding or planned at four sites:

- Kharkiv Institute for Physics and Technology: DOE completed a physical protection assessment report in September 1995 and has already supplied hand-held metal and special nuclear material detectors, computer systems, and accounting software. The project is expected to be complete by the end of 1997.
- Kyiv Institute for Nuclear Research: The project includes provision of a variety of MPC&A equipment, including hand-held metal and special nuclear material detection equipment, portal monitors, communications equipment, computer systems, a material accounting software system prototype, and seals. DOE provided MPC&A training in September 1995. A central alarm station, access control equipment, and intrusion detection equipment will be installed soon. Physical protection upgrades are expected to be complete by October 1, 1996, and MPC&A upgrades by November 1, 1997.
- South Ukraine Nuclear Power Plant: DOE has delivered a variety of MPC&A equipment (the same list as for Kyiv above, as well as a personnel badge system). DOE continues to purchase and install MC&A equipment upgrades. Physical protection upgrades are currently in the design stage and are expected to be complete by late 1997.
- Sevastopol Naval Institute: A site survey was postponed due to negotiations over the future of the Black Sea fleet and, until recently, complications involving access to a closed city.

Kazakhstan

An MPC&A implementing agreement was signed with Kazakhstan in December 1993. Work is proceeding, or planned, at four sites. DOD has provided a one-time allocation from fiscal year

(FY) 96 funds for the first project. DOE has used program funds to begin work at the other three sites.

- Aktau BN-50 Breeder Reactor: DOE conducted a site survey in November 1995 and plans to provide additional MPC&A training for reactor personnel in 1996. The Japanese government is cooperating with DOE in installing a spent fuel gate monitor.
- Ulba State Holding Company, Fuel Fabrication Plant: DOE has provided MC&A equipment, MPC&A training, and a computer system for MPC&A activities.
- Almaty Research Reactor: DOE conducted a site survey in September 1995 and will provide MPC&A training in early 1996. Additional cooperation under discussion depends on the availability of funds.
- Semipalatinsk-21: DOE is providing physical protection training. Experts have discussed nuclear materials security upgrades.

Belarus

An MPC&A implementing agreement was signed with Belarus in June 1995. Work, which began in advance of the agreement, is proceeding at one site.

- Minsk Institute of Nuclear Power Engineering (Sosny): The U.S. government has agreed to cooperate with the Swedish and Japanese governments to carry out immediate physical protection upgrades at this site. U.S. experts cooperated with Swedish experts to conduct a site survey in April 1994, and provided recommendations for physical protection upgrades to the IAEA. A team of U.S. experts visited the site in August 1995 and again in November 1995. The United States will fund upgrades at the central alarm station, MC&A upgrades, training in physical protection, nondestructive assay, tamper indicating devices, and other MPC&A equipment. All work at Sosny is expected to be complete by the end of 1996.

The Lab-to-Lab Program in Russia

While the Government-to-Government MPC&A program in Russia was temporarily foundering, the Lab-to-Lab program was proceeding on a parallel but much faster track. This program employs a "bottom up" approach to MPC&A improvements, in which U.S. and Russian scientists developed their own upgrade programs at individual facilities throughout Russia, without, until recently, significant involvement by government officials. From its inception the program has been astonishingly successful, especially in comparison with the slow progress of the Government-to-Government MPC&A program until summer 1995.

A Joint U.S.-Russian Steering Committee, made up of representatives of the participating U.S. and Russian laboratories, began meeting in mid-1994 to set priorities for the joint program. By summer 1994, the two sides had drawn up work plans with contracts specifying concrete deliverables. The program includes installation of upgraded MPC&A systems at the most vulnerable sites; as well as joint projects to develop, demonstrate, and produce MPC&A equipment. By December 1994, the first tangible results were in evidence. The first project completed was at building 116 of the Kurchatov Institute, one of the most poorly protected nuclear facilities in Russia. Seventy kilograms of HEU, used as fuel for zero-power criticality tests of a model space reactor, are stored at the Moscow site. Prior to the joint MPC&A upgrade project, the

fence surrounding the building was in need of repair, and there was no equipment to prevent laboratory workers or others in the building from stealing nuclear materials or equipment.[35] Only two months after the two sides began working together, fences had been put up or repaired, video cameras continuously monitored sensitive areas, and portal monitors were installed to deter insider thefts. Much of the equipment deployed was Russian. By early 1995, a MC&A demonstration system was also up and running at Arzamas-16. All this was achieved in the space of half a year, whereas the Government-to-Government MPC&A program, by that time, had been languishing for nearly two years. Programs are now underway at a wide range of sites throughout Russia's nuclear complex, including nuclear weapons facilities.[36]

The excitement and *esprit de corps* among U.S. scientists involved in the Lab-to-Lab program is palpable and has been extremely productive. Many factors explain this excitement: the opportunity to work jointly with Russia on a pressing security problem to which nuclear weapons scientists are particularly sensitive; the lure of a new program at a time of dwindling opportunities for weapons scientists; and the chance to work with their former enemies at places that hold a special fascination, such as at Arzamas-16, the famous, ultra-secret nuclear weapons design laboratory.[37]

For their part, scientists at the Russian laboratories appear thrilled by the success of the Lab-to-Lab program. For example, at the Institute of Physics and Power Engineering at Obninsk, technicians proudly demonstrate to visitors a nascent inventory system, which will eventually record the location, mass, and isotopic content of thousands of tiny plutonium and HEU disks used to fuel the fast critical assemblies at the site.[38]

Obninsk was once considered to be a prime candidate for insider thefts of nuclear materials, in part because of the easy portability of these disks. As a result of the joint work, workers have boarded up doors to minimize the number of exit points. Specialized doors fitted with sensors check workers' passes electronically, as well as their weights. Video cameras continuously monitor all activities. The "two-man rule" applies in the plutonium storage facility: scientists can enter the facility only in pairs. All employees must pass through a portal monitor upon leaving the facility. "The Obninsk system is a showcase for the very best in U.S. and Russian protection, control, and accounting capabilities," explains Mark Mullen, Special Assistant to the Lab-to-Lab program. "We're not only installing new equipment, but also helping spread the principles of nuclear materials safeguards in the most concrete way possible."[39]

Scientists at Obninsk are uniquely qualified to judge the relative strengths of the Lab-to-Lab and Government-to-Government programs, as it is the only facility so far to be targeted by both programs. There is unanimous agreement among scientists interviewed at the facility that the Lab-to-Lab program is more flexible and more efficient. Engineers explain that the Lab-to-Lab program allows them quickly to change course mid-stream if doing so will improve results. For example, these engineers claim that under the Lab-to-Lab program they were allowed to switch vendors in the middle of a project when they discovered the existence of an alternative device that was demonstrably superior to the original—something they could not do under the more bureaucratic procedures of the Government-to-Government program. They especially welcome the Lab-to-Lab system of contracts, in which each side commits to a list of concrete deliverables. This system has now been incorporated in the Government-to-Government program as well. They, like their American counterparts, enjoy working directly with scientists who understand their problems, rather than with chinovniki or bureaucrats. Moreover, the Lab-to-Lab program affords them greater

flexibility in choosing either Russian or U.S.-manufactured MPC&A equipment or a combination of both.

In the words of one DOE official involved in the program,

We recognize that the key to consensus between the United States and Russia on MPC&A was the creation of an indigenous MPC&A capability. As Russian personnel have been empowered to create, maintain, and purchase MPC&A equipment and services, we have gained a resolute buy-in from Russian scientists and officials....This has greatly increased the speed and scope of MPC&A cooperation.[40]

Moreover, Russian officials are in a position to lobby for greater MPC&A funding, which will enable the program to expand still further.

Perhaps the most important outcome of the Lab-to-Lab program is that it has created a cadre of safeguards enthusiasts in the field. The U.S. government is eager to cooperate with Russia in upgrading MPC&A for all sites with weapons-usable material, while protecting legitimate secrets that both sides still have. DOE has drawn up a comprehensive plan for projects through 2002. The program will only be as good as the scientists, technicians, and guards charged with running it, however. The enthusiasm and pride exhibited by personnel at Kurchatov and Obninsk is an important first step in the development of an indigenous safeguards culture, which in turn will influence the ultimate success of the entire joint effort. The long-term question is whether the success of the program depends on its small scale or whether it can be expanded effectively to larger-scale problems.

The GAN Program

In principle, GAN is responsible for inspecting and licensing all facilities that handle nuclear and other radioactive materials. In practice, it has been unable to enforce compliance at Minatom or at Ministry of Defense (MOD) facilities, at least so far. The MOD has done its best to prevent GAN, a civilian agency, from overseeing its nuclear stockpiles, much as DOD would fight the U.S. Nuclear Regulatory Commission (NRC) if the NRC had been given similar responsibilities. President Yeltsin repealed GAN's oversight over MOD facilities in July 1995.[41] GAN is still responsible for inspecting all Minatom facilities associated with production of nuclear materials, however, including plutonium production reactors and reprocessing facilities.

U.S. officials have tried to support GAN in its efforts to become an independent nuclear regulatory agency. In June 1995, DOE and GAN signed an agreement to cooperate on developing a national MPC&A system for Russia. The two sides met to begin planning their joint program in October 1995. GAN came to the meeting with six proposals: to exchange experience in developing regulations; to work together to design elements of a federal MPC&A information system; to request equipment for GAN inspectors and to develop Russian prototypes of the equipment; to work together on an MC&A information center; to request MPC&A training for GAN inspectors and operators; and to assess and upgrade MPC&A systems at six research reactors.[42]

Site visits by DOE are scheduled at four facilities for February 1996 and at two remaining facilities (Tomsk and Norilsk) in April 1996. Work is ongoing to develop a comprehensive plan of action. U.S. officials are clearly excited about GAN's readiness to begin cooperation immediately, especially at the six sites, all of which were identified by GAN as high-priority sites needing MPC&A upgrades.

The Warhead Security Program

The warhead security program consists of two parts: transportation security and storage security. Both parts deal only with nuclear weapons taken out of the Russian stockpile. Nearly $60 million has been committed under this program through FY 95, and $42.5 million was approved for FY96.[43]

Under the transportation security program, DOD is supplying supercontainers, used to protect warheads in transport from terrorist attack; emergency support equipment, including communication and diagnostic equipment (the latter used to determine whether there has been a nuclear yield in the event an explosion occurs); and security upgrades for rail cars, both for nuclear cargo and for personnel.

Under the storage security program, DOD is helping the Russian MOD to: 1) develop an automated inventory management system, the ultimate goal of which is to put tags on every warhead in storage; 2) implement storage site and guard force upgrades by supplying computers and guard force training; 3) improve the MOD's personnel reliability program, to include drug testing and personality testing; and 4) enhance storage site security, by providing generic material protection and control equipment.

General Maslin has claimed that the program has "really improved nuclear warhead protection during transportation."[44] While DOD is understandably proud of this program, officials hope in the future to move to a systems approach, identifying a full range of vulnerabilities for all weapons slated for dismantlement, from "cradle to grave." The biggest challenge in moving forward with this program, as was the case for the Government-to-Government MPC&A program, is Russian sensitivity about revealing security vulnerabilities at these sites.

PROSPECTS FOR THE VIABILITY OF THE MPC&A PROGRAM

A number of issues have emerged that may threaten the continued viability of the overall MPC&A effort. These include bureaucratic politics—both between partners and within the U.S. and NIS governments; potential cuts in funding; and continuing suspicions of U.S. government motives, especially on the part of Minatom.

Bureaucratic Politics: Hurdles in the United States

Beginning in FY 96, as a part of its effort to streamline the program, the Clinton administration transferred the MPC&A program from DOD to DOE. DOD had already transferred $30 million of FY 92-94 funds to DOE and, in order to ease the transition, has agreed to an additional top-line transfer of FY 95 DOD funds.[45] DOE made its own budget request for $70 million for MPC&A activities (including for Russia and the other NIS). Non-Russian NIS programs have been covered under Nunn-Lugar funds allocated in prior years, including $22 million for Ukraine, $3 million for Belarus, and approximately $17 million for Kazakhstan. DOE has funded MPC&A projects for Lithuania, Latvia, and Uzbekistan out of overhead.[46]

At the time, critics claimed that transferring authority for MPC&A to DOE, a symptom of what former National Security Council (NSC) staff member Rose Gottemoeller has called the "balkanization" of Nunn-Lugar, would reduce White House involvement in MPC&A projects and might ultimately damage their budgetary prospects.[47] Precisely the opposite occurred, however, at least in the immediate aftermath of the decision.

Shortly after the decision was taken to transfer the program to DOE, several steps were taken that worked to ensure interagency coordination and focus on the MPC&A problem. The NSC established an MPC&A interagency working group charged with submitting the program to interagency review, ensuring that the sites most deficient in security were preferentially targeted for assistance, providing instructions to diplomatic delegations, and keeping the issue at the top of the NIS foreign policy agenda. National Security Advisor Anthony Lake recruited Ken Fairfax, a renowned expert on fissile materials and nuclear security, to focus exclusively on NIS fissile material security issues for the NSC. Moreover, the White House drafted a decision directive that instructed agencies to devote substantial personnel, financial, and intellectual resources to NIS fissile materials security problems and to combating nuclear smuggling.

Nor did balkanization adversely affect the program's budget, at least for FY 96. DOE's budget request of $70 million for MPC&A projects, which was granted, was significantly higher than similar requests for any single previous year under the Nunn-Lugar program. The remainder of the Nunn-Lugar program did not fare so well: out of its $371 million FY 96 budget request, DOD received $300 million for all projects remaining under Nunn-Lugar. DOE plans to request $95 million for FY 97.[48]

Proponents of shifting the MPC&A program out of DOD and Nunn-Lugar, such as former Deputy Secretary of Defense Gloria Duffy, who until August 1995 was Special Coordinator for the Nunn-Lugar program, have observed that because Senator Nunn plans to retire, and Senator Lugar is busy with his presidential campaign, the program may lack a strong proponent in Congress and will require a broader base of support. Dr. Duffy has argued that giving budgetary authority to the agencies responsible for carrying out individual parts of what formerly came under the Nunn-Lugar umbrella inevitably will attract a broader group of Congressional supporters.

The long-term effects of "balkanization" of the program are difficult to predict, however. Ultimately, the success of the program will probably depend at least as much on the administration's willingness to build and sustain Congressional and public support as on NIS partners' continuing willingness to cooperate. Although in principle it might be easier to promote a single, unified Nunn-Lugar program than several related projects housed in separate agencies, the agencies that have been responsible for running the projects (DOE with respect to MPC&A; the Department of State with respect to the International Science and Technology Center) may be better suited to testify on behalf of the projects than is DOD.

Bureaucratic Hurdles in Russia

The response of the Russian government to the problem of nuclear security is complicated. On the one hand, most official statements deny that Russia is the source of any of the weapons-usable material seized in smuggling incidents. Russian government officials tend to blame the nuclear smuggling problem either on German "provocateurs" or on journalists. For example, SVR General Evstafiyev wrote in a recent article,

With respect to the so-called leakage of nuclear materials from Russia, the Germans were the initiators. Following the Germans, the Americans also got involved. It is obvious that before October of last year the leakage was a problem of only one country—Germany. Ninety percent of the illegal nuclear-material consignments were seized on German territory.[49]

Russian officials claim publicly that the government has taken a thorough inventory of its fissile material stockpile and that nothing is missing. Minatom's spokesman has told a group of journalists that the material missing at Minatom facilities "is not in the realm of tons of kilograms, but grams. You might not agree with this, but it is a fact."[50] Before the spate of significant smuggling incidents beginning in 1994, however, senior Minatom officials claimed that many significant quantities of plutonium were missing from a single facility, the RT-I plutonium separation plant in Chelyabinsk.[51]

Despite frequent official denials that Russia faces a nuclear security problem, the Russian government has actively sought assistance in establishing a modern fissile material inventory system and in upgrading physical security at nuclear sites.

The Yeltsin administration also issued two important orders related to nuclear security. On September 15, 1994, President Yeltsin issued a decree "on urgent measures to perfect the system of accounting and storing of nuclear materials," that charged a newly established interagency commission to develop a plan to improve nuclear security and accounting.[52] Subsequently, on January 13, 1995, Prime Minister Chernomyrdin drafted a resolution that ordered GAN, in consultation with other agencies, to develop and implement a state nuclear materials control and accounting system. It also ordered the Ministry of Finance to allocate the necessary funds "on a priority basis."[53]

More impressive is the fact that, in private conversations, lower level Minatom officials acknowledge the seriousness of the nuclear material inventory problem. These admissions contrast sharply with interviews of more senior officials, and with the public statements of many Russian officials in the press. One mid-level Minatom official interviewed for this study, who had worked for the IAEA, was adamant in his belief that the problem was far worse than generally recognized.[54]

The most disturbing bureaucratic development that emerges in conversations with Minatom officials is that ministry's alleged plans to take over control of the Lab-to-Lab program. At least one senior Minatom official has expressed grave reservations about what he calls the "chaotic nature" of the Lab-to-Lab program. Some of these officials also remain deeply suspicious of U.S. motives and are convinced of the need to keep the system of physical protection a state secret. In the view of these officials, resistance to allowing Minatom more control over the program is only evidence that the United States has ulterior motives for working with the nuclear weapons laboratories.

However this potential crisis is resolved, these issues are bound to reemerge. Government agencies have a natural tendency to expand their territory, a characteristic that organizational theorists call "bureaucratic imperialism." Agencies are most likely to exhibit "colonizing" behavior when "boundaries are ambiguous and changing," or when programs are new, with ill-defined owners.[55], If this theory is correct, it is possible that turf battles in both countries will continue into the indefinite future. This tendency must be resisted if the program is to be successful.

There is growing sentiment in some agencies in Moscow that Minatom is functioning as a "state within a state" and should be reigned in. Yeltsin's National Security Council staff is currently drafting a presidential decree that would limit Minatom's powers and require it to submit export proposals to interagency review.[56] The root of the problem, in the view of one Ministry of Foreign

Affairs official, is the system of closed cities that has overseen design and production of nuclear weapons. Over the past decades, Minatom has had all the responsibilities of a state in these cities, and it has grown accustomed to power and secrecy. Minatom currently controls agricultural production on a land mass the size of an oblast, and more than one million people work for the ministry, which translates to a large number of votes. The most egregious example of Minatom's apparent independence from the rest of the government was its attempt in 1995 to include enrichment equipment in the sale of a nuclear reactor to Iran.[57]

The Response of Non-Russian NIS Governments

As mentioned above, non-Russian NIS partners have generally been far more cooperative on MPC&A issues than Russia. As one DOE official has explained, "These are smaller countries with smaller governments. There are fewer bureaucrats able to set up barriers." Another important distinction is that Russia is the single nuclear weapons state in the NIS, with the largest amount of weapons-usable nuclear material and the most complicated fuel cycle. Moreover, as non-nuclear weapon states party to the NPT and subject to IAEA safeguards, the non-Russian NIS governments inevitably have fewer reservations about protection of classified, weapons-related information.

Obstacles in carrying out MPC&A projects have been fairly prosaic, including problems with shipping, customs, taxes, duties, and reporting. There have also been problems, as in Russia, with access to closed cities. An additional area of disagreement in the non-Russian NIS has been the definition of the scope of work. As another DOE official explained recently, "While some countries have been slow to accept the extent of work necessary to upgrade indigenous MPC&A systems, others have requested and been turned down for assistance in areas outside our mandate, i.e., non-MPC&A upgrades (dry storage, fire protection, emergency response, etc.)." Despite these problems, MPC&A work with non-Russian NIS partners is expected to be completed by the end of 1997, five years earlier than the work in Russia.

Concerns About the Pace of the Program

Critics have accused the Clinton administration of exceedingly slow progress in cooperative threat reduction in the area of MPC&A. As one prominent critic has claimed,

The foot-dragging that has characterized much U.S. and Russian implementation of such measures...is deplorable....The responsible bureaucrats in both countries, most of whom appear to be in no hurry to get on with the job, need to be reminded in particular that protecting plutonium and highly enriched uranium...represents not only one of the most urgent of arms control and nonproliferation tasks but also one of the most cost effective.[58]

Bureaucratic battles inevitably hamper the program. Government officials, especially in the United States and Russia, have allowed interagency and even interpersonal rivalries to stymie progress. Perhaps even worse is the danger that U.S. and Russian bureaucrats, in their zest for control, will damage the program's greatest strength, which is its flexibility. The worst possible outcome would be if Minatom succeeds in taking control of the Lab-to-Lab program, especially if U.S. funds are required to go through Minatom, rather than directly to the facilities where MPC&A activities are taking place. This shift in control would significantly damage the program's flexibility, and could impair excellent working relationships that have developed over several years.

The principal obstacle to progress, however, is not bureaucratic infighting. It is the lack of trust. Lingering suspicions about U.S. motives persist, especially in Russia, despite the substantial progress already achieved through cooperative efforts. Alleged Minatom attempts to take control of the Lab-to-Lab program, for example, are partly a symptom of this deeper problem. Activities related to nuclear weapons have always been the most closely held of government secrets, and development of trust inevitably takes time. Many Russian officials believe that the U.S. government is still insufficiently aware of Russian sensitivities. In the words of one Minatom official, "It is very important that you stress repeatedly that you have no intention of stealing secrets. You don't do this enough." U.S. officials might profitably heed this advice.

CONCLUSIONS

The MPC&A program, though only a few years old, is already fulfilling one of the principal objectives of the Nunn-Lugar program—reducing the risks of proliferation resulting from the breakup of the Soviet Union. Ultimately, success will depend on four variables explored in this article: trust between the United States and NIS partner governments; bureaucratic politics in both donor and recipient countries; continued Congressional funding, which in turn depends on public awareness of the nuclear security problem; and the extent to which the flexibility of the program can be maintained and enhanced.

Until now, the program has been unusually flexible, in that it incorporates parallel, mutually reinforcing components. The advantage of this multi-pronged approach—including projects managed from the bottom-up as well as from the top-down—is that when problems arise, as they inevitably will, cooperation may nonetheless proceed along an alternative route. This principle was illustrated most dramatically during the first two years of the Government-to-Government MPC&A program, when, try as it might, the U.S. government could not convince the Russian government to accept equipment it obviously needed. However at the same time, Lab-to-Lab cooperation was proceeding at a rapid pace. The multi-pronged approach is the greatest strength of the MPC&A effort, and might usefully be incorporated into other parts of the Nunn-Lugar program. Other useful innovations include contracting directly with NIS facilities and personnel for goods and services, thereby fostering indigenous capabilities.

While significant progress has been made at many NIS nuclear facilities, many sites are still vulnerable to theft. A convincing inventory of nuclear materials has yet to be taken in Russia, and the MPC&A system for warheads is still inadequate. These are among the most serious threats to international security, and deserve far greater U.S. funding than they have received so far.[59] The problem is sufficiently grave that government agencies in all the relevant countries cannot afford to conduct business as usual. To the greatest extent possible, interagency rivalries and lingering suspicions should be set aside. This effort, according to one of the program's most prominent proponents, U.S. Secretary of Defense William Perry, is neither an aid program nor a means to achieve unilateral Russian disarmament. It is "defense by other means," a particularly cost-effective way for taxpayers—in both the United States and the NIS—to protect future generations.[60]

[1] The author wishes to thank the Council on Foreign Relations, the Hoover Institution, and the MacArthur Foundation for funding this research: Nicholas Burns and Chip Blacker, for providing encouragement to pursue these subjects; Jerry Dzakowiz, for constant support: Matthew Bunn and Frank von Hippel, for providing tutorials and the constant motivation to do more; the members of the MPC&A and Nuclear Smuggling Interagency Working Groups, for insights on how government works; the many Russian and U.S. government officials who consented to be

interviewed and provided comments on this chapter, especially William Alberque and Kate Baur Bricker of the Department of Energy; Tatiana Krasnopevtseva, for helping to formulate and translate questions for interviews in Moscow; and John Shields, William Potter, Richard Combs, and Laura Holgate for their useful comments on earlier drafts of this study.

[2] President Clinton's Address to the Nixon Center for Peace and Freedom Conference, Mayflower Hotel, Washington D.C., March 2, 1995.

[3] As is explained below, beginning with the FY 96 budget request, U.S.-NIS MPC&A projects for nuclear materials will no longer by funded by the Department of Defense's (DOD's) Nunn-Lugar Cooperative Threat Reduction (CTR) budget. They will instead be funded out of Department of Energy (DOE) funds. Conceptually, however, MPC&A remains part of Nunn-Lugar and must be addressed in any comprehensive treatment of the Nunn-Lugar initiative. MPC&A for warheads remains a DOD Nunn-Lugar program.

[4] Author's interview with a U.S. government official, December 1995 (name withheld).

[5] Author's interview with unidentified Minatom official. Much of the material in this chapter is based on interviews in Moscow between November 3 and 15, 1995 with Minatom, GAN, and Russian Nuclear Security officials who asked not to be identified by name.

[6] Mark Hibbs, "Physical Protection Reportedly Eroding at Minatom's 10 Closed Cities' in Russia, *"Nucleonics Week,* January 2, 1995, p. 13.

[7] Author's conversation with *Gozatomnadzor* official, who requested not to be identified, November 8, 1995.

[8] Author's interview with Minatom official, who requested not to be identified, November 7, 1995.

[9] Even the best possible inventory system (with no system of allowed losses) would not solve the problem of the determined, well-informed thief who knows to spread his thievery out over a long period of time, always staying within the technical limits of the accounting system. According to the Head of the Department of Arms Control and Nonproliferation of Russia's Federal Intelligence Service (SVR), General Gaennady Evstafiyev, who was interviewed by the author for this study, "No accounting system can detect losses of less than one percent of the total inventory. This is why it is important to install a comprehensive MPC&A system." that is, one that includes not only accounting, but also systems to detect attempts to remove even small amounts of nuclear material.

[10] Author's interview with a senior member of Russian President Boris Yeltsin's National Security Council staff, November 1995.

[11] See, for example, David Osias, Testimony before the Senate Foreign Relations Committee, Subcommittee on European Affairs, August 22, 1995.

[12] Author's interview with a U.S. government official, December 1995 (name withheld).

[13] David Osias, Testimony before the Senate Foreign Relations Committee, Subcommittee on European Affairs, August 22, 1995.

[14] Stanislav Lunev, "Russia's Nuclear Safety Problems," Prism, Part 1, Volume 1, Number 22, October 20, 1995.

[15] Author's interview with a U.S. government official, December 1995 (name withheld).

[16] Author's interview with an unidentified Minatom official on November 14, 1995.

[17] The figure of 600 storage sites for 1989 is from the testimony of Gordon Oehler, the Director of the Nonproliferation Center, Central Intelligence Agency, before the Senate Armed Services Committee, January 31, 1995, S. Hrg. 104-35, p. 4. In an August 1995 discussion with U.S. officials, General Maslin noted that there had been 200 sites in 1991.

[18] Vladimir Orlov, "A Threat of Nuclear Terrorism Exists in Russia," *Moskovskiyc Novosti,* No. 44, June 25, 1995, p. 14.

[19] Kurt Campbell, Ashton B. Carter, Steven E. Miller, and Charles A. Zraket, *Soviet Nuclear Fission* (Cambridge: Center for Science and International Affairs, Harvard University, November 1991), p. 125. Conversations between Ashton Carter and Senators Nunn and Lugar in the formulation of this book were a major factor behind the genesis of the Nunn-Lugar program.

[20] Phil Williams and Paul N. Woessner, "Nuclear Materials Trafficking: an Interim Assessment," *Transnational Organized Crime,* I (Summer, 1995), pp. 206-238.

[21] Several technical aspects of the nuclear smuggling problem have been muddled in press reports. One of these is the distinction between nonfissile radioactive isotopes and fissile material used to make nuclear weapons. The former include medical isotopes which, although extremely toxic, cannot be used to create a nuclear detonation in a bomb.

A second important distinction, relating to the isotopic purity of fissile material, is between "weapons-grade" material and so-called "weapons-usable" material, which could be used, albeit less efficiently, in a nuclear weapon. Strictly speaking, HEU is uranium that has been enriched to greater than 20 percent U-235. "Weapons-grade" HEU refers to HEU that has been enriched to 90 percent U-235 or higher. U.S. and Russian bomb designers typically use weapons-grade fissile material in order to ensure a high degree of weapon reliability and efficiency, which also allows design of smaller weapons more easily transported by plane or in a missile warhead. However, HEU enriched to between 20 and 90 percent U-235 according to unclassified IAEA data, can also be used in a weapon, although a lower level of enrichment will require a larger amount of material to make a detonable weapon, resulting in a proportionately heavier and larger weapon. Similarly, "weapons-grade" plutonium typically contains no more than seven percent Pu-240. However, relatively less pure plutonium, including reactor-grade plutonium, can be used to make a bomb, albeit with an assured yield of only one to a few kilotons for a simple, Nagasaki-type design and a higher, but still reduced yield for more sophisticated designs. An understanding of these distinctions helps place the smuggling problem in some perspective: it is not as bad as many journalists would have the public believe, but it is far worse than many Russian government officials are willing to admit.

[22] Often overlooked are the many cases of stolen medical isotopes and other radiation sources. These incidents are discounted because radioisotopes cannot be used to make detonable nuclear devices; MPC&A programs cannot possibly address the threat they pose. But they can be used by terrorists to draw attention to their cause, to wreak havoc, and to terrorize civilians. Shamil Basayev, the leader of the Chechen group who took more than 1,000 hospital patients hostage in June 1995, has claimed credit for placing a packet of radioactive cesium in Izmailovski Park in Moscow, a popular recreation spot for families, frequented by tourists as well as by Muscovites. Cesium-137, a radioactive isotope used in the treatment of cancer, is a waste product of nuclear reactors with a relatively long half life, and areas contaminated with it require extensive clean-up. It can be absorbed into the food chain and is carcinogenic. Cesium is used in industry in photoelectric cells, for measuring the thickness or density of materials, and in gamma-radiography. A related concern is the possibility of terrorism directed against nuclear power plants or other civilian facilities. Dzhokar Dudaev, leader of the rebellious republic of Chechnya, has frequently threatened to attack Russian nuclear power plants or to commit other acts of nuclear terrorism. The Russian government formed an interagency group to address concerns about nuclear terrorism including Dudaev's threats. The group ordered that additional safeguards be put in place at power plants, for example, but the effort was not serious, according to a Minatom official who requested anonymity. An intelligent terrorist could easily circumvent the beefed-up controls, he said.

[23] For an excellent analysis of these incidents, see William Potter, "Before the Deluge? Assessing the Threat of Nuclear Leakage From the Post Soviet States," *Arms Control Today* 25 (October 1995), pp. 9-16. Experts speculate that the 0.8 gram cache of 87 percent enriched HEU seized in Germany may have come from the same source as the consignments seized in Prague, which were of similar isotopic content.

[24] Thieves of nuclear materials tend to be amateurs who have no specific buyer in mind. As General Gaennady Evstafiyev, the head of the Department of Arms Control and Nonproliferation of Russia's Federal Intelligence Service (SVR), has observed, "As a rule, the thieves hide the material with extreme care, often for a long time, and only then do they begin to search for a buyer." General Gaennady Evstafiyev, "Yademaya Mafiya v Rossii, Pravda I Mify," ("Nuclear Mafia in Russia: Truth and Myths") *Vek,* September 22-28, 1995, pp. 1, 10.

[25] Author's interview with a Minatom official, November 14, 1995.

[26] James Wyllie, "Iran—Quest for Security and Influence," *Jane's Intelligence Review,* July 1, 1993, p. 311.

[27] In 1994, nearly 600 kilograms of HEU were subsequently airlifted from this poorly secured site to safe storage in the United States in a joint U.S.-Kazakstani operation dubbed Project Sapphire. For a complete description of this operation, the events that surrounded it, and the possible "Iranian connection," see William Potter, "Project Sapphire: A Study of U.S.-Kazakstani Cooperation for Nonproliferation," paper prepared for the conference on "The Nunn-Lugar Cooperative Threat Reduction Program: Donor and Recipient Country perspectives," at the Center for Nonproliferation Studies, Monterey, California, August 20-22, 1995. Mark Hibbs "Kazakhs Say Iran Sought LEU for VVER Fuel, Not 'Sapphire' HEU," *Nuclear Fuel,* July 17, 1995, p. 11-12.

[28] *Ankara Anatolia,* in English, 10:15 GMT, October 6, 1993, as reported in an unclassified cable, serial TA06 10103193: *Istanbul Turkiye,* in Turkish, October 7,. 1993, as reported in an unclassified cable, serial NC0910082 693. Details of this incident are also based on a conversation by the author with Ozgen Acar, an editorial and special investigative reporter for *Cumhuriyet,* a major Turkish daily paper.

[29] Reuters World Service, "Iraq, Iran secretly buying on nuclear market," January 18, 1996; Reuters World Service, "Iran Objects Over German Nuclear Charges," January 25, 1996.

[30] The U.S. government has a comprehensive program to combat nuclear smuggling in addition to programs to enhance fissile materials protection, but space limitations preclude discussion of anti-smuggling initiatives in this paper.

[31] Beginning with the FY 96 budget request, MPC&A projects for nuclear materials will no longer be fumed out of DOD's Nunn-Lugar CTR budget. Instead, they will be funded by DOE. As of January 1996, MPC&A projects paid for by DOD funds include: 1) the Lab-to-Lab program for FY 95, which was funded by $15 million transferred from DOD to DOE in a one-time, top-line transfer; 2) Government-to-Government MPC&A projects through FY 95, which were funded by $30 million allocated to DOD between FY 92 through FY 94 for the (then) Nunn-Lugar MPC&A program; and 3) some of the non-Russian NIS MPC&A projects. DOE is now the Executive Agent for the entire MPC&A effort for nuclear materials. Warhead transport and security remain a Nunn-Lugar program, however. Author's interviews with DOD and DOE officials, November 1995.

[32] Information provided by a DOE official, December 1995.

[33]Ibid.

[34]Ibid.

[35] Mark Hibbs, "Russia Improving Protection for Sensitive Nuclear Sites," *Nucleonics Week,* March 30, 1995, p. 12.

[36] These include the Institute of Physics and Power Engineering Institute, Obninsk; the All-Russian Scientific Research Institute of Automatics; ELERON; the Kurchatov Institute; Arzamas-16; Chelybinsk-70; Avangard, Penza-19, Sverdlovsk-45, and Zlatoust-36 dismantlement facilities; and Tomsk-7. Recent bureaucratic decisions have slowed work at the dismantlement sites, however. Information provided by Department of Energy, November 1995.

[37] Arzamas-16 is located in a closed city straddling Nizhny Novgorod oblast and Udmurtia Republic. The first joint Lab-to-Lab project was initiated at this laboratory, which Russian scientists jokingly refer to as Los Arzamas, because it was partially modeled on Los Alamos. Public Affairs Office, Los Alamos National Laboratory, "Los Alamos Works with Russian on New Systems to Track Nuclear Materials," January 16, 1994.

[38] Author's tour of the Institute of Physics and Power Engineering at Obninsk, November 13, 1995. These disks, which weigh approximately five grams, could easily be slipped into a thief's pocket. There are tens of thousands of them at the site, totaling about eight metric tons of HEU and about 800 kilograms of plutonium.

[39] Los Alamos National Laboratory Public Information Group News Release, "U.S., Russian Scientists Demonstrate Nuclear Materials Security System at Russian Power Institute," September 21, 1995.

[40] Author's interview with a DOE official.

[41] Penny Morvant, "Gosatomnadzor Ceases Military Inspections," *OMRI Daily Digest 1,* No. 179, September 14, 1995, and "Statute on Nuclear Radiation Safety Updated," *Rossiyskaya Gazeta,* August 2, 1995, p. 4.

[42] Karpov Research and Development Institute of Physics and Chemistry, Obninsk; Institute of Nuclear Physics, Gatchina; Moscow Institute of Physics and Engineering, United Institute of Nuclear Research, Dubna; Tomsk Polytechnical University; and Nikel Combine, Norilsk.

[43] Author's conversation with DOD officials, November 1995.

[44] Interview with General Maslin in *Yaderny Kontrol,* reprinted in *The Monitor* (University of Georgia, Spring, 1995), p. 13.

[45] In addition, beginning in FY 1996, the Department of State assumed responsibility for the International Science and Technology Center (ISTC) as well as for several projects related to export control assistance to Ukraine, Belarus, Kazakhstan, and Russia.

[46] Author's conversation with DOE officials, November 1995.

[47] This critique and the events surrounding the "balkanization" of Nunn-Lugar are explained in detail in Rose Gottemoeller, "The Nunn-Lugar Program and Presidential Priorities in Nuclear Policy," prepared for conference on "The Nunn-Lugar Cooperative Threat Reduction Program: Donor and Recipient Country Perspectives," the Center for Nonproliferation Studies, Monterey, California, August 20-22, 1995.

[48] Information provided by DOD and DOE officials, November and December 1995 and February 1996.

[49] General Gaennady Evstafiyev, "Yadernaya Mafiya v Rossii, Pravda I Mify."

[50] Mark Hibbs, "Europeans Term 'Worthless' Minatom Claim that No HEU or Pu is Missing," *Nuclear Fuel,* March 27, 1995, p. 12.

[51] *Ibid.* The IAEA defines a significant quantity as eight kilograms of elemental plutonium and 25 kilograms of HEU enriched to at least 20 percent U-235.

[52] "Ukaz President Rossiskoi Federatsii, O pervoocherednyx merakh po sovershenstvovaniyu systemu i sokhrannosti yedemykh materuyalov," ("Decree of the President of the Russian Federation on Emergency Measures to Perfect a System of Secure Storage of Nuclear Materials") September 15, 1994.

[53] Resolution of the Government of the Russian Federation, "On Priority Projects for 1995 to Develop and Implement the State Nuclear Materials Control and Accounting System," January 13, 1995, no 34.

[54] Author's interview with Minatom official, November 14, 1995. This official refrained from blaming the smuggling problem on German provocateurs or on journalists exaggerating the problem to sell newspapers. Nor did he employ another tactic in vogue among officials interviewed by this author, as well as in official statements in the press—deflecting attention to the problem by focusing on Western failings in the nonproliferation arena, such the West's alleged responsibility for the Pakistani, Israeli, South African, and Iraqi nuclear programs. This mid-level Minatom official was so determined that the urgency of the MPC&A problem be communicated that he asked to read over the author's written translation of interviews to ensure that no important points had been missed.

[55] Graham T. Allison, *Essence of Decision* (Boston: Little Brown, 1972), p. 96.

[56] Author's interview with a senior member of President Boris Yeltsin's National Security Council staff, November 1995.

[57] Alexei Yablokov, "Atomic Energy Ministry Mixed Up Its Own Interests With National Ones," *Izvestia,* June 2, 1995, p. 3.

[58] John Holdren, "Nobel Lecture Delivered on Behalf of the Pugwash Conferences on Science and World Affairs," Oslo, Norway, December 10, 1995.

[59] For an excellent proposal on how future funds should be allocated for MPC&A activities, see John Holdren, "Reducing the Threat of Nuclear Theft in the Former Soviet Union: Outline of a Comprehensive Plan," unpublished proposal submitted to Senator Richard Lugar, November 1995.

[60] Secretary William Perry, Speech before the National Press Club, January 5, 1995. Secretary Perry was referring to the entire Nunn-Lugar effort. He said, "It's neither Russian aid, nor is it unilateral Russian disarmament. Indeed, for the United States Nunn-Lugar is defense by other means, a particularly effective way to protect ourselves against nuclear weapons that were once aimed at our cities."

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Reflections on Nuclear Smuggling

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I embarked on the study of nuclear materials smuggling from the former Soviet Union after many years of observing another modern illegal enterprise--the international traffic in narcotics. I have often reflected on the striking differences between these businesses. For example, illegal drugs are distributed in mass markets, and the sales volume is enormous (totaling hundreds of billions of dollars annually, according to most estimates). By contrast, markets for stolen or diverted nuclear materials are narrow, rarefied, and inaccessible to many aspiring merchants. Indeed, Western and Russian authorities are hard pressed to verify actual cases of stolen materials reaching bona fide customers. The oligarchic structures (or cartels) that dominate sectors of the narcotics trade do not seem to exist in the nuclear smuggling business, which is outwardly disorganized, ad-hoc, and driven by amateur criminals. Drug dealers often exhibit attention-seeking, violent, and politically obtrusive behavior, whereas nuclear smugglers in general prize secrecy and stealth, and leave few imprints on their surroundings. Drugs exact a visible, continuing, and tangible toll on the institutions and social fabric of the countries that produce and consume them, whereas the dimensions and severity of the clandestine movement of nuclear materials are not known with certainty--indeed, experts and policy analysts disagree over whether nuclear smuggling poses a genuine threat of consequence to Western societies and to the international order.

When conducting the research on this topic, I have therefore been constantly preoccupied with the significance question. Indeed, the vast majority of recorded smuggling cases involved only small quantities of fissile material or radioactive material of little or no use in weapons production. Furthermore, the number of criminal nuclear transactions in the West has dropped perceptibly since the mid-1990s. In Germany, for example, the number of smuggling incidents dropped 60 percent between 1994 and 1996, and the number of nuclear seizures declined by 80 percent. And there haven't been any seizures of weapons-usable material in the West since 1995. Nevertheless, we should avoid the temptation of equating the observed reality of the nuclear traffic with the pattern of the traffic as a whole.

It is unclear, for example, why a serious nuclear businessman would want to transport his wares from Russia to the Middle East or South Asia by way of Germany or Central Europe, which makes little sense in terms of geography or smuggling logistics. Perhaps more adroit and sophisticated smugglers are operating surreptitiously in today's nuclear marketplace, managing a shadow traffic in nuclear materials and components that is far more lethal than the trade detected by the constabularies of Central and Western Europe. Indeed, my own findings, based on countless interviews with some very well-connected people in Russia, suggest that the modalities and routes of this shadow market already are established, and that prospective buyers include both so-called rogue states and more pro-Western countries that also currently covet nuclear weapons programs.

Naturally the West has a major strategic and normative stake in "non-proliferation," and U.S. programs to bolster nuclear safeguards and export controls in the NIS indisputably are necessary and worthwhile. But I am convinced that such programs have stopped or will stop nuclear

smuggling in Russia and other new states. I think there are several grounds for concern, and I'll mention them here.

First, the principal underlying causes of the traffic--collapsing nuclear economies, escalating crime and corruption, growth of a privatization mentality," and waning central government control over the nuclear sector--remain essentially unchanged in the transitional societies of the former Soviet Union. The strains of privatization and defense conversion are taking a tremendous toll within the nuclear complex. Economic variables, I think, are primary. You all know about the hardships faced by nuclear workers, and about how poorly salaries at research and design facilities compare with salaries elsewhere in the Russia economy. If nuclear managers and scientists are faced with a choice between respecting some abstract ideal of non-proliferation and ensuring the livelihood of themselves and their families, some of them may opt to steal or sell material to which they have access. Furthermore, the partial deterioration of the control systems that existed in Soviet times increases the likelihood that criminal proliferation schemes of nuclear industry managers and their bureaucratic or criminal cohorts will proceed undetected or with minimal interference from the authorities.

A second reason is that--historically--U.S. intervention to combat criminal activities abroad have not proved particularly successful. A noteworthy example is the vaunted overseas war against drugs, which has failed signally to halt or even diminish the flow of cocaine, heroin, and other toxic substances into U.S. markets. Now, our programs to stop nuclear smuggling in the NIS are better conceived and more professionally managed (albeit not better funded) than our overseas drug problems, and distinctly different market forces drive the movement of drugs compared to nuclear materials. Nevertheless, we cannot expect a 100 percent success rating from our policies to halt serious nuclear leakages-no matter how ardently we might crave such a result. According to an estimate by Russia's Federal Security Service, Russian authorities are able to seize only 30 to 40 percent of the radioactive material that escapes in one way or another from nuclear enterprises. Of course, we have programs designed to increase the odds of preventing thefts from NIS nuclear facilities, but it will be years before such programs can extend state-of-the-art security protections to all NIS sites housing sensitive nuclear materials.

This leads to my third point, which is that the Russian nuclear control regime was particularly vulnerable to theft in the chaotic period immediately following the disintegration of the USSR (roughly from late 1991 through 1995). U.S.-Russian cooperation programs to strengthen security, accounting, and control at Russian enterprises started slowly and did not produce tangible progress until 1995. How much leakage actually occurred during the approximately 4-year window of vulnerability cannot be identified with certainty. However, traffickers captured in major smuggling episodes in Europe in 1994 (Prague and Munich) report that significant quantities of uranium and plutonium may have escaped from Russian government control during those years. The current location of these illusive materials is anyone's guess. They may be still secreted somewhere in Russia, possibly in the neighborhood of the enterprises where the thieves are (or were) employed. Or they may have been exported successfully to client states. Or they may be wandering the globe, transferred from middleman to middleman in the search for potential customers.

I'd like to share with you here the contents of a German news report on the recent activities of the Colombian plutonium smuggler of Munich fame, Justiniano Torres Benitez. According to the report, Torres may have smuggled out of Russia a lot more plutonium than was seized at the

Munich airport in August 1994. The report, citing a German police source, said that Torres had stashed 5 kilograms of plutonium and 2.3 kilograms of uranium in a warehouse in the north of Bogota, Columbia, and that he planned to sell the merchandise to the Cuban government for $40 million (what the Cubans could do with such materials is not clear; maybe resell it at a profit to some Middle Eastern country). The same sources said that Torres claimed to have another 9 kilograms of fissile material hidden somewhere in Germany. Obviously this is a pretty crazy story, and I'm still trying to check it out through my own source networks in Colombia, but anyhow it calls attention to this problem of loose nuclear materials--we don't know what's really out there.

Finally, collusive practices of senior nuclear managers heighten the risk of serious nuclear proliferation episodes. Although Russian officials claim that most thefts are the work of lowly workers, major heists and other types of diversions almost certainly require the participation of enterprise top management. Furthermore, enterprise personnel can employ (and, I believe, have exploited) a range of channels to market fissile materials abroad, including corrupt MINATOM officials and MINATOM-affiliated companies, organized crime groups, operatives in the Russian intelligence service, and even visiting Western scientists. Some of the instrumentalities of diversion reflect a high degree of professionalism. Russian customs officials, for example, worry that sophisticated smugglers can conceal enriched uranium or plutonium in exports of legal radioactive cargo. Of course, the customs and licensing documentation might read iridium-192, cobalt-60, cesium-137, or some other relatively ordinary radioisotopic material. To date, Russian customs has not deployed in the field the advanced radiation detection systems necessary to distinguish one type of gray radioactive metal from another. (A few prototype spectrometers have been manufactured in Russia, and the Russians are seeking foreign funding to produce more of these.) Other clandestine schemes have been devised to circumvent inventory controls and other elements of MPC&A systems--indeed, some nuclear diversion scenarios are in a sense "consensual," and do not involve theft at all in the accepted sense of the term. When the privatization mentality invades top echelons of the nuclear control system, maintenance of "non-proliferation" regimes becomes very problematic.

What, if anything, can the West do to stop criminal nuclear proliferation from the NIS? Certainly a good case can be made for maintaining and even expanding current programs to contain the spread of sensitive nuclear materials--we need to cover the obvious bases and plug the obvious holes. Perhaps some shift in emphasis would be worthwhile. More attention needs to be given to helping nuclear workers find alternative ways of earning a livelihood (as our drug control efforts include creating income alternatives for coca farmers and small-time cocaine processors in the jungles of South America). We need to improve the so-called "second line of defense" against nuclear smuggling by strengthening law enforcement and customs cooperation with the NIS, especially Russia. The Russians urgently need state-of-the-art detection equipment at internal and border customs checkpoints, but I'm told we can't provide this because Russia won't accept Nunn-Lugar requirements that U.S.-made equipment be monitored in the field by representatives of U.S. government agencies. (Perhaps this problem is now being resolved.)

Ultimately, though, the lab-to-lab programs, the export control programs, and other instrumentalities of nuclear cooperation with the former Soviet Union are unlikely to disrupt the patterns of corruption and collusion that give rise to serious proliferation episodes. In broad terms, the illicit nuclear traffic embodies painful economic and institutional transitions in the NIS,

including the catastrophic effects of downsizing on the well-being and morale of nuclear employees. Western assistance can mitigate some of these repercussions, but cannot repair the underlying weaknesses in the economic and organizational infrastructure.

Proliferation: A Changing Threat?

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QUESTIONS AND ANSWERS:

J. Stern: I agree that biological weapons probably pose a more immediate threat to US national security than the few cases of nuclear smuggling we've seen so far. But you are exaggerating the threat: BW are hard to acquire. And disseminating biological agents over large areas is extremely difficult.

J. Adams: Agrees. I think that nuclear weapons require enormous effort, theoretical expertise, and is susceptible to monitoring, none of which particularly applies to BW.

J. Stern: Disseminating biological agents inside a building or structure would be easier than disseminating them over open areas.

J. Adams: Yes, but if the task is to terrorize, you only need to kill 300 people. Imagine the panic. We have no civil defense program. Responsibility is spread over lots of government agencies.

E. Nadler: The media has hyped nuclear smuggling efforts, which did help to deter criminals, but the media doesn't pay much attention yet to BW. It has been the focus of attention recently in Iraq.

J. Adams: The BW issue with Iraq is partly a reason to beat-up on Hussein. Seven-eighths of the proliferation information on the web is nuclear. The American public doesn't view it. The issue is that the balance is off center.

A. Weber: I agree that the balance is off on the policy side. But BW is getting media attention: NBC, ABC, PBS and BBC are interviewing us about BW and our cooperative threat reduction program in Russia.

B. Pollack: A point of clarification: is CW included?

J. Adams: If ranked, the first should be BW, with NW second, and CW third.

E. Ewell: There is no coordinated effort in fissile material smuggling. Do you think there is an effort to coordinate efforts to counter BW smuggling?

J. Adams: We want to look forward. Nuclear is not done as expected.

J. Niewodniczanski: Nuclear weapons are a threat to world peace. I can't image BW would effect world peace.
J. Adams: Maybe.

V. Brovkin: No evidence doesn't mean it doesn't happen. There are air flights without custom inspections. Open borders. Smuggling has always gone on, and it is not always recorded.

J. Adams: I agree. Where's the beef?

J. Immele: A question about resources. The only programs that are increasing are those for protection of the sources of fissile materials. There is not a lot spent on prevention of nuclear smuggling. There is more spending on CW/BW. Media attention doesn't reflect the dollars. I agree we need to adjust the programs. You have implied a relationship between government dollars and media coverage. What do we do about this?

J. Adams: Partly have people like me complaining. Tasking the media to do the job differently. CBW hasn't got the same treatment as nuclear because there is more talk, more gaps are exposed. It may not be a good tack to have the media treat CBW similarly to nuclear.

UNITED STATES PROGRAM
Synopsis: Defense Science Board on Transnational (Terrorist) Threat*

John Immele
Department of Energy
Washington, D.C.

The Defense Science Board (DSB) is one of the two senior advisory boards in the Department of Defense. (The other is the Defense Policy Board.) It typically has several on-going Task Forces addressing important issues in defense technology, force structure and strategy. Each summer it conducts a Summer Study on a topic of broad significance to DoD as a whole. Recommendations of Task Forces and Summer Studies are submitted to the Secretary of Defense for decision.

The 1997 Summer Study addressed DoD responses to transnational threats, which includes all forms of terrorism, including biological, chemical, and nuclear terrorism, and–more generally–threats posed by the emerging fact that it no longer requires the resources of a nation to do immense harm to US forces and bases overseas or even to American cities. The Summer Study was co-chaired by Dr. Bob Hermann, former Assistant Secretary of Defense, and Gen. Larry Welch (Ret.), former Chief of Staff of the Air Force. At DoD's request, several people from the DOE labs and from DOE participated in the Summer Study. Secretary Cohen has already directed implementation, within DoD, of several Summer Study recommendations and others are being reviewed.

The Summer Study (and DoD in general) recognize that DOE has a significant role to play, with DoD, in dealing with these threats, now and in the future. Several of the recommendations of the Summer Study relate to DOE, in particular to functions in DP and NN. If, after review, DOE decides to implement some of these recommendations, there could be a impact on DOE budget planning for FY'00 and beyond, since the recommendations pertain to DOE mission responsibilities.

The principal findings of the Board are included in six recommendations. Details involving DOE are principally in 4, 5, 6:

(1) Sec Def should treat transnational threats as a major DoD mission with intelligence and technology focus not unlike a major regional conflict. <u>It is recommended that the Secretary of Energy commit to a corresponding DOE mission element.</u>

(2) Present DoD, DOE and Intel capabilities were judged extensive; however, critical WMD capabilities are eroding or fragile. <u>This DSB report is not critical of what has been started, its intent is to encourage and build.</u>

(3) Lack of integration government-wide. DoD can lead by helping define an end-to-end operational concept and "system-of-systems" structure to address Transnational Threats.

(4) The greatest leverage against most terrorism is tactical warning and intelligence. An integrated, secure information infrastructure is proposed (pp. 37-40, C1-C4) that allows efficient fusion and correlation of data already collected by many national and international agencies. (DOE

should assure the inclusion of information on nuclear material sources and from export control.)

(5) (Mostly) technology recommendations include:
(Nuclear: pp. 41-46, C6-C9) The task force believes that for costs far less than those commensurate with the consequences of a terrorist nuclear explosion, capabilities can be developed to deal effectively with a larger range of possible threat scenarios. Added to the current effort should be a major program component which looks to the farther future. The development program should assume that, as it is successfully completed, procurement and operational resources can be made available which are much greater than those today.

Prototype large arrays of networked sensors for search and screening of urban and military base areas. Long-term R&D including gamma ray camera for remote detection, active search for heavily shielded material, forensics and remote disable. Extend MPC&A and CTR beyond 2002. Additional DOE funding in FY00 of $52M is supported. (This breaks out as $32M for NN and $20M for DP in FY00 and $460M and $150M, respectively, over five years.)

(Chem-Bio: pp. 47-51, C10-C12) Augment DoD CB defensive program by $1B over five years. Highest priority to mitigating consequences of CB attack. Aggressive intelligence including new sampling and collection techniques, e.g., bio-markers, microrobots and sticky electronics. Candidates for a robust development program: low cost alarms and masks, stand-off real time detectors, field employable mass spectrometers for BW analysis, rapid large area decontamination methods, antidote autoinjectors for civilian use, multi-valent vaccines and anti-viral agents.

(Info warfare: pp. 51-54, C12-C14) The Report builds on 1996 Summer Study and proposes a delta of $200M in DoD budget. There are implications here for safeguarding DOE computers (NN-50), e.g., improved barriers that respond automatically to the threat of attack; software modules or 'wrappers' for the protection of legacy programs; more robust protection of the communication infrastructure.

(6) Strong role for the National Guard in consequence management. Institutionalize Nunn-Lugar-Domenici in DoD at $200M per annum, including state and local equipment and training of first responders. FEMA is actually planned to take over this budget item; in either case, NN-60 and DP-23 play a role in WMD training and preparedness. (See pp. 26-31, C-14-C15.)

*Reference: Final Report (Vol. 1) of the Defense Science Board 1997 Summer Study Task Force on DoD Responses to Transnational Threats

Status Report from the Russia/ NIS Nuclear Material Security Task Force, MPC&A Program, U.S. Department of Energy

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ABSTRACT

This paper reviews the cooperative work planned and accomplished by the U.S. Department of Energy's (DOE) Russia/Newly Independent States (NIS) Nuclear Material Security Task Force. The Task Force directs the DOE's Nuclear Material Protection, Control and Accounting (MPC&A) program. Since 1994, DOE and its national laboratories have worked cooperatively with experts in Russia, the NIS, and the Baltics to improve nuclear material security and accountability at 53 identified sites in the region containing weapons-usable material. In addition, this cooperative program is developing MPC&A training and regulatory measures to enhance and ensure the sustainability of these upgrades. In fiscal year 1998, seven sites in Russia began operations of site-wide upgraded MPC&A systems. The program also initiated a cooperative program with Minatom to develop ministry-level regulations for MPC&A to complement the federal MC&A systems regulations and operated a prototype Russian national nuclear material accounting system. The first graduate level MPC&A Masters degree program at the Moscow Engineering Physics Institute Technical University completed its first semester at the end of 1997. Also, the program expanded its cooperative work with the Russian Federation Navy by signing an additional protocol to increase and expand MPC&A work at all identified Navy sites in Russia. In the NIS and Baltics, 2 sites in Kazahkstan and one site in Ukraine completed MPC&A upgrades.

PROGRAM BACKGROUND AND TASK FORCE INFRASTRUCTURE

The United States, Russia, the Newly Independent States, and Baltics are cooperating to enhance nuclear material protection and control in the region under the U.S. Department of Energy's (DOE) Material Protection, Control, & Accounting (MPC&A) program. The DOE developed this cooperative program in the early 1990s to respond to post-Soviet Union deterioration of protection and accounting conditions of nuclear material stored at 53 identified sites in Russia, the NIS, and the Baltics. The mission of this cooperative program is to reduce the threat of nuclear proliferation and terrorism by rapidly improving the security and accountability of all weapons-usable nuclear material in forms other than nuclear weapons at nuclear sites in the region. Its strategy is to (1) reach agreement for MPC&A cooperation with all sites containing weapons-usable nuclear materials; (2) implement systematic and rapid MPC&A upgrades that compare with U.S. and international standards; and (3) ensure long-term effectiveness of improved MPC&A systems through training and regulatory developments and fostering of indigenous production and maintenance of MPC&A equipment in the region. However, the program does not finance normal operating and maintenance costs associated with the upgrades nor does it pay salaries to foreign

nationals. It does not construct new buildings, unless compelling reasons and more cost-effective measures require it to do so. Finally the program does not train guard forces or provide or pay for weapons.

Specifically, this cooperation began under the Cooperative Threat Reduction Program in 1992 and Laboratory-Laboratory Initiative in 1994. Subsequently, this cooperation was strengthened and refined by the Clinton-Yeltsin Joint Statement on Nonproliferation in May, 1995, and the June, 1995, Joint Statement, signed by former Secretary of Energy Hazel O'Leary and Russian Atomic Energy Minister Viktor Mikhailov, initiating MPC&A upgrades at five key sites in Russia. Several months later, in September, 1995, President Clinton issued a Presidential Decision Directive on "U.S. Policy on Improving Nuclear Material Security in Russia and the Other Newly Independent States" (PDD/NSC-41), which established securing nuclear materials in Russia, the NIS, and Baltics, as one of the United States' top national security priorities.

Also, under this directive, the DOE was assigned formal responsibility within the U.S. government for directing and financing all components of its MPC&A program. Program budget expenditures through fiscal year 2002 (the program's scheduled lifespan) are estimated to be $800 million, with highest annual funding levels planned for fiscal year 1999. Current 1998 fiscal year funding is $137 million.

To meet the responsibility assigned by the PDD/NSC-41, the DOE created a Russia/NIS Nuclear Material Security Task Force in September 1995. The task force is within the Office of Arms Control and Nonproliferation. The task force, in coordination with national laboratories, implements the MPC&A program. The task force is divided into the director, deputy director, and office of the director, where logistics, travel, budget, exports, planning, and outreach occur. Management and advise is undertaken through a laboratory advisory panel representative and directors advisors, with three program leads managing the work for Russia and the NIS and Baltics.

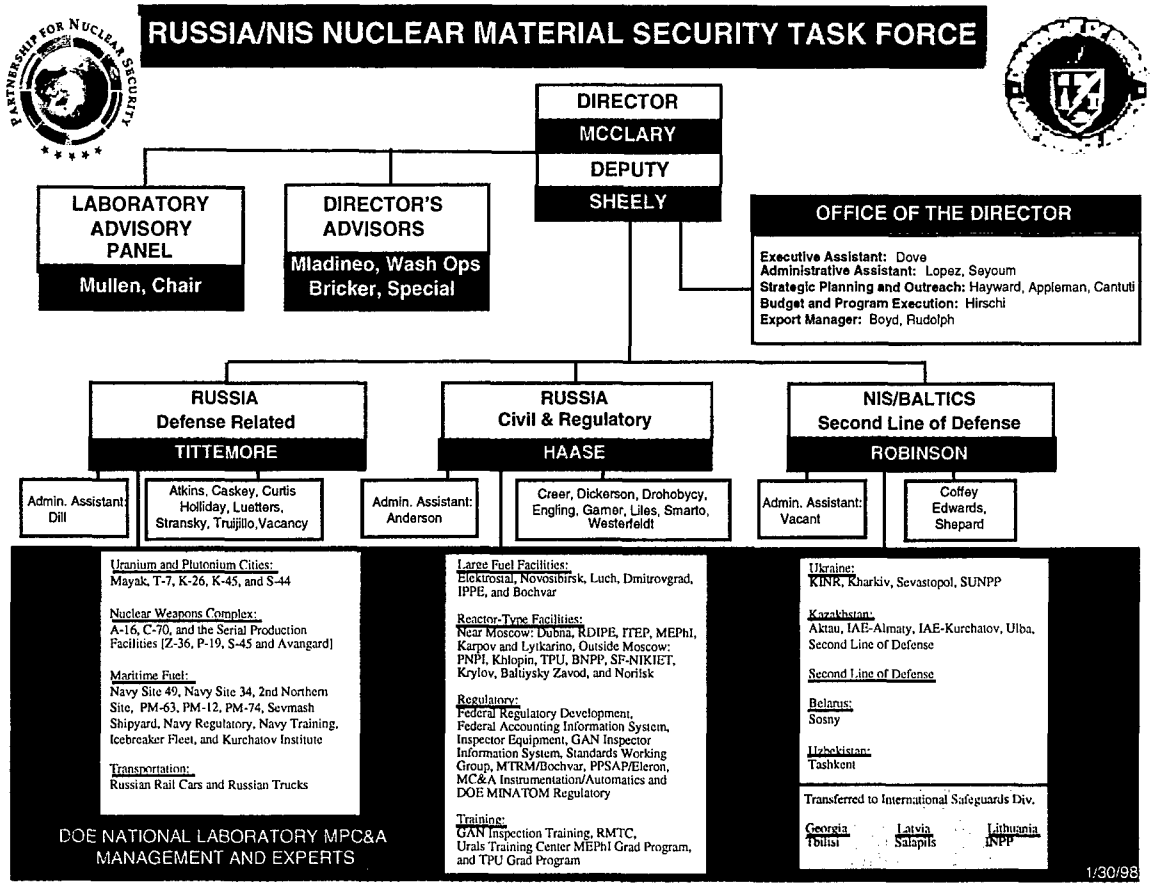

Figure 1: The task force is organized to implement and manage the MPC&A program effectively.

MPC&A UPGRADES TO ENHANCE NUCLEAR SECURITY

Modern, well-designed MPC&A systems provide a cost-effective and reliable way of securing nuclear material from both insider and outsider threats. Improving these MPC&A systems at sites where nuclear material is inadequately protected is a critical component of nuclear material security strategy because such improvements prevent nuclear material from entering the smuggling pipeline, where it is difficult or impossible to retrieve. Effective MPC&A systems thus provide the first line of defense against nuclear smuggling that could lead to nuclear proliferation or nuclear terrorism.

Examples of MPC&A upgrades utilized by the program include:

- Installing portal and vehicular monitors to detect unauthorized movement of weapons-usable nuclear materials;
- Enhancing physical protection systems: locks, fences, barriers, gates, badging systems and interior and exterior sensors;
- Locating tamper-indicating devices to prevent unauthorized removal of nuclear material
- Applying barcode systems to track and inventory nuclear material; and
- Adding alarm and computer systems upgrades to process sensor data and communication system's response time.

ACCOMPLISHMENTS IN FY1998

To date, cooperation to strengthen and modernize MPC&A measures is underway at 53 sites in Russia, the NIS, and the Baltics. By the end of 1998, the program anticipates having 27 sites with upgraded MPC&A systems, an increase of 10 from 17 sites with upgraded systems in 1997.

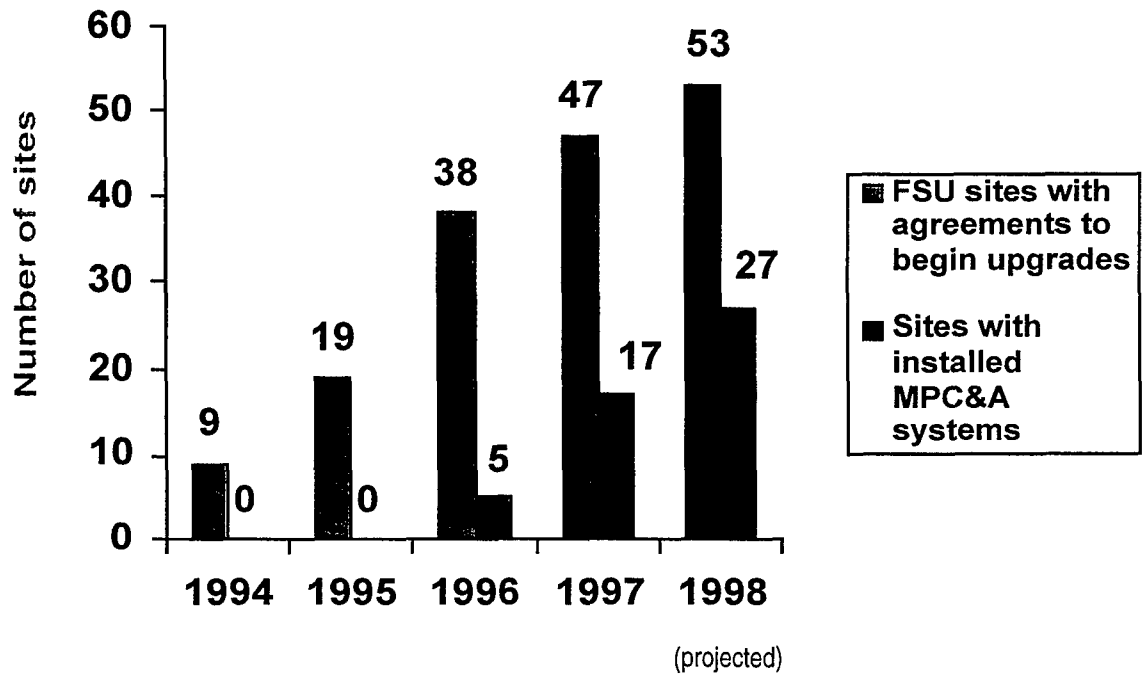

Figure 2: The chart illustrates progress to date in securing weapons-usable nuclear materials at identified sites in Russia, the NIS, and the Baltics.

RUSSIA

Of the 53 sites, 40 sites are located in Russia. Seven of these Russian sites began operation of new site-wide upgraded MPC&A systems as of December 1997. These are

(1) the Joint Institute of Nuclear Research (Dubna)

(2) the Moscow Research and Development Institute of Power Engineering

(3) the Moscow Institute of Theoretical and Experimental Physics

(4) the Karpov Institute of Physical Chemistry,

(5) the Khlopin Radium Institute

(6) the Sverdlovsk Branch of Scientific Research Design Institute of Power Technology

(7) the Beloyarsk Nuclear Power Plant.

In addition, at the Siberian Chemical Combine (Tosmk-7), site-wide portal monitors and metal detectors were installed and commissioned in 1997.

In addition to site-wide upgraded systems, ongoing work continues at remaining sites to enhance MPC&A systems. For example, at the All-Russian Scientific Institute of Experimental Physics (VNIIEF-Arzamas-16), new MPC&A systems were installed at reactor and production facilities, increasing the security of metric ton amounts of weapons-usable nuclear material contained in these facilities at this site. At the All-Russian Scientific Research Institute of Technical Physics (VNIITF-Chelyabinsk-70), pedestrian portal monitors and vehicle portal monitors were installed and are operational throughout the site, enhancing the protection of all the HEU and plutonium at this site.. At the State Research Institute, Scientific Industrial Association "Luch," recent MPC&A upgrades installed in late 1997 are operating at the central storage facility within the site, increasing security of hundreds of kilograms of HEU. At Elektrostal, in building 274, a new MPC&A system was commissioned. Also, at the BFS Critical Assembly in Obninsk, modernized MPC&A upgrades were finished and operating in late 1997.

In the area of regulatory cooperation, Russia and the United States jointly developed and drafted

(1) MPC&A regulatory legislation for establishing Russian Federation federal MC&A systems regulations;

(2) basic rules for nuclear MC&A; and

(3) provisions for MC&A inspections and physical protection oversight.

These regulatory efforts are currently awaiting adoption by the Russian legislative process. In September 1997, the MPC&A program also initiated a cooperative project with Minatom for the development of Minatom's ministry-level regulations for MPC&A, which is intended to complement the federal MC&A systems regulations effort that is pending adoption. Other regulatory cooperative efforts in late 1997 have provided inspection equipment for GAN inspectors, and developed and operated a prototype of the Russian national nuclear material accounting system.

In MPC&A training and education, a dedicated MPC&A training center at the Russian Methodological Training Center (RMTC) was established at Obninsk and a MPC&A graduate degree program at the Moscow Engineering Physics Institute Technical University (MEPhI) was created. In September, 1997, at MEPhI, the first semester of the graduate level MPC&A Masters program started. Graduates from this program are expected to receive their degrees in early 1998. At the RMTC, in late 1997, the training program identified full time instructors and is currently developing and refining curriculum needs. All prerequisite, fundamental, and basic courses in MPC&A are expected to be fully developed and in place by the spring of 1998.

In the area of transportation security, in late 1997, the MPC&A program completed and successfully tested the operation of a prototype railcar during a five-day trip over Russian railroads and delivered two upgraded railcars for operational test by their owners at the Production Association Mayak and the Siberian Chemical Combine.

The MPC&A program has expanded its cooperative work with the Russian Federation Navy. On December 12, 1997, in accordance with the principles of the *Joint Statement on Cooperation between the Russian Ministry of Defense and the DOE on Control, Accounting, and Physical Protection of Nuclear Materials*, signed on July 16, 1996, a protocol was signed to increase and expand MPC&A cooperation at all identified Navy sites in Russia. This protocol specifically

identifies refitting three refueling ships with upgraded physical protection, control, and accounting equipment; designing and implementing an integrated project to consolidate and secure all fresh HEU fuel for the Russian Federation Navy Pacific Fleet; and designing and implementing a site-specific MPC&A upgrade program for HEU assemblies for at least one shipyard. Also, in late 1997, the United States and Russia completed construction of a physical protection annex at the Northern Fleet nuclear fresh fuel storage facility at site 49.

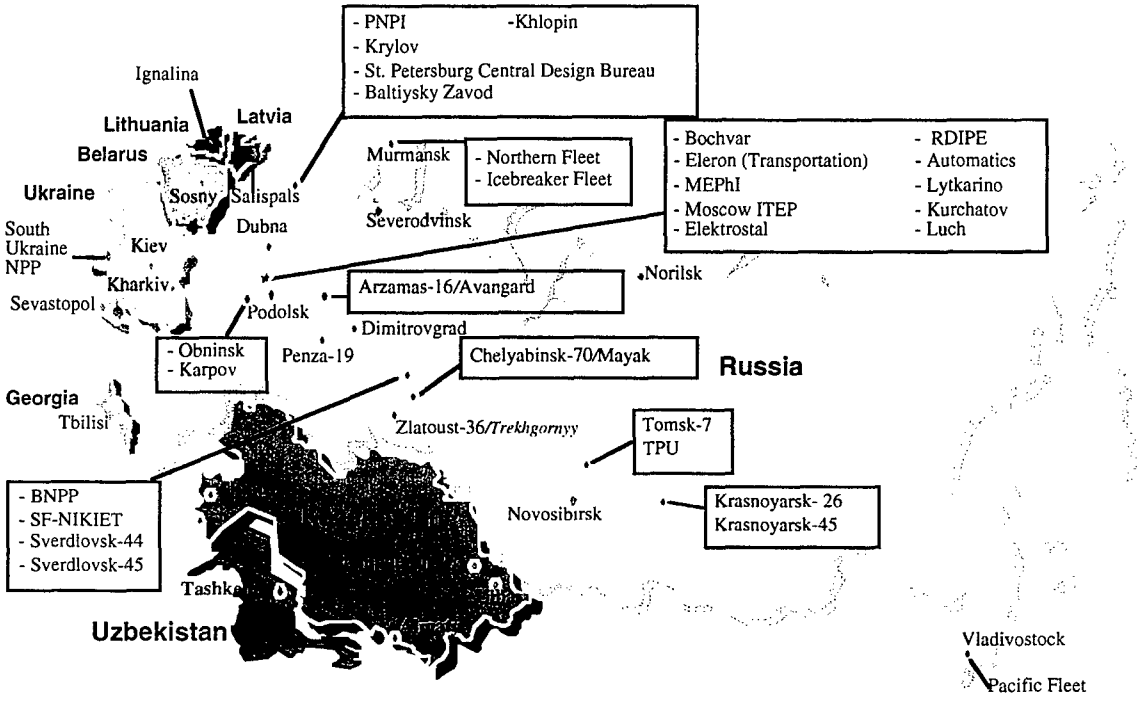

Figure 3: The map shows locations of sites of cooperation under the MPC&A program in 1998.

THE NIS AND BALTICS

There are 13 sites in the NIS and the Baltics. In late 1997, 3 sites completed MPC&A their upgrades at

(1) the Institute of Atomic Energy - Kurchatov, Kazakhstan

(2) the Ust-Kamenogorsk, Ulba Fuel Fabrication Plant, Kazakhstan

(3) the Kiev Institute of Nuclear Research, Ukraine

Meanwhile, ongoing cooperative work continues at two other sites in Kazakhstan and three sites in Ukraine. These upgrades are scheduled for completion this year at the Aktau, BN-350 Breeder Reactor and the Almaty, Research Reactor in Kazakhstan, and in Ukraine at the Kharkiv Institute of Physics and Technology (KPIT), the Sevastopol Naval Institute, and the South Ukraine Nuclear Power Plant (SUNPP), Konstantinovsk.

Sites in Belarus (1 site), Georgia (1 site), Uzbekistan (1 site), Lithuania (1 site), and Latvia (1 site) finished upgrades during 1996, protecting many kilograms quantities of weapons-usable nuclear material. There are no additional plans to initiate new cooperative work in these countries.

However, DOE is maintaining the sustainability of these systems in these countries through its Office of Safeguards, within the Office of Nonproliferation and National Security.

The accomplishments illustrate the continued success of the program's cooperative efforts in addressing the concerns and problems of nuclear material security and accountability in Russia, the NIS, and the Baltics. The program has built and developed strong working and professional relationships with key officials, facility managers, and scientists in all the cooperating states which has also contributed greatly to this program's success. This interaction, unheard of a decade ago, is instrumental in the evolving development of nuclear material security in the region. While the cooperative and untiring efforts of the program participants have yielded many successes, much remains to be done. In the coming years, the Department of Energy will build upon these successes and continue its cooperation, working together with other U.S. government agencies and foreign partners to control nuclear materials and enhance international security into the next century.

Questions and Answers:

D. Beals: What is the objective of the MPC&A Program and how do you evaluate its effectiveness?

M. A. Hastings: The objective of the program is to rapidly upgrade security and accounting at Russian facilities by providing technological and cooperative assistance. The program evaluates its effectiveness through on-site interaction, assurance reporting, and also an evaluation effort currently being drafted. It is possible the Program will be extended beyond 2002.

D. Beals: How does the Program integrate issues regarding the government's ability to evaluate threats?

D. Ball: The Program is interested in evaluating multiple threats (e.g., insider threats), and is teaching vulnerability analysis as part of the Program.

J. Immele: The general issue of evaluation of effectiveness will be discussed at the end of the session.

I. Vasiliev: What is the funding level?

M. A. Hastings: Currently $137 M, formerly it was split between DoD and DOE, but now it is entirely funded through DOE.

Evaluating Physical Protection Systems in Rail Transit Using Combat Simulation

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ABSTRACT

An Automated Transportation Security System (ATSS) for nuclear materials in rail transit is currently being developed by Eleron (MINATOM) within the scope of the US-Russian cooperation pact. To evaluate the utility and effectiveness of the various components of the ATSS, a high-resolution entity-based simulation, developed by and located at LLNL was used. Approximately 90 exercises were run in three scenarios of attempted armed theft of the nuclear material. Quantitative and qualitative insights on ATSS performance were developed.

This paper details the process and results of a recent US-Russia study in the area of rail transportation security. The work is a task under the Materials Protection, Control and Accounting (MPC&A) program of the US Department of Energy (DOE) and the Russian Ministry of Atomic Energy (MinAtom) and was performed jointly by Eleron Laboratory, Moscow, and LLNL.

Most intersite transportation of Russian special nuclear materials (SNM) is done by rail. Special rail cars and trains are available for this purpose, and the trains are guarded both by on-train troops and response forces along the transportation routes. As part of the MPC&A program, Russian and US scientists have been collaborating on the design and implementation of improved security systems for the Russian special nuclear material trains. These systems are collectively known as the Automated Transportation Security System (ATSS). They include means of delaying access to the SNM, as well as a variety of improved communications systems.

There are a number of threats to this nuclear material transportation. They include theft by insiders, political activists, or terrorists. The latter group, terrorists, may be equipped with weapons ranging from simple rifles to advanced high-performance armament such as is available from armaments dealers around the world. The purpose of the study was to evaluate the improvement in security that adding the proposed systems would provide against that terrorist threat.

High resolution combat simulations were developed by LLNL as a comprehensive means of evaluating the results of armed combat. These simulations have been adapted to combat in and around buildings, in complicated terrain, and with a wide variety of weapons. They are used around the world at US Department of Defense (DoD) installations for training, mission planning, system acquisition evaluations, and other purposes and by DOE to evaluate and certify the security of US nuclear sites. They require players to take the role of the commanders of troops and use their expertise to fight the battles and take other actions effectively.

There are typically three steps in the evaluation of site security using high-resolution simulation: 1) scenario investigation, 2) gaming, and 3) data analysis. Scenario investigation involves using all available data resources to determine a likely composition of threat forces, details of guard forces

and their disposition, security systems both in the existing baseline cargo cars and in the improved ATSS upgrade mode, and the interactions of the security systems and terrorist penetration attempts. Eleron scientists made evaluations of the various delay times involved in the interactions, and these were validated by comparison with US experience. Three generic sites were chosen to evaluate the terrorist attack: 1) a level densely forested area distant from any military base, 2) a ravine where the train is stopped in a valley overlooked by potential attack locations, and 3) train tracks along the external border of a small city. In site 1 and 3, there was a highway intersection nearby the attack location to allow terrorists to rapidly leave the area. In site 2, vegetation was sufficiently thin to allow cross-country escape. The data from the systems chosen and the terrains constructed were recorded into the simulation database by LLNL. Comprehensive testing of the database was done of the database to ensure accuracy. Internationally available data was used for all data not specific to the Russian rail car.

Eleron provided computer-familiar scientists and engineers with adequate military background as players for the game. A series of over 90 games were run, distributed approximately equally over the three scenario sites, and half with baseline security systems in place and half with ATSS security systems in place.

Force ratio calibration is a key feature of site security investigations and evaluations that involve new security systems; this was the first gaming activity. If the number of terrorists used as threat forces are too small, the security systems are never used and no data is gathered on their effectiveness. If the number of terrorists used is too large, the troops defending the train are quickly eliminated, and the simulation becomes nothing more than the terrorists stepping through the process of cracking the security protection of the nuclear cargo. Thus, the ratio of defense to offense should be between overwhelming attack and overwhelming defense. This is the sensitive area of the defense/offense ratio, and is the area where interesting results about the utility of the ATSS can be gained.

In order to eliminate bias in the gaming results, rotation of players was performed on a periodic basis. Game arrangements were also randomized by LLNL controllers so that the game players did not have any information to move from game to game, such as the location of the nuclear material in the train or the location of the guards.

The results were most interesting and somewhat surprising. Since the simulations only covered the interaction of on-train guards with the terrorists, and did not continue to model the arrival of off-train response forces, the results have two components. One covers evaluation of the ATSS in assisting on-train guard forces to defeat the terrorist forces. The other evaluated the utility of the improved communication systems in bringing the response forces to the train stop site before escape can be accomplished.

The surprising improvement in the effectiveness of the on-train guards in the ATSS system is somewhat non-intuitive. In all three scenario sites, guards were more effective in defeating the terrorists when ATSS systems were installed. This result was understood by observing the games one by one. When the ATSS systems serve to delay the terrorists in getting into the cargo car and removing the nuclear material, it forces them to concentrate their forces at a specific, exposed location. Guards surviving the initial ambush have longer to regroup and counterattack. They have longer to set up an ambush of the terrorists as they leave the area of the car toward their

escape vehicles. The ATSS also lengthened the time that key terrorists, the explosives experts, would be exposed to being killed.

Interesting results also occurred with the response time considerations. The simulation recorded the times needed for all events, and these could be compared with response times to see how often response forces could arrive before the terrorists, if they were successful in obtaining the cargo, could escape. Adding ATSS would add five minutes to the time needed for the terrorists to make an unopposed entry to the cargo car and remove the nuclear target cargo. However, the game times for escape were from ten to twenty minutes longer. The additional time came from the delays caused by more counterattacks, the need to bring up reserve key specialists, and the need to better defend their exit and escape. Figures 1 and 2 show the extent of the improvements.

The following table shows the probability of defense success in four force-balanced situations: the baseline, with only ATSS delay systems, with only ATSS communications upgrades, and with both. The improvements were synergistic.

		No Comm Upgrade	Comm Upgrade
	Forest	0.10	0.28
No delay	Ravine	0.05	0.17
	Urban	0.02	0.26
	Forest	0.31	0.45
Delay	Ravine	0.19	0.39
	Urban	0.28	0.65

Table 1: ATSS Four-Way Result Comparison

These results have very clear implications for ATSS. First, the systems as developed are more effective than engineering calculations of delay times indicate. Only a high-resolution simulation can determine the extent to which this happened. Second, it points to the need to maximize the delay time along the optimal attack sequence in the design, as that is the key variable determining the success or failure of the protection of the nuclear cargo. Third, it shows that in geographic locations where response force times are commensurate with escape times, the ATSS delays and improved communications systems to summon response forces faster can make this mode of protection also significantly more effective.

Of course, no security system provides perfect security. What ATSS does is to eliminate weaker threats. It forces terrorists to employ larger forces that with the baseline systems, and this has the problem of making pre-detection of their plans more likely. It forces them to find locations even more remote for their attacks in order to extend response force arrival times, and these locations can be eliminated by stationing response forces in appropriate locations. The insights provided by the use of high-resolution simulation also provide recommended design changes to further increase the probability of successful defense of Russian nuclear rail cargo.

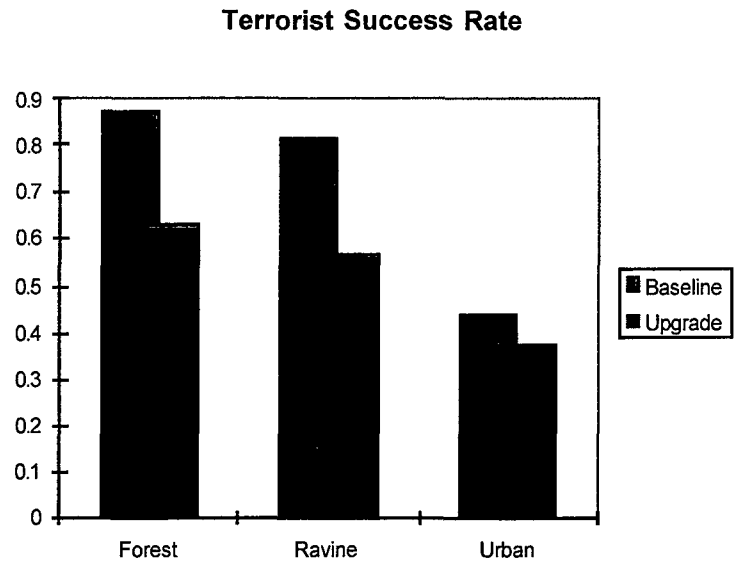

Figure 1: Terrorist Success Rate for Three Scenarios, Comparing Baseline and ATSS railcars.

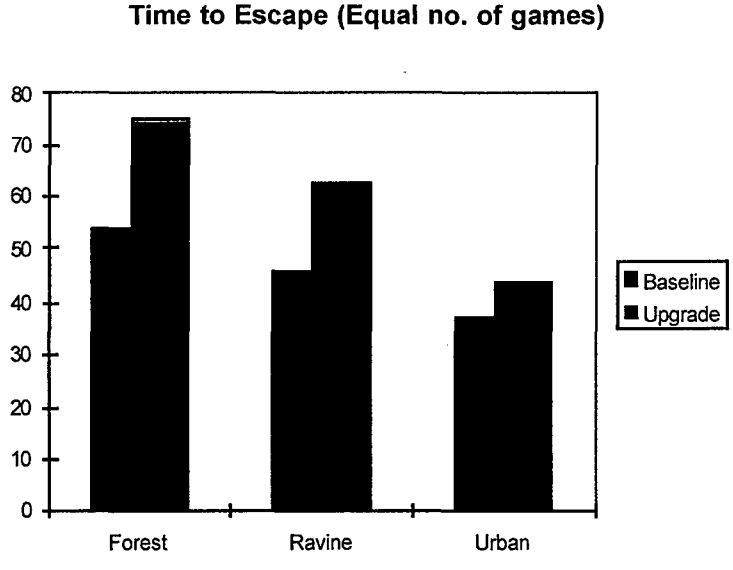

Figure 2: Escape Times for Three Scenarios, Comparing Baseline and ATSS railcars

Questions and Answers:

J. Larsen: Was LLNL designing and outfitting the rail cars or was it SNL?

S. Erickson: It was a team effort, LLNL was responsible for the videos, other Laboratories were responsible for other parts of the up-grades.

J. Larsen: Was it intended to blend in?

S. Erickson: Yes

R. Schuller: Can you give some details regarding the simulation? For example, the train speed, was the guard force killed, was the train derailed?

S. Erickson: The scenario assumed that the train was forced to a stop in the middle of an ambush setup. It was stopped by an obstacle on the track in a location where there was enough visual warning to bring the train to a halt without an accident or derailment. On some runs of the simulation, the guard force was killed, but on others the guard force was able to fight off the attack. By varying parameters, we were able to estimate how many guards would be needed in different situations to be able to defend the material.

G. Lyle: Does the simulation assume everyone is John Wayne?

S. Erickson: No, it permits the gamut to be evaluated, from Pee Wee Herman to John Wayne.

DoD/CTR Fissile Material Protection Projects

Andrew Weber
Pentagon
Washington, D.C.

THE DEPARTMENT OF DEFENSE'S COOPERATIVE THREAT REDUCTION PROGRAM IS ASSISTING RUSSIA TO MAINTAIN NUCLEAR WEAPONS SECURITY

by CDR Michael J. Demeo

Nuclear weapons security has been a major concern for the Ministry of Defense (MoD) of the Russian Federation, and for governments and news media of the West since the Soviet Union was disestablished in 1991. MoD has been tasked with maintaining a high level of security during a period of increasing numbers and frequency of shipments of Russian nuclear weapons necessitated by their being withdrawn back across new foreign borders, by implementation of arms reduction initiatives (INF, START I, and PNI 1&2), and while facing new internal dangers (e.g. terrorists). While MoD has repeatedly assured the West of its nuclear weapons security, public comments by former Russian officials about "loose nukes" continue to draw attention to the security of nuclear weapons under MoD control.

Western concern about the security of Soviet nuclear weapons was particularly high in late 1991. A coup attempt had occurred in August 1991 and the Presidents Nuclear Initiative of September 1991 (PNI 1) added a large number of nuclear weapons to be withdrawn to central storage sites in addition to the weapons movements under the INF and START Treaties. It was in this climate of uncertainty that the legislation sponsored by Senators Nunn and Lugar was passed by Congress in October 1991 which authorized and funded the Nunn-Lugar/Cooperative Threat Reduction (CTR) program. The disestablishment of the Soviet Union in December 1991 and the additional weapons to be withdrawn under PNI 2 of January 1992 added new challenges to nuclear weapons security and an urgency to our CTR negotiations in 1992 with Russia and the other nuclear weapons basing states of the Former Soviet Union.

WPC&A Program Start. The mutual concern by the U.S. and Russia about nuclear weapons security resulted in the nuclear weapons protection control and accounting (WPC&A) program area being a key element of DoD's CTR Program from the beginning. After signing the CTR Umbrella Agreement with Russia on 17 June 1992, implementing agreements were signed with the Ministry of Atomic Energy on behalf of MoD for provision of armored blankets on 17 June 1992 and for nuclear weapons railcar security upgrade kits on 28 August 1992. DoD immediately delivered 1500 surplus LANCE ballistic blankets in 1992, followed by 2520 newly constructed kevlar blankets in 1993 to enhance ballistic protection for weapons during shipment, and provided modification kits in 1994, which were installed during 1995-1996, to upgrade safety and security for 100 nuclear weapons cargo and 15 guard railcars.

Increased DoD-MoD Cooperation. Presidents Clinton and Yeltsin at the September 1994 Summit agreed to "Deepen DoD-MoD cooperation in ensuring nuclear security" and DoD and MoD representatives in October 1994 discussed enhancing security of nuclear weapons under MoD control. As a result, in a major expansion of the WPC&A program, Secretary of Defense Perry

and Minister of Defense Grachev in Moscow on 3 April 1995 signed the Nuclear Weapons Transportation Security Agreement and the Nuclear Weapons Storage Security Agreement. These two CTR agreements are the basis for ongoing, direct DoD-MoD cooperation to define security requirements, and to develop and implement WPC&A projects to assist MoD in maintaining the necessary level of security during shipment and storage of Russian nuclear weapons in support of their destruction and prevention of their proliferation.

NWSG. Since January 1995 the DoD-MoD Nuclear Weapons Security Group (NWSG), comprising DoD's CTR technical experts and MoD's 12th Main Directorate (responsible for nuclear weapons) technical experts, has been routinely meeting to define security requirements, and to develop and implement WPC&A projects to assist MoD in maintaining the necessary level of security during shipment and storage of Russian nuclear weapons, and for cooperative sharing of ideas and methods of enhancing security. The NWSG also looks for ways to expedite project development, and to add new initiatives and technical exchanges. Due to sensitivities concerning nuclear weapons, MoD has been cautious in what it reveals to DoD experts about storage sites or equipment used to support nuclear weapons transportation or storage. As a result, the 12th Main Directorate facility at Sergiev Posad is being used as the central site for delivery of WPC&A equipment, and a Security Assessment and Training Center (SATC) is being established there for MoD training, nuclear weapons storage site security assessment, upgrade project development, and for packaging of storage site security upgrade kits.

WPC&A Program. The WPC&A program was set up with a two-stage approach. The first stage addressed MoD's immediate needs for nuclear weapons transportation and storage security for increased shipments (START I, PNI 1&2, etc.), across new international borders, while facing new dangers (terrorists, etc.), and replacing aging equipment (e.g. computers). The second stage addresses MoD's longer range needs (new computer architectures for nuclear weapons inventory management), additional weapons shipments (START II), and the development of an integrated system to upgrade storage site physical security (equipment/sensors and measures). Projects are being developed and implemented: to enhance ballistic and security protection during transportation; to upgrade the guard force/weapons technicians; to respond to accidents/incidents; to computerize the inventory control; to assess security weaknesses; and to provide physical security upgrades at 30-50 nuclear weapons storage sites. DoD and MoD are using a systems approach in development of these projects to ensure they complement other initiatives and fit into an overall security enhancement program. The cooperative aspect of this program is to jointly find resolutions to nuclear weapons security concerns, not only by developing CTR projects, but also by sharing and comparing security philosophies, methods, and procedures such as those related to the Personnel Reliability Program.

WPC&A Project Status: Nuclear Weapons Transportation Security Projects.

Armored Blankets. Objective: Enhance ballistic protection during transportation. Provided 1500 ballistic blankets in 1992 and 2520 kevlar blankets in 1993.

Nuclear Weapons Cargo and Guard Railcar Security Upgrades. Objective: Enhance security and safety (fire/ballistic protection) during transportation. Security upgrade kits provided in 1994 and installed by March 1996 in 100 cargo and 15 guard railcars.

Supercontainers. Objective: Enhance security and safety during transportation with extra fire, ballistic, and handling protection. Contract awarded in December 1995 using same design as

supercontainers being provided to Russia by the U.K. 149 supercontainers delivered in 1997. After testing, 150th delivered in February 1998. Two prototypes used in testing will be provided for training.

Emergency Support Equipment. Objective: Provide mobile equipment for MoD use in emergency response. The container design was finalized and container construction began in February 1996. Five sets of equipment and overpack containers delivered in 1996-1997. MoD cadre trained in September 1996 in St. Petersburg. Three Canberra radiation detectors modified for underwater use delivered in early 1998. Additional equipment is being procured to augment the sets and to train MoD personnel.

Accident Information Analysis System. Objective: Provide computers to outfit headquarters in St. Petersburg and Moscow and regional centers for MoD to monitor incident/accident status, and to support assessment, response, and clean-up activities. Computers procured/tested in November-December 1997; training/installation in February 1998.

Nuclear Weapons Storage Security Projects.

Nuclear Weapons Automated Inventory Control and Management System (AICMS). Objective: To automate MoD's nuclear weapons inventory control with a modern computer network. 50 computers provided in 1995-1996 for MoD training, site upgrades, and for development of software and hardware prototypes. Training conducted in 1996-1997. MoD-developed software completed at end of 1997 and the hardware configuration design due in June 1998. To speed up this project: 1) U.S. integrating contractor to assist in final computer architecture definition, and procurement of computer and interface components in 1998; and, 2) DoD providing 100 computers for use in a stand-alone mode; starting May 1998 in an Interim configuration so MoD can start immediate software checkout, training, and filling out of the data base matrix. Final configuration hardware (additional 200 computers, printers, etc.) will be ordered in June 1998 for delivery starting November 1998. Installation by MoD starts in late-1998, and operational testing of final deployed network system by mid-1999.

Site Vulnerability Analysis Training and Equipment. Objective: To provide capability to assess security vulnerabilities at MoD's nuclear weapons storage sites. Computer equipment and ASSESS - Analytic System and Software for Evaluating Safeguards and Security - computer model software provided in 1996. Additional computers provided in 1997. Training conducted in St. Petersburg 1996-1997. ASSESS computers, software, and training will be relocated to SATC in Sergiev Posad.

Guard Force/Weapons Technicians Upgrades. Objective: To upgrade MoD's guard force. Additional ASSESS vulnerability training in November 1997. Contract for procurement of dosimeters for weapons technicians; December 1997.

Personnel Reliability Program (PRP). Objective: To upgrade MoD's guard force. Contracting process started in 1996. Portable drug & alcohol testing equipment delivered to St. Petersburg in November 1997 and training started in early 1998. Five polygraph sets delivered to Sergiev Posad in November 1997 and training in January-February 1998. Fixed site laboratory contract to be awarded in April 1998. Training and fixed lab installation in FY98.

Nuclear Weapons Storage Site Physical Enhancements. Objective: To upgrade external and internal physical security at MoD's 30-50 nuclear weapons storage sites using commercially

available technologies, and to develop equipment and training for guard forces. DoD is using a systems approach to the evaluation and enhancement of security to ensure that separate elements of DoD-provided and Russian-procured material complement without overlap in addressing the full range of security challenges. A SATC will be established at Sergiev Posad where modern physical security equipment, technology, and materials will be installed and evaluated. Nuclear weapons storage sites will be evaluated for vulnerabilities and kits of physical security equipment will be assembled for installation at up to 50 storage sites. Training will be conducted on use of the new security equipment and on ASSESS. In addition, guard/rapid reaction force training and equipment upgrades will be developed. DoD contracted with Eleron in October 1996 for a feasibility study on SATC set up and use. In November 1997, the Russian firm Eleron received a contract to produce the SATC security design, and the U.S. company Bechtel received a contract to outfit and establish the SATC. Bechtel presence at SATC started in February 1998.

Nuclear Weapons Storage Site Physical Enhancements – "Quick Fix". Objective: To meet MoD's immediate site security needs. Contract awarded to Russian firm Tenzor in April 1997. Delivery of 50 km of "Quick Fix" fencing and sensors occurred September-December 1997. Contracts awarded in March 1998 for 100 km of engineering fence; in April 1998 for 475 km of cabling. MoD to install all.

New Projects.

DoD and MoD are discussing new possibilities for project development.

MILES Guard Force Training Equipment: Objective: To upgrade MoD's guard force training. DoD will provide to MoD additional information on the equipment capabilities, availability, and training for this weapon laser trainer for guard forces and commercially available alternatives.

Nuclear Weapons Surety Team exchange: Objective: To share nuclear security concepts. A three meeting exchange between Defense Special Weapons Agency's Nuclear Weapons Surety Team and MoD counterparts to discuss concept of nuclear weapons security with emphasis on inspection philosophy and underlying safety concepts. This would support efforts at the Sergiev Posad SATC to provide guard force training and to upgrade storage site security.

"Without DoD's Cooperative Threat Reduction assistance the Russian Federation would not have the same level of success in safely and securely dismantling nuclear weapons."

-- Col Gen-Col Yevgeniy P. Maslin, Chief of the 12th Main Directorate, 28 March 1996.

Conclusion: The most important DoD-MoD direct cooperation in the CTR Program is that of the WPC&A program area under which DoD has been providing assistance to enhance security of nuclear weapons under MoD control. The CTR WPC&A program totaled $116 million in FY 92-97 and $36 million is to be added in FY98 funds. WPC&A projects are being developed to address both MoD's immediate and longer range needs, and will support START I, II, & III eliminations and early deactivation as well as nuclear weapons being transported for dismantlement under earlier arms control initiatives (PNI 1&2 and INF). Project development has been very fast from definition of requirements to initiation of the contracting process, and MoD is very pleased with the type and quality of WPC&A assistance provided. MoD has been candid about stating its needs for security enhancement projects to maintain the proper level of security during this period of increased weapons shipment due to arms control initiatives. However, MoD has been cautious in what it reveals to DoD experts concerning storage sites and nuclear weapons, and DoD experts

have to depend on MoD inputs in project development. Projects will continue to be developed to meet expanded needs, and DoD and MoD interactions will continue to improve an already collegial relationship. The very good cooperation between DoD and MoD on the WPC&A program will continue to benefit the U.S. and Russia through enhancements to the safety and security of nuclear weapons transportation and storage, and improvements in the area of non-proliferation. And finally, the large number of weapons shipments flowing back to dismantlement sites in Russia will be safer to us all.

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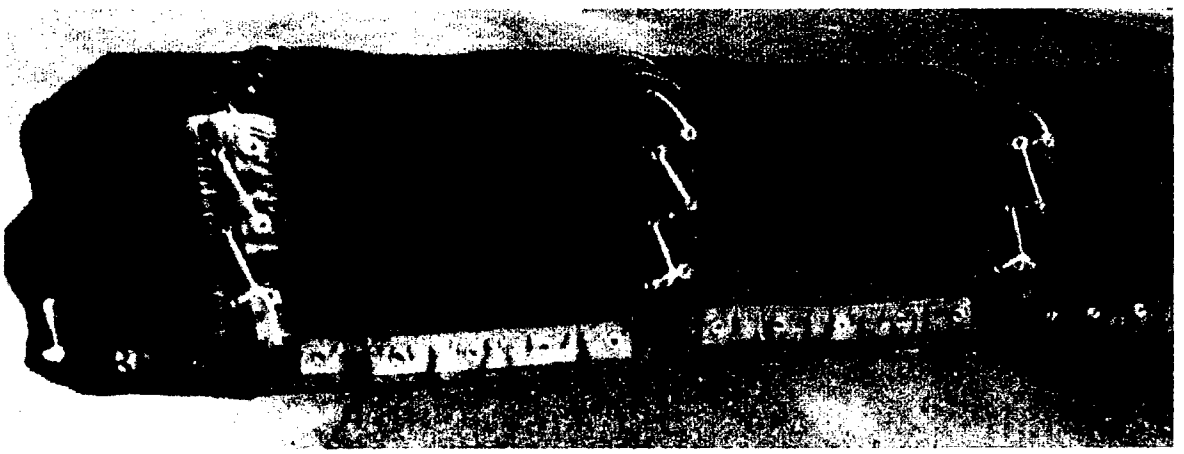
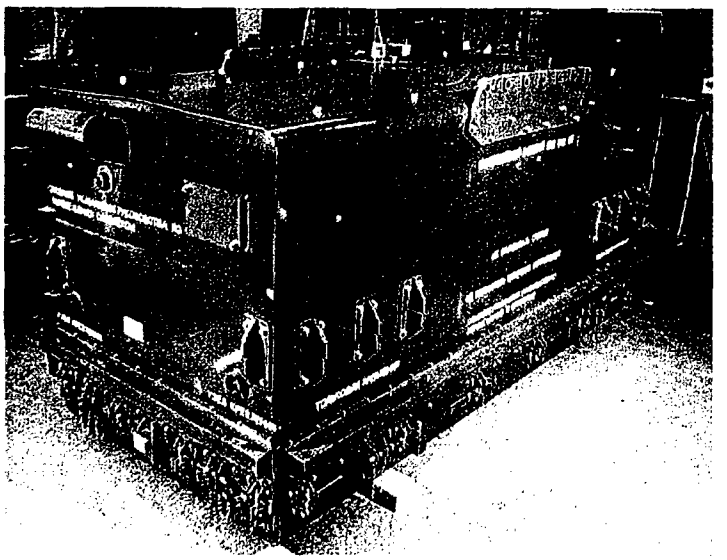
1. Insulation and sensors being installed in nuclear weapons cargo railcars



2. Armored Blankets



3. Supercontainer

4. "Quick Fix" type fencing with sensors

Questions and Answers:

M. Eisenstein: What happens during dismantlement?

A. Weber: The components are destroyed.

E. Ewell: What types of CTR activities in new countries have been added?

A. Weber: Removal of 21 MIG 29 fighters from Moldova, training in Uzbekistan and Kazakhstan, additional projects are being developed with Uzbekistan

N. Dellenbach: What is the impact of cooperation? How does it integrate with other countries?

A. Weber: Efforts are complementary, the European Union is encouraged to increase participation, Japan is supplying 20,000 containers, etc.

J. Immele: With regards to Pu disposition, France and Germany are working with Russia on MOX

A. Weber: Other things are being done to help employ weapons scientists, through ISTC and STCU (total of $35 M), which has active European Union participation.

C. Olinger: Is there a backlash of governments to Western involvement in their security?

A. Weber: No, there have been some issues with the Duma, but the partners want more cooperation.

S. Mullen: What is the timeline for nuclear weapons storage sites?

A Weber: Some equipment has been delivered over the past 2 years, but it is really just starting.

I. Vasiliev: Several speakers have mentioned aid to former states in terms of providing protection enhancements to individual sites under Minatom, rail systems, protection for second line of defense (i.e., borders). Among all these, no one talked much about second line of defense. Does it mean once protection is finished at source, does that solve the problem? How much is involved in political motives?

A. Weber: There is a $10-20 M program with the FBI/U.S. Customs Service for the second line of defense. Only in last year has it began to grow. An example was the training of 40 Uzbekistans and Kazakstans in Budapest. There has been lots of DoD and NSC discussions about increasing the level of engagement to include Russian border forces. Also, the State Department, with DOE help, has an export control program.

I. Vasiliev: It is still something to be discussed.

A. Weber: We are ready to put things into action. For awhile Russian border was said to be under control, but now we look forward to more visionary partners like yourself.

I. Vasiliev: We can cope, but it is not something which can be done in a languid manner.

M. A. Hastings: We do not view work at the sites as the total solution. It is part of other activities, and the issue of the state of nuclear weapons is of global concern, responsibility and priority.

V. Brovkin: On whose authority does material get into and out of Mayak?

A. Weber: Part of the project is a transparency agreement to observe change of custody from military to Minatom.

J. Larsen: Is Mayak the first of many sites?

A. Weber: It will be the major site. As we move into START 3, we may have to consider a second site.

J. Immele: Russia and the US are still discussing whether Mayak will store pits or nuclear materials as ingots.

J. Ford: Will Mayak be under IAEA inspection?

A. Weber: Yes, it will be under IAEA safeguards.

J. Immele. There is still discussion on that, as IAEA would only cover material, not components.

EUROPEAN STATUS AND CASE STUDIES

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SUMMARY:

It has been a pleasure to attend this 5th Workshop on Fissile Materials, and I want to take this opportunity to again thank the sponsors, the Center for Global Security Research at the Lawrence Livermore National Laboratory, and the Institute for National Security Studies of the U.S. Air Force Academy for all their work in organizing it. At least one representative of the Center for Nonproliferation Studies has attended each of the five meetings in the workshop series, and we have always found them to be informative and useful sessions. We certainly plan to participate in any future sessions, as well. Let me begin my comments by highlighting what I think were some of the more interesting aspects of the presentation made yesterday by the presenters on the two panels which I moderated that included case studies from Eastern Europe and the Newly Independent States (NIS) of the former Soviet Union. Then I will proceed to make a few general comments about the workshop as a whole and to suggest ways in which future sessions of the workshop might be made even more productive than this one has been.

EUROPEAN AND NIS CASE STUDIES:

All the presentations were of a high quality, but because of our limited time, I will simply highlight what I thought were the most illuminating aspects of several of the eight presentations made on the two panels which I moderated.

Vladimir Brovkin's presentation on the proliferation implications of the fragmentation of authority and the privatization of the state in Russia was extremely insightful and provocative. As an observer of Russian politics myself, I agree with his conclusions about the extent to which central control has broken down and the degree of autonomy which has been acquired by many organizations which are formally part of the Russian state. His discussion of smuggling operations run out of military bases in Georgia and the Russian Far East is particularly worrisome. Having read similar accounts in the Russian press myself, in particular a January 1998 report in *Izvestiya* about an automobile smuggling ring operating out of a "closed city" operated by the 12th Main Directorate of the Russian Defense Ministry in Khabarovsk Kray, I share Professor Brovkin's concerns. But beyond the possibility that semi-autonomous elements of the Russian state may be involved in trafficking in nuclear materials, Professor Brovkin's analysis should also prompt us to think about how Western policies might take more fully into account the devolution of authority in Russia. Policies that aim at influencing the Russian federal government may not always be sufficient to address certain issues related to proliferation.

Emily Ewell's discussion of nuclear smuggling incidents in the NIS since 1995 was interesting because it focused on possible explanations for the apparent lull in proliferation-significant cases of nuclear smuggling since 1995. One common explanation for this lull is that smugglers have become more sophisticated, and are thus not being caught as frequently. The 1997 case of the smuggling ring at the Ulba Metallurgical Factory in Kazakhstan showed that smugglers no longer

fit the profile of the disgruntled individual facility employee or amateur. The ring at Ulba was well-organized, including mid-level officials at the plant, and diverted hundreds of kilos of LEU from the facility. We cannot exclude the possibility that similar groups have been operating even more successfully at some other facilities, possibly evading detection. Some Russian officials, for example, have said that a group of as few as four employees at some facilities could divert material without being noticed for some time.

Ms. Ewell also discussed a case involving a research institute in Chelyabinsk that shipped one radioactive isotope to Great Britain under customs documentation indicating that the shipment contained another isotope. This method could be used to "legally" export fissile materials under false documentation. As the presentation by Mr. Vasiliev of the State Customs Committee of the Russian Federation indicated, Russian authorities do not have sufficient equipment to easily differentiate between legal shipments of radioactive isotopes and illegal shipments of fissile materials which may be packed with them. The Chelyabinsk case suggests that sophisticated smugglers may have been "legally" exporting fissile materials without being detected. Together with the Ulba case, this case indicates that it would not be prudent to conclude that the apparent lull of proliferation significant smuggling cases since 1995 means that significant quantities of fissile materials have not been diverted during that time.

In his presentation, Dr. Bekhzhad Yuldashev of the Institute of Nuclear Physics in Tashkent, Uzbekistan, reminded us of the importance of covering the southern approaches to Russia. Border controls in the Central Asian states of the NIS are generally much weaker than those to the west of Russia. Dr. Yuldashev pointed out that the Uzbek customs services, for example, lack the necessary equipment to detect radioactive materials at all border crossing points. It is thus possible that more smuggling is going on in that direction than public reports would suggest. Dr. Yuldashev also indicated, however, that his institute has the ability to design and help produce this equipment. He suggested that his institute would be very interested in cooperative projects with Western partners to produce such equipment. He also added that his institute would welcome the cooperation of other Central Asian institutions in such projects. So while the southern frontiers may be relatively open currently, it should be possible to improve the situation with cooperative programs. Such programs would also serve the broader goal of fostering the development of a community of nonproliferation experts in the Central Asian region.

COMMENTS ON THE OVERALL WORKSHOP

In my view the presentations at the workshop were highly useful, and brought many of us up to date on the activities of our colleagues in government agencies, universities, and research institutions. The workshop serves an important function in that respect. However, I think the workshop could be improved if each session had a common theme or set of questions on which the individual presentations could be focused. Each session of the workshop could attempt to answer a specific set of questions, helping to form a consensus on key issues among specialists in the field. Such an approach would lend each session of the workshop additional coherence, but more importantly, would contribute to what I believe would be a useful longer-term goal. It would allow the workshop series to be structured so that the results of each session serve as a building block for the next session. In this way, it would be easier to develop a cumulative body of collective knowledge on the subject of illicit trafficking in fissile materials. This approach would allow the workshop to make an even greater contribution to the development of nonproliferation policy.

On another note, this workshop series is important because it highlights the continued importance of efforts to improve the security and safety of fissile materials in the NIS. Although the issue is receiving quite a bit of attention and financing from U.S. government, in my view it is still not given the emphasis it deserves. The former Soviet nuclear arsenal and its associated industrial facilities represent one of the most pressing direct threats to U.S. security. In my view it should be a top priority, with much higher levels of funding than currently allocated. I also think this workshop has helped demonstrate that the goal of improving nuclear security and safety in the NIS should not be traded off against other foreign policy goals, such as NATO enlargement, which address much more ambiguous and diffuse threats to U.S. security.

Illicit Trafficking of Radioactive Substances and Nuclear Materials in Poland - Preventive Measures

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1. LEGAL REGULATIONS

All the activities involving use of radioactive and nuclear materials in Poland are regulated mainly by the Parliament Bill named „The Atomic Energy Act" of 10th April 1986, with later amendments, requiring that a license from the competent authority (i.e. National Atomic Energy Agency) is to be obtained for carrying out such activities, as production, conversion, storage, transport or use of and trade in nuclear materials and radioactive sources and waste, taking into account special exemption levels, as defined. It also says that a person who, without required license, conducts the mentioned above activities, is liable to penalty such as depriving of liberty or fine. The President of the National Atomic Energy Agency (NAEA) issued, among others, the following regulations concerning radioactive sources and nuclear materials:

- Rules of Accountancy and Control of Sources of Ionizing Radiation (1987),
- Rules of Accountancy and Control of Nuclear Materials (1987),
- Rules of Physical Protection of Nuclear Materials (1988),
- Conditions of the Import into, Export out and Transit through the Republic of Poland of Nuclear Materials, Radioactive Sources and Devices Incorporating such Sources (1988, changed in 1997).

In 1993, the Polish Parliament issued the Act on Special Control of Foreign Trade in Goods and Technologies subject to International Agreements and Obligations. According to it, the Minister of Economy defined a list of goods and technologies covered by this Act; the last amendment of the list was done on 31st December 1996, and its format is based on the control list of the European Union. This list contains among others items crucial to the nuclear fuel cycle and to nuclear explosive devices, as internationally proposed and agreed by the Nuclear Suppliers Group, published as the IAEA documents - INFCIRC/254/Rev.1/Part 1 (Trigger List) and Part 2 (Dual-use Items) with later updates. The licensing and control resulting from the above mentioned Act was entrusted to the Department of Export Control of the Ministry of Foreign Economic Relations (since January 1, 1997 - the Ministry of Economy). The decision making process involves several Ministries, according to their competencies, and final license is issued by the mentioned Department of Export Control. Regarding questions related to nuclear materials, equipment, technologies and dual-use items important for nuclear fuel cycle, a license by the President of the NAEA is a precondition to the general export/import license.

A Point of Contact of the international system of information exchange on illicit trafficking of radioactive and nuclear materials is located at the NAEA. The NAEA is also reporting to the

International Atomic Energy Agency Safeguards System on cases when nuclear materials are revealed at the Polish borders or within the Polish territory.

At all the crossing points of Polish borders, it is the officers of the Border Guard who have the title to control, stop or to deny the entry to Poland of radioactive and nuclear materials and waste, on the base of the Parliament Act on Border Guards of 1990. Also customs officers who check baggage crossing the border are equipped with the instruments enabling them to detect radiation sources and to intervene in such cases. In order to insure a proper functioning of these mechanisms the President of the NAEA has signed special agreements with the Heads of the Main Office of Border Guards and Main Office of Customs, under which he may assist both partners in training the personnel, evaluating and identifying the detected suspicious and undocumented goods, in equipping with measuring devices, etc. The President of the NAEA has signed a similar agreement with the Office of State Security, also involved in physical protection and in prevention measures against the illicit trafficking of nuclear materials. His obligations are executed by services of nuclear research institutes and by the Central Laboratory for Radiological Protection, including also a special emergency service squad alert around the clock. Cost of installation of the stationary detection devices at border checkpoints utilized by the Border Guards is covered by local authorities, administrating the territory of the crossing points.

2. PREVENTIVE MEASURES AT THE BORDER

The main threat for the Polish territory arises from:

- attempts to import radioactive substances (exceeding the defined exemption levels) without legal licenses or permits or with false cargo documents,
- attempts to import radioactive waste for storage or utilization (such action is prohibited by the Environmental Protection Act),
- illegal transport of radioactive and nuclear materials.

In 1990 it was decided to equip all the border checkpoints with radiometric instruments. The main element of that system are stationary devices, sometimes referred to as „portal monitors", containing large volume sodium iodide scintillation crystals and computerized control and signal panels. They are sensitive enough to detect low activity gamma ray sources transported in a vehicle or carried by a person passing through the gate, even along the opposite side of the road or of the railway track (they detect 125 μCi of Cs-137 from a distance of 5 m., when moving with a speed up to 30 km per hour, if unshielded). At present (as on December 31st, 1997) 103 such devices are deployed (47 at road checkpoints, 33 at railroad checkpoints, 13 in the airports and 10 in the harbors on the Baltic Sea). They cover practically all the entry points at the Polish Eastern border (with Russia, Lithuania, Belarus and Ukraine) and majority of the crossing points at the borders with other neighbors. An alarm is usually activated when the measured gamma dose rate exceeds two times the normal background level. Patients having had undergone treatment with e.g. radioactive iodine are routinely stopped and they are now instructed to carry medical certificates to this effect. In 1997 out of more than 82 million cars and trains passing by the portals, 14978 indicated an elevated radiation and after some additional examination in 487 cases the entry was denied (in 1996 these numbers were 80 million, 19 000 and 640, respectively).

The border guards are also equipped with more than 600 portable dosimeters and surface contamination meters. These instruments enable the guards and the custom officers both to check the passer-byes more carefully, identifying reasons for the detected radiation and to find some substances already smuggled to Poland; in 1997 there were more than 10 cases when illegally carried radioactive substances were discovered in that way.

In June 1996 the Border Guard was provided with a special van equipped with the instrumentation for detection of arms, drugs and radioactive materials. This mobile unit is usually utilized at the Warsaw International Airport but is also often used at the road checkpoints of the Eastern border of Poland.

The borders of Poland may be now recognized as well protected against any illegal trafficking of radioactive materials; in case of the attempts of smuggling of nuclear materials the situation is more difficult, since there are no devices, neither stationary nor portable, to detect HEU or Plutonium. The table 1 lists some examples of interventions at the border in 1997, the identification of isotopes has been performed by the Central Laboratory for Radiological Protection unit.

3. LABORATORY AND FIELD ANALYSES

The Central Laboratory for Radiological Protection (CLRP) in Warsaw, answering the requests of the Border Guard, police, the State Security Office or prosecutor offices, identifies and analyses radioactive and nuclear materials found at the borders or within the territory of Poland. The Laboratory applies alpha and gamma-ray spectrometry for radioactive substances and high-resolution nondestructive gamma-ray spectrometry for uranium samples, enrichment of ^{235}U being determined by the Matussek procedure. The emergency squad of the CLRP may also utilize a mobile laboratory with the high resolution spectrometer to be employed at the site. The wet chemistry is used to determine chemical composition of uranium oxides, if needed. At present the Laboratory is unable to determine neither enrichment of HEU or Pu isotopes, nor the origin of nuclear material. The number of different interventions of the CLRP mobile emergency squad equals to 60 - 100 per year; the Table 2 lists some of the incidents of the recent years, other than interventions at the border.

There are some analytical possibilities at other Polish research institutes and universities, both by nondestructive or radiochemical techniques; such capabilities are e.g. at the Institute of Atomic Energy in Swierk near Warsaw or at the Institute of Nuclear Physics in Krakow. At the Institute of Nuclear Chemistry and Technology in Warsaw a passive neutron detector system, with 18 + 6 ^{3}He gas counters and a coincidence circuit makes possible to determine concentration of even Plutonium isotopes (above 10 mg of ^{240}Pu) and to examine a spatial distribution of the fissile isotopes in the sample.

All the samples of radioactive substances and nuclear materials, of the illegal or unknown origin, found in Poland, are collected and - while awaiting any legal procedures - stored at the CLRP.

Table 1. Some interventions at Polish borders in 1997

January 24 - Swiecko cp[1] (Germany)	Entry of the transport of 120 bags with 5000 kg of contaminated blackberries (3400 Bq/kg of Cesium

	isotopes) denied
February 28 - Hrebenne cp (Ukraine)	Entry of 19.9 tons of contaminated copper scrap denied
April 6 - Kukuryki cp (Belarus)	Entry of 20 tons of contaminated stainless steel denied
April 8 - Kukuryki cp	Entry of 19.25 tons of contaminated copper scrap denied
April 11 - Budzisko cp (Lithuania)	Entry of 20 tons of contaminated steel scrap denied
April 24 - Krakow, Balice Airport	A parcel containing ^{3}H, ^{57}Co and ^{125}I sources without necessary documents stopped
May 12 - Kukuryki cp	Entry of 18.24 tons of contaminated copper scrap denied
June 6 - Terespol cp (Belarus)	At the sleeping car of the Moscow-Warsaw train contaminated hidden works of art - an old cross and around 10 paintings, as well as two spots of the same isotope (^{131}I) in the car - found; no owner identified, goods taken
July 2 - Konradow cp (the Czech Republic)	Entry of agricultural machinery with steel parts containing admixtures of ^{60}Co denied
August 3 - Dorohusk cp (Ukraine)	Entry of 800 items painted with Radium dye denied
August 29 - Kuznica Bialostocka cp (Belarus)	Entry of 400 items painted with Radium dye denied
September 27 - Swiecko cp	Entry of contaminated nonferrous metals scrap denied
October 1 - Krakow, Balice Airport	A parcel containing ^{241}Am sources without necessary documents stopped
October 10 - Kukuryki cp	Entry of 22 tons of contaminated copper scrap denied
October 23 - Kukuryki cp	Entry of some tons of contaminated copper scrap denied
October 31 - Kukuryki cp	Entry of 21.6 tons of contaminated copper scrap denied
November 5 to December 31 - Czeremcha cp (Belarus)	82 cases of denying the entries of dried mushrooms (630 kg in total) containing about 185 kBq/kg of Cesium isotopes

Table 2. Some interventions of the Central Laboratory for Radiological Protection other than at state borders

October 17, 1992	Terespol, private apartment	natural Uranium, 1.58 kg, Soviet origin
November 5, 1992	Radom, private garage	natural Uranium, 0.42 kg, Soviet origin
March 8, 1993	Gdynia, private apartment	1 container made of depleted U; inside - 500 g of Uranium oxide (powder), Soviet origin
April 5, 1993	Nowy Jawornik by Swidnica roadside	2 big empty containers for high activity sources, inscription in Russian
April 9, 1993	Rzeszow, private apartment	2 containers with 3.75 kg of natural Uranium, origin unknown
April 28, 1993	Braniewo, private apartment	1 container with 1 mCi Cs-137 source, Soviet origin
August 30, 1993	forest near Szczecin	7 Co-60 sources, 1 mCi each, Soviet origin
November 23, 1993	Cmilow near Lublin, a farm	natural Uranium, 2.54 kg, in form of a cylinder, Soviet origin
May 30, 1994	Przemysl, private apartment	1 container with two Sr-90 sources 5 mCi each , Soviet origin
April 1994	Cieszyn, a car near a border checkpoint	a package with 50 Uranium fuel pellets (850 g), enrichment 2%, as indicated b y foreign experts - from Ignalina NPP, Lithuania
May 29, 1995	Koszalin, private apartment	container with two Cs-137 sources, 52 mCi and 2.1 mCi, stolen in 1992 from the former Soviet military base in Borne-Sulimowo
November 7, 1995	Glucholazy, car leaving Poland to the Czech Republic	11 containers with Sr-90 sources, below 37 MBq each, origin unknown
January 28, 1997	Opole, roadside	1 container with 5 mCi Sr-90 source, Soviet origin
April 15, 1997	Pruszkow, metal scrap yard	container with inscription in Russian. Inside 20 mCi Sr-90 source of 20 mCi

Questions and Answers:

I. Vasiliev: The systems you described on the border are not suitable for detecting SNM. Why?

J. Niewodniczanski: Yes, they only detect gamma rays, there are no ^{3}He neutron detectors.

M. Sparks: Are the portal monitors at harbors for trucks?

J. Niewodniczanski: Yes, and portal monitors are only at guarded checkpoints, there are no such monitors elsewhere, like in the mountains, etc.

S. Erickson: Is there a black market?

J. Niewodniczanski: There have been some attempts, once thieves tried to find customers. It turned out that their "customer" was a policeman. There have been no proven cases of transactions on a black market.

N. Reuter: How many cases have there been of material which was seized in Poland but which did pass the border?

J. Niewodniczanski: In 1995, 0 cases, in 1996 less than 10, and in 1994 about 20.

S. Mullen: What type of material was seized?

J. Niewodniczanski: Depleted and natural uranium.

R. Lee: Where did it come from?

J. Niewodniczanski: Some of it came from former military bases.

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Russian Armed Forces Shrinking and Implications for Potential Mass Destruction Weapons Proliferation

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Opinions here presented reflect only author's point of view and are not to be understood as representative of opinions held in any institutions the author is working or has worked for.

INTRODUCTION

Even though we do not consider that nuclear proliferation is the most urgent theme to supervise in Russia, we must nevertheless keep on having a close look at it, because of the domestic instability of this country. Russia is still convulsed by a genuine transformation of the state, the economy and the society with deep consequences on the defense capacity. The economic and financial decay, which is one of the first cause of this situation, may be considered as the main hindrance to the policy of no-proliferation in the three following fields: denuclearization, commercial cooperation and control of fissile materials.

On a political, military, technical and industrial point of view, Russia perpetuates its heritage as a nuclear power. Russia keeps a fairly sufficient nuclear capacity thanks to its industrial and technical capacity. It also keeps the necessary skills to maintain its arsenal operational, the Start II treaty be ratified or not by the Duma. The nuclear weapons will retain their exceptional importance now and in the foreseeable future because Russia can not propose an alternative to them. Nevertheless, the economic difficulties compel the country to neglect the issue of nuclear safety, and very often Russia finds itself involved in a commercial policy of selling nuclear capacities abroad at the risk of encouraging proliferation. The risk seems to be very strong when we look at the cooperations that have been established with China and to a certain extent with Iran. Yet, today we may consider that Russian policy of no-proliferation, if certainly less demanding then in western countries, is all the same strict enough to ensure a minimum of stability. In fact, there is an instable balance between the Russian forces which have inherited the Soviet nuclear capacity and intend to maintain it in good shape, and the commercial and financial imperatives that play to the detriment of security. The instable balance is particularly clear when studying the relationship between China and Russia.

1. NUCLEAR CAPACITY

The capacity of Russia to remain a credible nuclear power, while maintaining a no-proliferation policy is a problem which presents four challenges :

- the modernization of nuclear weapons, the future arsenal and the circumvention of current international treaties,

- the commercial strategy and nuclear cooperation,
- the brain drain,
- the necessity to maintain the appearance of global military credibility and cut the defense budget.

The nuclear capacity and the strategic arsenal have been inherited from the Soviet era, but the doctrine has evolved to become a Russian one. In addition, if the weapons, in order to maintain the credibility of Moscow, are to be modernized, the armed forces must take the new economic context into account. The new doctrine of Russia reflects this situation. Moscow seems to place heavy emphasis on nuclear weapons in order to deter its relative conventional inferiority. Nuclear forces are cost-effective as strategic deterrent, even though, as the General Staff has pointed out, they lack the necessary flexibility in the face of low intensity conflicts[1].

The modernization of the nuclear weapons and the treaties.

The Russian economy has not the capacity to engage in a radical modernization of its weapons. Nevertheless the possibilities to circumvent the treaties, and particularly the CTBT, exist. The political instability, the social decay and the fear of the extension of NATO, compel Moscow to maintain its nuclear power. This policy should enable Russia to imbalance its conventional inferiority.

The Russia's Strategic Missiles Forces (RSVN) have yet some difficulties to maintain the operational readiness with serious personnel problems and equipment that are to be pushed beyond normal tolerance. In addition, the service life of aging missiles such as the SS-18 had to be extended. There is here a real source of danger for the near future.

Developing new-generation systems.

The future arsenal of Russia may first be characterized by an evolution of the structure of the forces with a reduction and a reconfiguration. This evolution is an answer to the policy of disarmament but also to the perception of the threat which has changed.

The main current priority is to develop and deploy first-strike-survivable mobile systems. In the long term, the emphasis should shift to greater missile accuracy.

The sea component should dominate the future arsenal, with the nuclear submarines coming into first line.

Russian scientists are also working on third-generation nuclear weapons.

Given the seven to ten year production cycles of development of new weapons, new resources should be devoted to researchers in order to replace the aging and obsolete systems. The main difficulty will probably be to find the necessary resources for the design and production centers while implementing the necessary reforms of the armed forces.

The commercial strategy.

If the nuclear industry is unlikely to expand rapidly in Russia, some non-Russian former Soviet states are likely to continue to expand their nuclear sector.

[1] The potential internal conflict, especially in Caucasus, will compel Russia to maintain a high level of expenditures for military operations but also to develop new weapons suitable for this kind of operations.

Russia still has a natural market for the improvement of safety measures, the development of nuclear reactors and the supplying of nuclear fuel of the water pressurized stations (VVER) and graphite moderated reactors (RBMK) operating in Central Europe countries.

Yet, the economic difficulties compel Russia to conquer new markets in Asia and in the Middle East. This policy represents a danger for the environment and the security. If the VVER 1000 are relatively safe, it is not the case for the VVER 440 and the RBMK reactors.

The commercial and financial necessity, particularly because of the on going cooperations with Iran, China and India, may be considered as a threat to the official non-proliferation policy of the government.

Braindrain.

Out of the thousand of engineers, only 2000 to 3000 scientists can be considered as really interesting for Third world proliferators. Those scientists still have top careers and their movements abroad are globally controlled.

Minatom is the key to making a nuclear containment work, as it owns or controls the vast majority of the fissile materials. Nevertheless Minatom should improve its nuclear security and accounting systems in order to reach western standards.

2. WEAPONS DISMANTLEMENT

The dismantlement of the nuclear weapons (tactical and strategic) still goes on even though the changes that have allowed Russia to reduce its stockpiles of nuclear weapons have made no-proliferation efforts harder. The Russian authorities seem to be satisfied with the international cooperations, particularly with France within the "Aida[2]" program. This program helped Paris to build a more constructive relationship with the Russian nuclear complex. Moscow intends to use the MOX technology to eliminate its military plutonium.

Yet the economic and financial difficulties are a serious brake to the operations of dismantlement, inventorying, securing and safely of fissile materials.

If the dismantlement of the nuclear weapons seems to be going well, many questions still remain, particularly as for the rhythm, the cost and the security of the operations of dismantlement for each category of weapon. If the Russian fissile material accounting systems seem to be globally reliable, some improvements should be implemented in order to preserve the control of all materials.

The dismantlment operations.

Because of the important number of weapons to dismantle, it is not sure whether Russia has the financial capacity to fulfill all its engagements. Indeed Russia will have to decommission large numbers of missiles, silos, bombers and submarines.

Stockpiles.

The arms control and disarmament treaties made possible by the thawing of the cold war have generated a volume of surplus weapons and other equipment. This surplus have been boosted by the unilateral decision to scrap useless equipment.

[2] AIde au Démantèlement des Armes nucléaires.

The stockpiling of the weapons is an obliged operation during the dismantlement operations.

Three kind of difficulties are to be resolved, corresponding to three categories of possible accidents : nuclear, pyroradiologic and radiologic. The dangers of those three categories being in descending order.

- the security an the protection of the environment,
- the risks of a nuclear accident before the operations of dismantlement, the security of the transportation ,
- pyroradiologic accidents during the operations of dismantlement, security problems,
- radiologic accidents after the operations of stockpiling :
  - difficulties to evaluate the total quantities of fissile materials to dismantle,
  - the stockpiling conditions.

Russia will also have to deal with the question of the disposal of missile propellants. Indeed, most soviet-made missiles are liquid-fueled, whereas most French missiles are solid-fueled. The fuels contain some hazardous materials which make the operations highly difficult and costly.

The risks of fissile material and weapon thefts.

If the specter of the accidental, illicit and inadvertent use, or the theft of Russian nuclear weapons and fissile materials may not be ignored , such a threat should not be overevaluated. Indeed most specialists consider that the military stockpiles are well guarded and globally the nuclear forces are not in the state of collapse that we can see within the other military forces. Russia's economic and social deterioration did not weaken control over its nuclear weapons.

Yet, a real threat exists within the laboratories and nuclear sites belonging to the civil nuclear cycle. The real danger comes from the poorly paid scientists who could see the opportunity to get some money by stealing fissile materials which, in most cases, can not be used for the militarization of a third world or terrorist nuclear weapon.

The following considerations should be taken in account by Russian specialists to make dismantlement operations safe :

- To make the operations verifiable,
- to make renewed use of fissile materials impossible,
- to make thefts and diversion impossible (especially when under control of civilians),
- to comply strictly with international treaties within the time limits.

3. COMMERCIAL COOPERATION AND NO-PROLIFERATION

The economic difficulties and the necessity to fund the restructurization and the modernization of the armed forces compel the Russian government to conquer new markets in Asia and in the Middle East. Such a policy is made possible thanks to the high level of technology of highly qualified scientists.

Nevertheless we should underline that by refusing the mostly radical cooperations of proliferation, Moscow has demonstrated its will to conciliate a necessary commercial priority and a no-proliferation policy.

With Russia increasingly reliant on arms exports as a mean to support the domestic defense industry, Moscow is likely to promote aggressively its wares abroad.

Particularly in the case of China, we should take care of the risks of technologic transfers from Russia to Peking. Yet, this danger must not be surevaluated in the field of nuclear technologies because of the very sensitive aspects of that cooperation.

On the contrary, the cooperation between China and Russia in the field of conventional weapons should be supervised carefully in order to avoid high technologies transfers, especially in the field of naval and air capacities. China's increasing desire to acquire the latest Russian hardware with subsequent obligatory sales of the license for the production may be regarded as a real concern[3].

CONCLUSION

According to the author's opinion the risks of proliferation of nuclear weapons and/or fissile materials should not be over evaluated today. Yet, this optimism does not prevail over the future. The evolution of the economy and the society in the near future could influence radically our opinion about the situation.

Certain developments in Russia (and which could be a source of instability) could pose increasing nuclear danger to the western community.

That is the reason why we should, first promote programs that directly improve nuclear security and second build a constructive relationship with the Russian government. Those two points should participate actively to the implementation of a true and reliable no-proliferation policy in Russia.

QUESTIONS AND ANSWERS:

A. Weber: Can you comment on the details of the (nonproliferation and counterproliferation) French Program?

N. Dellenbach: There is such a program, not as big as that in the U.S., but it is appreciated by Minatom.

[3] China purchased from Russia US£ 4.7 billion worth of arms. From 1992 to 1996, China imported two batches of 50 SU-27 aircraft. Later, China purchased a license for the production of 200 SU-27SK (without the right to reexport those equipment to third world countries. In November 1996, a contract was signed for the delivery of 2 Sovremenny class destroyers for a total cost of US$ 800 million. China also bought 2 Kilo-class submarines for a cost of US$ 500 million.

State Weakening and Proliferation: The Russian Case

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Fissile materials proliferation is without doubt major an issue for international security. Whatever our opinion about the emergence of new nuclear power (a fact which could be not necessarily as dangerous as it is usually thought), covert or illegal proliferation would certainly increase uncertainty and reduces international stability[4]. In this context, transition, with its related economic and industrial depression, and military establishment shrinking in Russia are certainly presenting the current non-proliferation regime with some uncertainties[5]. The more so because state is going weak in Russia and privatization can be seen going out of bound with all relevant problems connected to policy implementing we can then imagine. To try to assess what are and could be consequences of the current Russian State weakening is certainly a priority topic now. It entails however to try to define the context, and specifically what a non-proliferation commitment could and would mean.

I. PROLIFERATION AND NON-PROLIFERATION: CONTEXT AND CONCEPTS

Proliferation can be on purpose or involuntarily. A government can decide to share some specific technology to another one or it can be unable to stop some private process of sharing the same technology. Between these two clear cut situations, the wistful proliferator and the weak non-proliferator, we have also to take into account the lenient proliferator. That is a government which has not made its mind toward wistful sharing, which is technically able to stop any private process of sharing, but which thinks its is not concerned by this problem and refuses to take any action. A lenient proliferator can be a disguised wistful proliferator or it could be a weak state preferring to focus its meager resources toward what it considers more important problems.

The distinction between these three situations shows the necessity not to focus only on governmental policy concerning proliferation, or technology sharing, but to enlarge the picture to the decision implementing process and the strength of governmental actors. These three situations are just ideal-types in a complete spectrum of possible scenarios for technology transfers. They emphasizes the frequently forgotten fact that to commit itself to a non-sharing (or non-proliferation) policy entails costs, both in a monetary meaning (costs of security operations) and in a political

[4] In a book published in 1992, I had made a case against the current zero-proliferation policy as unrealistic in the long run and potentially destabilizing. But the so-called emergent nuclear power statute I then referred to is not to be understood as advocating complacency nor as advocating dismantling restrictions on fissile material trade. See J. Sapir, *Feu le système soviétique?*, La Découverte, Paris, 1992, pp. 177-180.

[5] The military establishment shrinking will be specifically addressed by Mr. Dellembach.

meaning (to allocate some resources to a non-proliferation strategy implies a decision on the government's political agenda). Here reasoning about proliferation has to go close to what has been developed on theoretical matters by economists and particularly by Herbert Simon works. If cognition is a limited asset to individuals and organizations alike, it is unrealistic to expect a government to be able to focus on too many issues simultaneously[6]. Even a well entrenched policy, if it has to be implemented in a very complex way implying the simultaneous management of a large number of complex technical problems, can become lax at its periphery. The cost of achieving a consistent degree of implementation on every aspects simultaneously can just be too much even for a wealthy organization. Leakages are to be expected when an organization has no other way but to discriminate between core issues and secondary issues in managing a complex system.

To realistically assess the proliferation problem entails the necessity of admitting that 100% perfect implementation is, in the long run, a dangerous assumption whatever the political posture of the concerned authority.

At government level, wistful proliferation can be the result of a formal alliance, the sharing of common ideas, the willingness to embarrass a third part. Inability to stop technology sharing can result of too weak security agencies or of vested interest so entrenched that the government is unable to implement its policy. This implies that the strategic implication of such a sharing is not perceived the same way by the government and part of the society. In itself this means a fairly divided society on most important topics like international security or alliances. The lenient proliferator then is another kind of weak government, either too weak to politically assume what it perceives as a legitimate policy or too weak to directly confront some vested interests and risk then to have to publicly admit its inability to control them. Leniency then is a posture purposely hiding the fact that government's point of view is actually an isolated minority in the society. A close comparison to the lenient proliferator was historically the American lenient neutrality toward Great Britain in 1940.

A second lesson here arises. Focusing on the formal posture (is a given government agreeing or not agreeing with non proliferation principles) without taking into the picture how governmental perceptions are or are not shared in the society as a whole is a blatant mistake. The reliability of any political commitment in a democratic society is directly linked to the government's ability to engineer a political consensus on the given issue. The lack of such a consensus could either restrict government's abilities to commit itself or open to it new opportunities for covert diplomacy inside its own country by playing some interest groups against others.

Any discussion about proliferation which would not take into account the core-periphery dilemma in implementation and the internal policy context of foreign policy commitments would be bound to be fruitless. Worse, it could generate dangerous misperceptions either about some commitments stability or about the real goals in foreign policy.

6 "In a world where information is relatively scarce and where problems for decision are few and simple, information is almost always a positive good. In a world where attention is a major scarce resource, information may be an expensive luxury, for it may turn our attention from what is important to what is unimportant", H.A. Simon, "Rationality as Process and as Product of Thought", in American Economic Review, vol. 68, n°2, 1978, pp. 1-16, specif. p. 13.

II. RUSSIA'S WEAK STATE AND PROLIFERATION

Applying this methodology to current Russia could highlight what is somewhat perceived as an inconsistent policy toward proliferation. As a matter of fact the Russian government committed itself to a strict non-proliferation posture. But, in the same time, it is confronted to different problems, all of the serious, concerning the process of shrinking and reshaping its nuclear military-industrial complex. High stockpiling and dismantling costs are adding to the burden of high social and industrial costs linked to overdeveloped a nuclear industry. In this context Russian State capacities are stretched to the utmost by the necessity of both safeguarding what can be called nuclear security and avoiding uncontrolled technology sharing coming from a cash starved industrial sector.

Foreign aid is certainly reducing the pressure felt at governmental level. However too many sectors and too many projects are competing for the foreign bonanza to guarantee a perfect efficiency of foreign aid. This was to be expected. In a country so large and so developed, foreign aid cannot have more than a marginal effect, even if marginal effects can be important and even decisive in some situations.

The official posture about proliferation is then to be contested. The more so if we extend the picture to deliveries means and general technology. The farther we go from materials directly connected to nuclear weapons, the lesser the intent to implement strictly a costly policy. This is a direct application of the first methodological remark made hereabove. But there is another reason for official policy contestation. To a large extent the current economic, social and international policy implemented by the Russia government since 1993 is not perceived by large society segments as consistent with Russia's national interest. Even more, the government is not always credited with full political legitimacy for two main reasons: the current Constitution is seen as illegitimate either because strong doubts are held about the December 1993 referendum validity or just because it lacks the necessary checks and balance to be seen as a truly democratic Constitution, and the federal government habit of defaulting its own obligations either to its own employees (civil and military[7]) or to regions[8], or both. This lack of legitimacy is specially serious in a country where federalism is still a newborn child. Federal economic and fiscal policies are openly contested in many regions. The quick development of regional *Veksel* schemes is giving birth to regional payment systems which could evolve into local currencies.

As far industry is concerned, contestation of the official non-proliferation policy then is to take two different forms. First some entities, regional or sectorial ones, are deeply concerned with costs of the current policy toward nuclear issues. One can mention the *MINATOM* but also regional administrations when large nuclear facilities are locally deployed. These actors are mainly concerned by forthcoming exports. They expect either to reap large benefits from exports (*MINATOM*) or to see enterprises kept afloat through exports, reducing then pressures on local

[7] We just have to keep in mind the ongoing process of wage non-payments, still not corrected early 1998 for civil servant and military personnel.

[8] At the end of 1997, the federal budget had paid to regions only 65% of transfers and 10% of subsidies it had to according to the budget law. This is as worse as in 1996 and 1995. For a general discussion of Center-Regions relations in the context of Center legitimacy collapse, M. Mendras, "Le réveil politique des provinces", in *Nouveaux Mondes* , n°7, winter 1997, pp. 27-46, and J. Sapir, "Les Russies économiques", in Idem, pp. 47-82. See also, J. Sapir, "Economie politique de la régionalisation et de la désintégration", in A. Brigot, (ed.), Les Territoires de l'Union, *Cahiers d'Études Stratégiques* n°19, GSD-EHESS, Paris, 1997, pp. 51-74.

budgets for social assets and local safety nets. One has to add to these actors large Russian banks when they have acquired significant shares of industrial enterprises connected to the nuclear industry. These banks are seeing some of their former highly lucrative activities cut short by competition. They need to have a much more active owner policy. If this is good news as far industrial restructuring is concerned it means too that some banks could have now common interests with traditional industrialist lobbies. An export minded policy is certainly to be lobbied for as exemplified by civilian nuclear contracts with China, India and Iran. The lobbying activity could be reinforced if the government is afraid to lose control on some of these actors. To make a hard stand against an export policy would mean either you have enough resources to relieve some of concerned actors or you could afford, socially, economically and politically to let them die away. The Russian government certainly does not have as much resources needed to make subsidies or procurement for national project a credible alternative to export. In the same time it probably cannot afford to let its nuclear complex going down the river.

A second form is much more ideological. Some projects are highly controversial because the US opposition to them, like nuclear cooperation with Iran and China. Even if making sense from a Russian point of view, agreeing with US policy still is highly suspect in Russia.

If political suspicion is to be added to federal government controversial legitimacy, the possibility arises that at the local level some concerned actors could decide they know better than Moscow what is good for Russia, especially if it is good for them too. The high level of collusion between political and economic elite at regional level precludes any attempt of indirect control through the legal federal deconcentrated chain of command. Direct control by-passing local or sectoral authorities is of course possible but costly in means and legitimacy. If such a procedure can be used, it cannot be relied upon in a systematic way. The federal government then has no option but to try to reach a compromise with other significant actors on the export issue if it wants to limit the risk of everything breaking loose simultaneously. Some Russian export projects, looked after with suspicion in the United States, could well actually be an exercise in damage control by the Federal government. Agreeing on some kind of exports is probably the best way to implement an effective prohibition on other projects.

However, when a policy is bargained with actors directly involved without the filter of the political representation (that is a Parliament) a price has to be paid for by the government. First it tacitly agrees to put itself on the same footing than private interests, which is a way of institutionalizing collusion. Second, by not making the decision public in the legitimate arena, the government restricts its own ability to resist demands coming from concerned actors. The problem here is not the principle of bargaining. Trying to make one-sided decisions could lead to even worse results as it has been exemplified by Russian policy since 1994. But cutting short democratic procedures, whatever one can think of the current Russian Duma has necessarily the effect of downgrading government's status.

Hence the Russian government is probably confronted to an Hobson's choice. If it sticks one-sided to its official commitment about proliferation, it lacks both effective means and legitimacy to implement what he could decide, running then the obvious risk of seeing its control ability openly defied. If it bargains with involved actors the way it is doing, it nevertheless downgrades its standing of the "above the fray authority", and opens a huge door to collusion, which ultimately could make it a prisoner of vested interests. If it goes to the Parliament it runs a risk to see its policy openly overturned. One wonders here if nonetheless it would not be better a solution.

Government through minority rule never has been a good omen for democracy and rule of law. In that way the current attempt by Prime-Minister Tchernomyrdin to come to term with the KPRF majority in the current Duma is probably more democratic than most of Russian self-styled democrats proclamations.

III. THE MOVE TOWARD THE CORPORATIST STATE AND ITS IMPLICATIONS FOR INTERDICTION

In a greater context, the issue of the reliability of any government commitment is akin a rule abiding problem. Are agents under this government legitimate authority prone or not to abide by laws and rules. Abiding is just not simply a problem of cost/benefit computation by agent. Because implications of rules and law breaking are usually too important and too difficult to completely assess, agents here are not rational maximisators. Their rationality, quoting again Herbert Simon, is more procedural than substantive[9]. Here, the very fact that one and only one system of rules is to be abided by or to the contrary that agents are facing competitive systems of rules is extremely important to understand how the will behave and to forecast to what extent they will be rules abiding, and the cost of implementing rules compliance[10]. Usually when we try to forecast how any government will stick to and implement a public commitment like a non-proliferation one, we assumes it is in charge of making rules and making rules abided by on a given territory. This is the classical Nation-State concept. However more and more the traditional Nation-State is facing the competition from what can be called a Corporate-State.

An American economist belonging to the institutionalist school, William M. Dugger, has made a case for a comparison between state and large corporation relative powers which is certainly enlightening when trying to assess the current Russian situation[11]. Part of Dugger's argument is grounded on John Commons's definition of sovereignty linking this very concept to the ability of any collective actors to adjudicate disputes. In a way a large corporation is able to adjudicate some disputes, at least inside the space it controls. Dugger then went so far to write:

"Since the traditional state and the large multinational corporation serve as alternative sources of sovereignty, I propose that we downplay the monopoly on violence aspect of the state and define the state as any agent that exercises sovereignty .(...) None the less, the similarity of the nation state and the corporate state should not be taken too far. (...) The nation state has the power to tax and to use violence. but the corporate state has the power to withhold information and to withdraw investments. The corporate State needs the security of tenure and the physical safety provided by the nation state. But the nation state needs the investment and the jobs provided by the corporate state.(...) The corporate state is most effective in its competition with the nation state in societies

9 "In all these situations (men) use selective heuristics and means-end analysis to explore a small number of promising alternatives. they draw heavily upon past experience to detect the important features of the situation before them, features which are associated in memory with possible relevant actions.", H.A. Simon, "From Substantive to Procedural Rationality", in S.J. Latsis (ed.), Method and Appraisal in Economics, Cambridge University Press, Cambridge, 1976, pp. 129-148, specifically p. 136.

10 For a similar point of view grounded this time in experimental psychology, A. Tversky, "Rational Theory and Constructive Choice", in K.J. Arrow, E. Colombatto, M. Perlman and C. Schmidt, (eds.), *The Rational Foundations of Economic Behaviours*, MacMillan & St Martin's Press, Basingstoke, New York, 1996, pp. 185-197.

11 William M. Dugger, "Transaction cost Economics and the State", in C. Pitelis, (ed.), *Transaction Costs, Markets and Hierarchies*, Basil Blackwell, Oxford, 1993, pp. 188-216.

where the nation state ideologically denied the ability to own means of production. the corporate state is also most effective when the nation state with which it contends is a small country with a weak economy, desperately in need of corporate state's investments [12].

When we look back to current Russia's situation, quite clearly the Nation-State has been denied the ability to own means of production (thanks to Mr. Chubaïs and all...), the economy is weak, desperately needs investment, and by the way State monopoly on violence has been quite successfully eroded[13]. Russia can then be seen as a perfect example of a weak State which could be successfully challenged by corporate-State.

If now we turn toward the corporate-State, it can be defined as a local space of segmented rules. When more than one corporate-state is in operation in a given country, part of the system of rules is actually segmented and economic or social agent are adjusting their behavior to this reality. Of course this adjustment process can be checked if agents can forecast an attempt from the Nation-State if not to crush corporate-states at least to reduce their rules making ability. Large corporation can then operate in European countries without creating too much a segmentation problem as their internal rules system is to be consistent with the one edicted by the Nation-State. But such a situation, which can be termed asymmetrical cooperation, implies a kind of powerful and legitimate Nation-State. In Russia, the Nation-State survival is frequently linked to help given by some large corporations. Gazprom, but also large banking groups are first here to come to mind. During the last financial crisis, December 1997, the Russian Central Bank had to ask three of the biggest Russian banks for a loan of 2 billions US dollars. When the federal budget is unable to provide subsidies needed by some regions or some administrations, the government had to ask Gazprom and Lukoil for free deliveries of gas and energy.

Such a situation certainly helps the making of a much more symmetrical cooperation between corporate-states and the Nation-State. This is the essence of collusion. We are then moving from a combination between corporate and Nation states toward a kind of fusion, which could be termed the corporatist State. One of its main characteristic would be rules segmentation.

Back to our proliferation/non-proliferation topic, we have to understand that effectiveness of any interdiction operation relies heavily on rules unity. this is why, when inter-governmental cooperation is needed to implement an interdiction operation the most important issue is the compatibility of each country rules and laws system. In a way, what is coming in Russia is a situation where implementing the federal government policy would become alike an inter-governmental operation, not only between federal and local authorities but between the federal government and some very large corporation behaving like integrated states.

This is raising some doubts about the dynamic efficiency of interdiction operations in the current Russian context. More precisely, interdiction operations will more and more have to be focused on a very precise target, be it a product or a group of rules-breaker, to be effective. This is a good example of the too much information/too scarce cognitive resources described by H. Simon. But, if a non-proliferation commitment is to be a credible one it is to be enforced on the total spectrum of relevant products, and on the total spectrum of potential infringers.

[12] Idem, p. 191.

[13] I do not elaborate here on the process of Armed Forces shrinking which to be dealt with by Mr. Dellembach presentation.

CONCLUSION: IS ZERO-PROLIFERATION THE SUITABLE GOAL IN RUSSIA?

This admittedly very synthetic and rapid assessment of the Russian situation leads us to a grim two pronged conclusion. The current non-proliferation commitment will be on one hand more and more contested by powerful actors and the ability of the Russian government to implement effective interdiction operations will decrease with the progressive shift toward what we have called a corporatist State. In the same time, this commitment will mobilize a growing share of government resources on a diminishing number of targets, increasing the probability of leakages at the periphery, and simultaneously increasing what could be called the periphery. This would entails diffusion of dual-capable technologies and of "conventional" weapon systems, some of them are actually much more destabilizing in Eurasia than fissile materials. One have to remember that, in some peace-keeping operational context, some long range mortars, a weapon which is not precisely a high technology one, are enough to close an airport, curtail civilian-relief operations and create political havoc among countries part of this operation. Non-proliferation will then be progressively eroded without any alternative than counter-proliferation, a policy itself fraught of political and military risks.

May be it is time to ask again if the zero-proliferation option as sold by the US government to much of its allies is the best stabilizing policy we could have in a less than perfect world. After all, creating from scratch even a minimal nuclear deterrence system is so costly and complex an undertaking that very few countries can afford it. By opening a window to become a legal nuclear power but under strict political conditions, a task admittedly which is far to be simple, may be could we rebuilt a kind of international stability much more efficiently than by sticking to a diminishingly effective policy needing so-called "surgical" military operations to cope with its own failures. By the way, we could then free enough resources to address the problem of dissemination, i.e. the spreading of high level conventional weapons, a process certainly much more relevant now for international security and stability.

Fragmentation of Authority and Privatization of State: Implications for Proliferation

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THE PROBLEM:

Proliferation of missile technology, fissile material and know-how from the countries of the former SU has been seen primarily as the problem of theft or unauthorized transaction. Most research on this subject begins by cataloguing the known cases of theft or attempted sale of fissile material which could be used to produce weapons. Thanks largely to the efforts of Graham Allison and his team of researchers at Harvard the problem has been identified. The causes of the problem have been defined as the collapse of the Soviet Union and emergence of three more nuclear states; dismantling of the missiles as a result of the arms control treaties which created opportunities during transfer, storage and liquidation; economic dislocation which led to sharp falling in state orders for military related hardware and financing of research and production facilities.

Having identified the problem in these terms, some valuable and useful policies have been started, such as putting modern locks on Russian nuclear facilities, creating employment for starving Russian scientists, launching civilian production programs at some Russian facilities; buying uranium from the Russian suppliers; and trying to shut down plutonium production facilities. No doubt these measures are beneficial within the parameters of how the problem was defined.

The problem however is that this is not the entire problem. The way Allison and his team defined the problem focussed attention on theft and unauthorized transfer exclusively. For the last several years, researchers have been looking for, counting and compiling information on all attempted theft cases, when one soldier would walk in and steal so many grams of uranium. The underlying assumption in this definition of the problem is that proliferation may occur as a result of a violation of the rules. The assumption is that there are rules, that there are procedures and that there is a government agency in charge. If we define the problem in these terms than the most logical solution is to put better locks, give money to bankrupt government agencies and create other incentives for them to sell to us rather than to the rogue states. All these measures signal to the Russians that the US is concerned and is willing to pay a hefty price to insure non-proliferation. Inadvertently this approach may create a Russian habit of counting to be paid for observance of the treaties already on the books.

The fundamental flaw in this approach is that these assumptions are wrong. Today the Russian state is weaker than at any time in this century since 1917. Central government is splintered into competing cliques and clans none of whom control the situation on the ground. Parts of the government such as the armed forces have been free from any control, or supervision and were free to conduct armed sales and transfers that are now investigated for embezzlement and corruption. The problem with the current approach to the proliferation issues is the habit of thinking that we are dealing with the Russian government that controls the situation. It is time to comprehend that this is no longer the case. Russian state is weak and ineffective. Russian government is splintered and corrupt, and its authority is limited. Dissolution of authority has

occurred. Many of the state functions have been privatized. Nominally state companies act as private corporations with their own foreign policies and export priorities. Governors of provinces, plant directors, and research institutes, -- all have an opportunity to pursue autonomous transactions including with foreign partners which are difficult to trace, control or supervise. The main danger of proliferation of dangerous technologies, materials and know-how is not coming from a single individual committing an act of theft, walking past poorly locked facility, rather it is from the sale or transfer of these items by a nominally government company or facility which either escapes controls or acts in complicity with government officials. Patrons of such deals in government may act in this fashion as a result of monetary compensation; or out of political conviction.

1. Why Fragmentation of Authority?

Fragmentation of authority is a lack of respect for law. Rules and regulations are simply ignored and there are few mechanism to enforce their implementation. Today the Russian state is incapable to collect most of its taxes or pay wages and pensions. It is even less capable of controlling and monitoring its import and export operations, as billions of dollars are fleeing the country.

Fragmentation of authority is rooted in the political attitudes prevalent in the late 1980s leading up to the collapse of the Soviet Union. Authority was firmly attached to the Communist party. When it was suddenly discredited and banned, a vacuum of authority was formed. This was the time of the war of sovereignties when every republic and every region issued its own constitutions, elected its own presidents and ignored central authority or laws.

Collapse of authority is a state of mind. It is a realization that central government has no means to enforce its control. It is a realization that power, property and assets are up for grabs. The way the SU collapsed implied that constitutions, laws and procedures could be thrown out. What mattered was not that what was legal but that what one could get away with. With the collapse of the Soviet Union, Russia experienced a beginning of the profound social political and economic transformation which some observers have called a revolution. In 1992-1996, the greatest re-division of property since the Bolshevik revolution has taken place. This process is now known as the nomenclature privatization. What happened was that the factory managers, executives of the Soviets, party officials with connections, KGB officers and those that had held the reigns of power prior to 1991, began to use their privileged position for buying up real assets in their provinces. Some succeeded and some failed. Some lost, while others won. Names have changed and younger energetic people had entered the fray. Nevertheless what happened was that the former Soviet elites, especially the Red directors, Komsomol and KGB wound up as owners of Russia's major industrial assets.

For the purposes of this discussion what is important is that they did it by subverting open competition, relying instead on patronage connections, bargain basement prices, exclusion of foreigners, fake auctions and bribery of state officials. Huge industrial enterprises were sold at unbelievably low prices to former managers, Soviet executives or other privileged bureaucrats. According to Interior Minister Anatoly Kulikov, "Kovrov mechanical plant, supplying firearms to the Armed Forces and Interior Ministry was sold for some three million dollars. The individual price for such giants as Uralmash, the Cheliabinsk tractor plant, and the metallurgical plant did not exceed four million." The lesson learnt in these transactions was that one gets things done not by relying on law, but on the right connections in high places. What one could get away with

depended on whom one knew or how much one paid. Kulikov referred to a criminal alliance between criminal structures [i.e. organized crime] and corrupt officials.

Privatization of state assets has been lauded in the West as one of the major accomplishments of the Yeltsyn administration. It was perceived in the West as a sign that Russia was moving along the path of market reforms. What was overlooked, however, was that Russia was also sinking into the system of lawlessness, corruption and crime. Those who obtained property by bribes and connections were not going to wake up the next morning as honest businessmen and gentlemen. The climate of interaction which was set up during the Yeltsyn privatization of assets stimulated procedures based not on law but on patronage networks, bribery and corruption.

2. Privatization of State:

Fragmentation of authority in 1989-91 led to the collapse of the Soviet Union, collapse of respect for law and in 1992 to privatization of industrial assets by nomenclature. The next stage was the privatization of state. Privatization of state can be defined as usurpation of state institutions, and state functions by private interests who use those state entities for their own private benefit while these state entities remain nominally a part of the state. For example if in a country an agency in the armed forces, an agency which is a part of state by definition, is usurped by corrupt officials who use its facilities and capabilities for private enrichment, this is an example of privatization of state.

How is privatization of state different from mere corruption? Corruption is a process or a situation whereby individual employees of a state agency abuse the law for their private benefit. Corrupt officials know they violate procedures and act usually contrary to the official policy and conduct of the institutions they work in. The very reason they take bribes is to go around the existing practices or rules. In the conditions we call privatization of state, nominally state agencies make the rules themselves. They are free to pursue their own private interests while in theory remaining state institutions. If customs service in a particular province decides by itself what goes through and what dues are assessed and how much is sent to Moscow and how much is kept for itself, that is an example of a private interest having usurped a section of the state agency. If a director of a research institute which nominally is state property makes a deal with a foreign partner and sells to him advanced technology with direct or indirect complicity of government officials in violation of export regulations or treaties, that is an example of privatization of state.

The notion of private property and state property remains blurred in Russia. Under the Communist rule a habit had been formed to regard state property as nobody's. Custodians of that property, directors, managers and other state officials knew then that they could not sell that property yet they also knew that they could get away with false accounting, inflated production figures, clandestine business operations, etc. This was the normal practice: to dupe the state and go around the rules was the standard practice. When the state authority collapsed and former managers obtained that property by means they had gotten used to, they proceeded to operate in the same manner as before, now as real owners. To cheat the state continued to be a well established practice.

3. The Army of Traders:

The privatization of state by corrupt officials took particularly ugly forms in the armed forces. According to Prosecutor General of the Russian Federation Skuratov, "The Army is undoubtedly in the lead in terms of the number of cases connected with corruption which we have." Just as the oil or railroads ministers or the traffic policemen who had turned assets in their custody into their

source of revenue, the army officers began to regard military hardware as "theirs." Unlike oil or railroads the army could not be privatized overtly. It remained a state institution. In reality however, army's top brass while remaining in state service, turned the hardware, equipment, airfields and airplanes into the source for personal enrichment. Those state officials who worked at sites that could not be privatized, similar to the factory managers wanted to extract the maximum benefit from the property under their custody. Army commanders knew that they could not privatize the tanks in their custody; yet they found ingenious ways to hide some property from the state, sell weaponry to third parties and abuse their position of authority for self-enrichment while remaining state functionaries. If factory managers could privatize state factories why could not army generals regard state assets under their custody as a source of enrichment as well? As a result army bases in some parts of the country turned into business enterprises. Construction troops were deployed to build country estates for generals; some units were deployed in smuggling operations.

Hidden behind the checkpoints of military bases, unaccountable to anyone other than their military superiors, the army brass was free to exploit opportunities which presented themselves after the collapse of the USSR. According to an expert study:

> The frequent pilfering of unit equipment and supplies by military personnel of all kinds and the routine misuse of manpower and material resources rapidly became a sophisticated multidimensional ubiquitous series of criminal enterprises fostered and sustained by systematic corruption.

One can distinguish three main levels of privatization of state by the elements of the armed forces.

Theft:

Military hardware pilfering, falsifying of accounts, sale of military hardware by soldiers, junior officers and unit commanders was one of the most widespread forms of crime in the army. According to a special report of NTV (Russian Television network) in St. Petersburg "trading in stolen weapons had become a genuine industry." Weapons depots were poorly guarded and criminal gangs showed interest in buying weaponry of all kinds. According to Dmitry Minin, head of St. Petersburg Directorate for Combating Organized Crime, "Large quantities of explosive materials had entered the criminal world from army stores."

Underpaid officers in many districts simply had to fend for themselves in the conditions of the fragmentation of state. They were not paid for months, and their only means of survival was the hardware in their custody. Just like the workers whose wages were not paid for months, the army officers sold off the weapons in their custody in lieu of wages unpaid by the failing state. This form of embezzlement, theft and abuse of authority was particularly widespread in the North Caucasus during the Chechen war. According to the Proliferation Primer of the US Senate, "During 1996, thieves reportedly often disrupted Strategic Rocket Forces communications to operational units on numerous occasions by mining copper and other metals from communications cables."

Notorious was the Command of the Russian group of forces in Germany before their withdrawal in mid 1994. Officially sanctioned sale of assets turned into an operation enriching the Minister of Defense and his cronies. Illegal sale of military hardware ran into millions of dollars. Similarly in the Baltics the commander of the Baltic Military District was involved in large scale illegal sale of fuel, metals and explosives. Even after the withdrawal of the Russian troops, the networks which

had been established continued to function, mostly in the area of smuggling and illegal exports. The most important lesson from the scandals involving Pavel Grachev and the Western Group of Forces is that no state agency in Russia, not even the Prosecutor General had control over or complete access to documents on the transactions committed. The Minister of Defense and his pals were autonomous players in illicit sales of military hardware.

War Materials Trafficking:

The second level in the privatization of state by army officers was systematic and prolonged operations in illegal trafficking of weapons, and other materials using army bases and resources. A case in point was the operation run by Major-General Rodionov, commander of the Long Range Aviation base in the Far East. The base was turned into a transportation hub for moving commercial goods into China by-passing customs of course. Bomber pilots and crews were involved in this money-making venture. Similarly, military buildings and equipment which had belonged to the Construction Troops were privatized, as it turned out, by a civilian company staffed by relatives and friends of a group of officers. Housing for troops withdrawn from Germany was misappropriated. Lack of accounting and supervision made it possible for nominally state agencies pursue commercial activities of their own. According to the Proliferation Primer paper

> Despite the danger posed by transfers of sensitive technology to proliferators like Iran, Russia's cash starved nuclear and defense industries have pursued such sales. It is unclear how much control central government officials have over such sales. Senior Russian officials have approved some deals and Moscow appears unwilling or unable to halt others.

What is in common in all of these cases is the transformation of the military command hierarchy into criminal-commercial networks who had usurped state assets and functions. At the local level there have been cases reported of army commanders engaging in sale of military hardware on their own. It is not inconceivable in today's Russia that a collusion in an X province between army commanders, provincial governor and border guards would sanction sale of war-making materials or know-how to a foreign state without knowledge or approval from Moscow. In theory export licenses are required, and laws and regulations governing the export of sensitive materials are on the books. In practice however, licenses and permits can be easily circumvented by the right connections and the right amount of a bribe. Quite in accord with this assessment is an observation in the Proliferation Primer:

> Russia's disorderly transition from central planning towards the free market makes credible reports of the transfer of sophisticated missile guidance components to Iraq without government approval.

Obviously illegal weapons trafficking has been extremely difficult to prove or prosecute. Even cases which had received publicity in the press or in the Duma have been hushed up. Consider a rather well-known scandal known as "Arms for Homes" deal. The known facts of this case are as follows: In 1992 the Lithuanian firm Selma received a contract to build housing for the Russian military personnel in Kaliningrad. As payment it was to receive two ASW boats and two torpedo boats from the Baltic fleet. "The value of each unit, Russian and Lithuanian investigative organs established, were clearly understated — allowing the parties to the contract to skim off major profit." At it turned out, this was just the beginning. In 1993 negotiations included the sale of

> T-72 tanks, BNP-2 infantry fighting vehicles, Mi-8T helicopters, "Grad-1" multiple rocket launchers, D-30 howitzers, "Tunguska" and "Igla" surface-to-air missile systems, "Fagot" antitank guided missile system, and so forth, as well as consignments of ammunition for them...

Using payment for housing as a cover, high ranking army officials used the scheme for major arms trafficking operation. The Lithuanian firm in this case, played the role of a "buyer, middleman, and vendor."

And the third level of privatization of state in the armed forces is the creation of nominally state agencies or companies which in the course of their operations turned into criminal and privatized enterprises with direct involvement of top government officials. The case in point is Rosvooruzhenie. Created in 1994 on the orders of Yeltsyn Rosvooruzhenie was supposed to be a state company in charge of Russia's export of military hardware. Viktor Samoilov of the Defense Ministry cadres department and a friend of the then Defense Minister Pavel Grachev was named the director. Most Bank was one of the officially authorized banks to handle transactions and Yeltsyn's body guard Korzhakov was given some supervisory functions over the export operations. Oleg Soskovets, the Deputy Prime Minister became the Chairman of the Interdepartmental Commission also involved in Rosvooruzhenie operations.

In 1995 reports began to appear of improprieties with Rosvooruzhenie exports. Transactions were not recorded, money raised disappeared and attempts to investigate were cut short. According to Prosecutor General Skuratov, a "number of commercial structures, when preparing the contract to deliver MIG 29 fighters to India" misappropriated budget funds." A state company was de-facto privatized. State bureaucrats of the highest level diverted some of the revenue into foreign accounts and used the export operation for personal enrichment and political ends. Military hardware that disappeared without a trace in the last five years is counted in hundreds of millions of dollars. A large portion of it was sold at international markets. Even when the military hardware sales are legal, no one knows how much exactly Rosvooruzhenie takes for itself. According to Ruslan Pukhov, Director of the Strategies and Technologies Analysis Center, "Rosvooruzhenie itself claims to be taking a 3% - 7% commission for its services. Its critics maintain that the company takes considerably more, up to 30%." Illegal activity of the Russia's military -- smuggling, diversion of equipment, illegal business ventures, and weapons trafficking, has earned them the name -- mafia in uniform.

Nuclear smuggling pops up on the pages of the press now and then as a concern of various International agencies. Most cases of nuclear smuggling have focused on specific individuals who managed somehow to circumvent the rules. A much greater danger in this respect lies with the in theory state companies and labs which had engaged in what appeared as legal trade. According to Nikita Nikiforof of Minatom:

> ...nuclear export is one of the few truly profitable spheres in Russia's foreign trade business. Needless to say, our domestic businessmen were quick to catch on to the commercial attractiveness of such ventures. But implementation of these plans is seriously impeded by the state monopoly stipulated by the federal legislation. However, practice shows that our business circles are usually cunning enough to find loopholes in the legislation. Numerous small-size enterprises, formed within the state-owned companies of the nuclear industry, are now smuggling nuclear materials.

The term smuggling in this case stands for exporting in violation of existing export regulations. That, however, can only be done with the complicity of high ranking government officials. Although a smoking gun is missing, a Canadian intelligence report stated that "suspicions linger about widespread corruption and involvement in the [nuclear] trade at the highest levels of the Russian government." The CIA Director John Deutch was much more explicit:

> In fact, various reports suggest there are vast networks, consisting of organized crime bosses, government officials, military personnel, intelligence and security service officers, as well as legitimate businesses. These networks would have the resources and the know-how to transport nuclear weapons and materials outside the former Soviet Union.

In addition to hardware transfer, in recent months increasing number of Western reports pointed to systematic know-how transfer. According to Proliferation Primer, "Apparently Russian experts were still advising Iran on how to mine uranium ore and process it for eventual use in its nuclear program." Moreover, what has particularly upset American observers, was that the Russian government was denying its complicity in proliferation. According to Richard Speier in the Proliferation Primer, "Russia is either incapable of controlling such [missile] exports or is unwilling to control them."

Another problem as regards proliferation is that in addition to leakage of sensitive material or know-how due to profit-seeking, there also may be patronage of proliferation activities in high places out of political conviction. It is quite conceivable in today's Russia that a government official would cover up illicit transaction in proliferation banned materials as a deliberate and calculated policy to hurt US interests regardless of what President Yeltsyn says in public. A Communist commander may decide to sell weapons in his custody, guided by his feelings for the US. Foreign policy thus is becoming privatized as well.

Institutes, army bases, and nuclear facilities conduct their own dealings with foreigners circumventing existing regulations with an unambiguous complicity of the government. According to a recent assessment, "As for Iran, Primakov acknowledges that Russian scientists may be helping Tehran build missiles but they are free-lancers who are difficult to stop. [According to Primakov] "Some leakage at the personnel level is possible." According to Russian Space Agency Director Yuri Koptev, Iran had received Russian missile technology at the "initiative of individual enterprises." The fact that state enterprises could have passed sensitive technology abroad confirms that they acted as private entities despite being state property in theory and that state officials at the highest level sanctioned those transactions. In either case, a state agency was acting on private interest.

CONCLUSION:

The US must proceed from the understanding that the Russian government today is not a government in the conventional sense any more. It is a conglomeration of a complex web of corrupt bureaucracies connected to business interests who are unaccountable, uncontrollable, unreliable, and prone to bribe-taking. Some in the government conduct their own foreign policy at adds with the pronouncements of President Yeltsyn. State agencies, army bases, customs service, research institutes have many opportunities to circumvent the existing regulations. The problem of proliferation will not be resolved by putting new locks at nuclear facilities. It will not be solved by pumping money into Russian impoverished research institutions. The problem cannot be solved by

Americans for the Russians. The first step in finding a remedy, however, is to understand the nature of the problem.

References:

Up to September 1995 ten cases of attempted theft were recorded at the Prosecutor's General Office in Russia, see: "Alexander Mytsykov, "Atomic Theft and Atomic Security: What the General Prosecutor's Documents Say." Yadernyi Kontrol' (No.9, September 1995) See also: Phil Williams and Paul N. Woessner, "The Real Threat of Nuclear Smuggling" Scientific American Vol. 274 No. 1 (January 1996) pp.40-44.

[i] See for example, William Potter, "Before the Deluge? Assessing the Threat of Nuclear Leakage From the Post- Soviet States," (October 1995) For an official list of cases, see: US Government Chronology of Nuclear Smuggling Incidents (1993-1996) March 21, 1996. (Appendix to the 20 March 1996 testimony of John Deutch, Director of Central Intelligence before the Senate Permanent Investigations Subcommittee on global proliferation of weapons of mass destruction and illicit trafficking of nuclear materials.)

Graham T. Allison, Owen R.Cote, Jr. Richard A. Kelkenrath Steven E. Miller, Avoiding Nuclear Anarchy. Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material (Cambridge, Mass. MIT Press 1995)

"Criminal Revolution or the Crime's Evolution," Rossiiskie Vesti (13 January 1998) p.1-2.

ibid.

[i] "General Prosecutor Views Crime Situation," Rabochaya Tribuna, (Moscow:29 September 1997) FBIS Daily Report (29 September 1997) Document Number FBIS-SOV-97-272.

[i] Graham H. Turbiville, "Organized Crime and the Russian Armed Forces," Transnational Organized Crime Vol.2 No.4 Winter 1995 p.61

[iii] "Russian Military Weapons Depots Become Supply Bases For Gangsters," Russian NTV 26 November 1997,

Galina Mashtakova, "Ordered To Steal," Moscow News 28 (24-30 July 1996) p.12. See also: Victoria Tripolskaya-Mitlyng, "A Parade of Troubles," Bulletin of the Atomic Scientist 52:6 (November 1996) p.17

A Majority report of the Subcommittee on International Security, Proliferation, and Federal Services. Committee on Governmental Affairs. United States Senate (January 1998) p. 17.

[i] Graham H. Turbiville, "Organized Crime and the Russian Armed Forces," Transnational Organized Crime Vol.2 No.4 (Winter 1995) p. 75

[i] "Military Prosecutor Views Corruption in Army." FBIS Daily Report 07-08-96 Document Number: FBIS-SOV-96-132.

[iii] The Proliferation Primer. p.17

[iv] ibid. p.24

[v] "Military Mafia Shady Dealings Exposed." Sovetskaya Rossiya (11 July 1996) p.5

[vi] ibid.

[vii] ibid.

ibid. p. 74

[ix] "General Prosecutor Views Crime Situation," Rabochaya Tribuna, (Moscow:29 September 1997) FBIS Daily Report 29 September 1997 Document Number FBIS-SOV-97-272.

Mikhail Gabovich, Moskovskie Novosti No. 35 (31 August - 7 September 1997) p. 13.

[i] Turbiville, p.62

[xii] See for example, Rensselaer, Recent Trends in Nuclear Smuggling," Transnational Organized Crime Vol. 2 No. 2/3 Summer/Autumn 1996 pp. 109-122.

[iii] The case of one scientist accused of sale abroad of double purpose material, see in: Alexei Tarasov, "Krasnoyarsk Physicists Sold Neither Atomic Bomb nor Their Country," Izvestiya (Moscow: 13 May 1996) p.2.

[iv] Anton Trofimov, "'Nuclear Shield' Burning Through The State's Protective Hand." Segodnya (Moscow: 17 March, 1996, p.1.7.)

[v] Canadian Security Intelligence Service publication: Commentary No.57. Smuggling Special Nuclear Materials. (May 1995)

[vi] "The Threat of Nuclear Diversion," Statement For the Record by John Deutch, Director of Central Intelligence to the Permanent Subcommittee on Investigations of the Senate Committee on Government Affairs. (20 March 1996) p.6

[vii] Proliferation Primer p.24

[viii] p.24

[ix] Daniel Williams, "Putting Russia Back on Global Map." Washington Post (January 25 1998) p. a24 col. 5

[x] "Russian Space Chief Admits Iran Received Missile Technology," Russian Reform Monitor No.382 9 February 1998

QUESTIONS AND ANSWERS

J. Immele: Given the time scales of the current forms of government in the FSU, what should we do differently?

V. Brovkin: Existing programs are very useful, and they solve things on one level. But it is not enough. Study the governments by their components. What can the components do? No one has authority over the whole thing.

A. Weber: Most effective programs deal with those governmental components. We have more leverage at the institute level (e.g., laboratory-to-laboratory) vs. government-to- government.

V. Brovkin: Of course you are right, unfortunately. Civil institutes are much better with better safeguards. Minatom has greater than 500,000 employees.

I. Vasiliev: The speaker made use of the open literature. Some of this literature is in opposition to the government, some represents government. One sees this type of discussion daily. Regardless of what minister occupies what post, there are Russian laws which determine import/export. No governor has the right to effect a single gram of nuclear material subject to import/export. For this purpose there exists active export control. All is subject to Customs control. Some organizations do engage in illegal export. Any country has such groups. In order to avoid apprehension, stress that only those organizations with appropriate releases can engage in trafficking in nuclear materials. The system does need to work more effectively.

C. Ollinger: Is there any evidence that the nuclear institutes are acting independently?

V. Brovkin: No.

Measures Adopted by the Russian Federation Customs Service for Control of Shipments of Fissile and Radioactive Materials

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N. Kravchenko,
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Moscow, Russia

The cutoff of illegal circulation of nuclear materials is organized within Russian customs agencies on the basis of the need to address two tasks:

1. Prevention of the illegal movement of nuclear materials across the border. This task is addressed by placing at border check points fixed and mobile systems for detection of nuclear and radioactive materials, and by setting up permanent monitoring of the presence of such materials in all vehicles, goods, and baggage.

2. Organization of in-depth selective inspection of nuclear and radioactive materials legally transported across the customs border of Russia for identification by name and quantity, as stated in the customs declaration.

In order to address these two primary tasks, work is under way in the following areas:

1. Establishment of a normative methodological foundation in this field.

2. Selection and creation of technologies and technical means for customs control of fissile and radioactive materials that are adapted to customs-control conditions.

3. The creation of staff structures from personnel of customs agencies who have been trained for this activity.

4. Interaction with federal executive agencies that perform state regulation of safety (security) in the use of atomic energy and other law-enforcement agencies in the area of interdiction of illegal movement of nuclear and radioactive materials across the customs border of the Russian Federation.

Let me dwell on each of these areas in more detail.

1. The activities of the Service for Customs Control of Fissile and Radioactive Materials are based on Russian Federation national law, as follows:

Federal laws: the Russian Federation Customs Code, the Law on the Use of Atomic Energy, the Law on Public Radiation Safety, the Law on Environmental Protection, and other legislative enactments.

In compliance with national law, the Service for Customs Control of Fissile and Radioactive Materials has received a license for this type of work from the Russian Federation Federal Inspectorate for Nuclear and Radiation Safety (Gosatomnadzor).

The regulatory document titled *Guidelines for Customs Control of Fissile and Radioactive Materials* has been put in place. It presents the criteria, methods, and procedures for monitoring, and the procedure by which customs personnel can take adequate actions in case they identify an instance of illegal movement of nuclear and radioactive materials.
As of October 1 of this year the number of customs houses authorized to perform customs processing of legally transported nuclear and radioactive materials has been restricted (to 18).

2. The development of technologies and technical means for detecting nuclear and radioactive materials under the conditions of customs check points is an important question. Because of the low-energy gamma spectrum, the detection of nuclear materials, especially U-235 and U-238, is quite problematic if one uses the portal monitors and portable gear that are widely encountered throughout the world and used to detect radiation contamination by technogenic sources (Cs, Co, etc.)[:] scrap metal, building materials, and other products.

Therefore, in building Russian customs detection equipment for nuclear and radioactive materials (the Yantar' fixed system, and the DRS-RM-1401 search dosimeter), their developers set the requirements that these systems meet U.S. standards C1237-93, C1112-93, and C993-92 for special nuclear materials detection systems (the American Society for Testing and Materials (ASTM)).

The Yantar' fixed system, which is designed to be installed at pedestrian, automobile, and rail check points, is a two-channel system: gamma rays and neutrons — a fact that is especially important for tackling the problem of nuclear-materials detection.

Testing of the Yantar' fixed system carried out at the VNIITF [All-Russia Scientific Research Institute of Technical Physics], the Russian Federal Nuclear Center, and the U.S. Los Alamos National Laboratory have demonstrated that it meets the aforementioned standards; a certificate has been issued to this effect.

At the present time, about 80 Yantar' fixed systems have already been installed at border check points in Russia. Further installation of them is planned.

The outfitting of customs agencies with DRS-RM-1401 portable search dosimeters has commenced.

Under an order placed by the Russian Customs Service, Green Star, a Russian firm in Moscow, has built an instrument that is fundamentally novel for customs work — the SKS-50 gamma spectrometer, which makes it possible to perform a customs inspection for nuclear and radioactive materials in special containers without opening them.

This instrument can name the isotope and give its activity, U-235 enrichment, and plutonium isotopic composition.

The accuracy of this instrument is entirely adequate for customs-control purposes. In February of this year this instrument took part in an international trial of methods of determining the enrichment of unknown uranium samples in containers at the Institute of Reference Materials and

Measurements (IRMM) of the Joint Research Center of the European Community Commission in Gil' [*transliterated*], Belgium.

Fifteen of the leading laboratories and companies in this field — from France, the United States, Argentina, Brazil, Hungary, Germany, Finland, and Belgium — took part in the trials.

In terms of accuracy of measurement, the gamma spectrometer is at the level of instruments from leading U.S. and European companies: for example, 48% of the measurements made by all participants in these trials had larger deviations of measurement results from the declared enrichment values than the Russian instrument had.

With a detector optimized for uranium, our measurement results differ from the declared enrichment values of the samples by no more than 0.42% throughout the entire range of enrichments.

In terms of miniaturization of the design and speed of presentation of measurement results to check against the declared parameters of the nuclear materials, the Russian customs instrument is peerless. Its cost is one-third that of the foreign models.

More details on the capabilities of this instrument and the practical aspects of its use at customs agencies can be found in the official materials of the 19th Annual Symposium of the European Association for Safeguards and Nonproliferation of Nuclear Materials (ESARDA), held in May of this year in Montpellier, France, where a report was delivered.

These instruments are now in use at four customs houses, and before the end of February 1998 they will be found at all 18 customs houses that process nuclear and radioactive materials.

However, the availability of technical means of radiation monitoring is a necessary but not sufficient condition for implementing effective customs control. Customs agencies must have trained specialists capable of reacting adequately to the detection of nuclear and radioactive materials by technical means.

Therefore, strengthening of the staffing of customs agencies with specialists in the areas of nuclear materials and their detection and radiation safety is a mandatory condition. The reverse approach — of implementing a policy of training customs personnel who have no special education in the principles of nuclear physics and nuclear-materials control — is doomed to failure. The total number of specialists in the Service for Customs Control of Fissile and Radioactive Materials is 400.

4. Interaction with Russian oversight agencies responsible for the safety of nuclear-materials handling is ensured by bringing them in, on a compulsory basis, for consultations whenever nuclear and radioactive materials are detected.

In conclusion, allow me to state the following.

1. The Russian Customs Service is prepared to cooperate on the matters presented herein on a bilateral or multilateral basis.

   As a first step, we are prepared to demonstrate Russian know-how to interested representatives of customs agencies, as well as the elements of our practical activities that I have spoken of today.

2. In turn, our Customs Service is interested in studying and using the positive experience of other countries in setting up control of nuclear and radioactive materials.

3. In view of the great length of the Russian borders, it will take several years to fully outfit border check points with radiation-monitoring equipment, and consequently the potential danger of illegal crossing of the borders by nuclear and radioactive materials will persist. Given our country's geopolitical situation, I believe that there are governmental agencies and politicians in other countries as well who are sincerely interested in the nonproliferation of nuclear materials and in putting a halt to contraband shipments of such materials within Russia.

We are ready to consider proposals for mutual participation in equipping the Russian border with Russian-made radiation-monitoring systems, which could be expressed in joint funding for outfitting the riskiest sections of the borders with this equipment. We understand that this is not a simple task, but it is workable and could be accomplished through appropriate programs of cooperation.

QUESTIONS AND ANSWERS:

S. Erickson: Any work on harbors?

I. Vasiliev: In 1996 we had a discussion with U.S. Customs Service. We talked about joint development of remote devices for harbors. We have plans to develop such a system in the future. If we find interest among our colleagues, it enhances chances of management looking favorably on such endeavors.

Nuclear Smuggling Since 1995: The Apparent Lull in Significant Cases

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Good afternoon. In this presentation, I'm going to discuss the apparent lull in significant nuclear smuggling cases since 1995. As I'm sure you are all well aware, there have been at least seven unambiguous cases of diversion and recovery of weapons-usable nuclear material that appear to be linked to the former Soviet Union. The first of these cases involved the diversion of 1.5 kg of 90% HEU from a Russian research and production facility in 1992, and the last case involved the recovery of 2.72 kg of 87.7% HEU in Prague in December 1994. But three years have elapsed since that last case.

In preparation for this presentation today, I looked carefully through the Monterey Institute's nuclear smuggling database in order to understand the types of NIS-related smuggling cases that have occurred since late 1994. In the past three years there have been a couple of dozen cases of radioactive isotope smuggling, a couple of dozen cases involving LEU and natural uranium smuggling, and roughly 15 cases involving the smuggling of dual-use nuclear materials. However, there has not been a single confirmed case involving even minute quantities of weapon-grade material that received coverage in the open source literature. Why?

I'm not going to try to give you a definitive answer to this question. Instead, I would like to raise for discussion a number of possible reasons for this apparent lull in significant cases, as I believe that it is too easy to say that nuclear smuggling is no longer a problem or a concern. I will use examples from the "non-significant" cases that we know occurred that may provide some insights into possible types of serious nuclear smuggling cases that may have gone undetected.

First I'd like to put forth two optimistic explanations for the lull, both of which assume that both the quantity and seriousness of nuclear smuggling incidents, in fact, has declined.

International assistance, and in particular U.S. assistance, has made a significant impact in the last three years. First and foremost, this applies to the U.S. Department of Energy's Material Protection Control and Accounting (MPC&A) Program, which has done some very impressive work in the past few years to secure weapons-grade material at nuclear facilities across the NIS. This program has been operating in conjunction with other U.S. programs such as the Nunn-Lugar Cooperative Threat Reduction program and the joint DOD-FBI Counterproliferation Program, to address the nuclear smuggling threat.

The MPC&A program began to move into high gear in 1995. It expanded tremendously over the last three years, covering a much greater number of facilities and countries. Having visited a number of nuclear facilities in the NIS and having seen the minimal state of physical protection at some sites early on, I myself have been very impressed by the increased security ñ including the fissile material vaults, cameras, fences and detectors that are now in place at many facilities.

The DOD-FBI program, to use another example, got off the group in mid-1997. It focuses primarily on the "Southern Tier" countries of Central Asia and the Caucasus ñ a region that was virtually ignored by U.S. nonproliferation programs in the early 1990s. This program includes counterproliferation training for border guards and law enforcement officials, providing information to and raising awareness among a key group of previously neglected NIS officials.

So, perhaps it has become significantly more difficult to physically divert, illegally transport, and sell nuclear materials.

Increased Awareness in the NIS. There is now increased awareness among policymakers and scientists in the NIS regarding the need to prevent nuclear smuggling, through better MPC&A at nuclear facilities, and more effective law enforcement, customs and border controls. The increased awareness and higher visibility of the issue is due in part to such factors as:

- the April 1996 Nuclear Safety Summit in Moscow, at which Russia admitted officially for the first time that nuclear smuggling was a problem requiring its attention;
- Periodic Gore-Chernomyrdyn Commission meetings.

These events, as well as various NIS programs that address nuclear smuggling, are receiving a great deal of media coverage. Whereas five years ago, Russian papers might have been more likely to publish articles about the mysterious and lucrative black market in nuclear materials, today they are more likely to run stories about the sophisticated technology and equipment being used to secure nuclear materials at, for example, the Kurchatov Institute, the Institute of Physics and Power Engineering in Obninsk, or Russian naval sites.

The higher visibility of efforts to prevent and deter smuggling means that it is more likely that a potential smuggler would think twice before attempting to divert and sell nuclear materials.

The next four possible explanations for the lull are more pessimistic, and assume that smuggling, in fact, continues to occur.

Nuclear smugglers are becoming more sophisticated. It is conceivable that sophisticated nuclear smugglers have become more savvy and have developed more streamlined communications with potential customers, and are using less circuitous routes to bring their products to market. The "visible" market in nuclear materials, including the numerous incidents in the Monterey Institute databases involving primarily non-weapons-usable material, is characterized by amateur criminals with no real buyers. More sophisticated smugglers likely would use sophisticated networks of insiders at nuclear facilities, and the insiders would be of a higher level, certainly including facility management. Such smugglers likely would try to manipulate the system to their advantage, though customs fraud, for example. Indeed, Russian customs officials have stated in interviews with the press that the easiest way to smuggle nuclear materials would be to lie on the customs declaration. Lastly, sophisticated smugglers would be more likely to avoid detection. One way to do this might be to move illicit nuclear materials south across the borders of the Central Asian and Caucasian countries—making use of existing narcotics trade routes and avoiding Europe altogether.

There have been a few incidents in the past three years that serve as good examples of more sophisticated methods of nuclear smuggling. One case involves the illegal export of the isotope iridium-192 from Radioisotope Factory No. 45 at the Mayak Production Association to a company

in the United Kingdom.While iridium-192 is certainly not weapons-usable, and the United Kingdom is not a country of proliferation concern, the case is interesting for several reasons:

The iridium was exported under falsified customs documents that had been prepared by the factory staff. The scheme was discovered only because, on one occasion, the factory sent a shipment of the iridium to a customs post in St. Petersburg, instead of to the local Kyshtym Customs Post. The customs inspectors in St. Petersburg were more savvy than their colleagues in the Urals, and noticed that the radiation level of the shipment did not match the radiation level stated on the customs documentation.

The factory director himself, Mr. A. Kalinovsky, ordered his staff to deliberately falsify the customs documentation;

Mr. Kalinovsky's scheme involved multiple exports over a period of at least two years;

Although a local court found Mr. Kalinovsky guilty, he was only sentenced to six months probation. When the prosecutor protested to a regional court asking for a harsher sentence, not only was his request not granted, but Mr. Kalinovsky's sentence was actually reduced to four years probation.

This is a clear example of a sophisticated smuggling scheme in which nuclear materials were illegally exported from a major Russian nuclear center with the direct involvement of facility management. This case happened to involve non-sensitive isotopes. But would the Kyshtym customs inspectors have been any more likely to intercept the illegal shipments had they contained highly-enriched uranium as opposed to isotopes? There is nothing to suggest that it would have been any more difficult to export weapons-usable materials than it was to export iridium.

Another interesting case involves the export of over one hundred of kilograms of low-enriched uranium and other assorted radioactive materials from the Ulba Metallurgy Plant in Ust-Kamenogorsk, Kazakhstan.

This case involves a group of "procurers" from Ust-Kamenogorsk, Kazakhstan, and group of "marketing specialists" from Novosibirsk, Russia. The Ust-Kamenogorsk group was led by Mr. P. Zenovyev, a former Ulba employee turned - Ust-Kamenogorsk metals trader. The Novosibirsk group was led by Mr. Krinitsyn, a Novosibirsk businessman originally from Ust-Kamenogorsk.

Mr. Zenovyev, through his contacts at Ulba, recruited a number of mid-level employees at the Ulba Metallurgy Plant and the Ust-Kamenogorsk Lead-Zinc Combine to divert low-enriched uranium (LEU), thorium, tantalum and other strategic and radioactive metals. His group sold these materials to Mr. Krinitsyn. Mr. Krinitsyn's marketing network consisted of six individuals, one of whom was a former Customs agent whose job it was to help with ship the material to customers abroad. According to one article, $3.5 million worth of shipments crossed the Kazakhstani-Russian border between Zenovyev's group and Krinitsyn's group. Shipments were sent on passenger buses and ordinary cars.

Eventually, the two groups were broken up by a collaborative effort by Kazakhstani and Russian security services. Kazakhstani security services arrested a group of 18 individuals in Ust-Kamenogorsk, including Mr. Zenovyev, for the theft of 146 kg of LEU, 439 kg of thorium, 58 kg of thallium, 20 kg of indium, and an undisclosed amount of tantalum. A Kazakhstani regional

court sentenced the group, which included 5 women, in December 1996. Mr. Zenovyev received 8 years in prison.

The Russian security services observed two transactions by Mr. Krinitsyn's gang before capturing Mr. Krinitsyn and his six colleagues in a sting operation. The two transactions included the sale of a small amount of "radioactive materials" to a Turkish citizen in the city of Sochi, and another to a "Korean citizen" in Novosibirsk. The sting operation involved the sale of 4 kg of uranium for $800,000. Subsequent searches of the suspects' apartments revealed an additional 5.3-kg of uranium.

This case demonstrates the complex insider networks that can be set up within major nuclear facilities, using the business contacts of former facility employees. Although this case did not involve weapons-usable materials, it demonstrates the ease with which nuclear material can be diverted and moved across internal NIS borders.

Lack of information/intelligence sharing. Perhaps there have been cases of diversion and/or trafficking in nuclear materials that NIS officials are aware of -- but have not shared with their Western counterparts in any detail. Despite intelligence-sharing agreements that were made at the April 1996 Nuclear Safety Summit, in fact there appears to have been very little intelligence sharing on nuclear smuggling cases.

For example, a Russian criminologist working on nuclear smuggling issues said during a recent trip to the Monterey Institute that Russian law enforcement officials knew of multiple diversions of fissile material from the closed nuclear cities, but that this information had not been released to the public. To give another example, Gosatomnadzor inspectors have reported that on routine inspections they have found nuclear material to be missing ñ including the discovery in 1996 that a fuel assembly containing 145 g of U-235 was missing from a research reactor at Tomsk Polytechnical University. Thus, there is some evidence that Russian officials are aware of cases of weapons-usable material diversion.

In addition, it is important to keep in mind that many NIS countries still have a state controlled press. The discovery of a major nuclear smuggling transit operation by law enforcement officials would be unlikely to make it into the papers in Uzbekistan, for example. Of those cases that have been reported in the press, an unusually high number appear to have taken place in the Baltics. This may be due, at least in part, to the fact that the press is more free and independent in this region.

Weapons-usable material may have been diverted, but not exported, in the early 1990s. As noted earlier, U.S. assistance for MPC&A at NIS nuclear facilities did not kick into high gear until about 1995. It is conceivable that large quantities of weapons-grade or weapons-usable materials were diverted during the window of opportunity in the early 1990s. Perhaps that material was not immediately exported, but set aside in various hiding places outside the boundaries of currently protected nuclear facilities. Would be-smugglers may be waiting until the right moment to make contact with a potential buyer, or may be waiting until the climate is more permissive and the political focus on nuclear smuggling has diminished.

There have been a number of cases over the past three years that involve the discovery of nuclear material (not weapons-usable) that had been diverted in 1990 - 1992. One such case involved the theft in 1992 of a 280-kg fuel assembly from the Ignalina nuclear power plant in Lithuania. The

theft was discovered in 1993 during a routine inventory of nuclear fuel at the plant. However, Lithuanian authorities recovered uranium fuel pellets and partially empty fuel rods that could be traced back to that same assembly on at least four separate instances in December 1994, March 1996, October 1996 and June 1997, when one of the thieves, a former guard at Ignalina, finally turned himself in. The former guard described how he and his cohorts had sold part of the material, and then buried the remaining material for sale at a future date.

Disincentive for Western intelligence services. In the aftermath of the Munich case, there has been a bit of a backlash against intelligence services in general and sting operations in particular. There was a great deal of public outrage in Germany that an intelligence sting operation could involve the import of dangerous radioactive materials on a passenger plane, thus endangering public health and safety. This led to a parliamentary investigation of the entire affair and a slew of accusations that there was not sufficient government oversight of the German intelligence service, the BND. As a result, the BND has been subject to intense scrutiny over the last few years, with many of its officials called to testify before a special parliamentary commission regarding their knowledge of the Munich case. In addition, there were many accusations from Russian officials that Western intelligence operatives, in their zeal to set up sting operations, were creating an artificial market in illicit nuclear materials.

Therefore, there may be a disincentive for Western intelligence services to actively pursue potential leads in this area. When they do come across information on cases, they may also be less inclined to publicize this fact. In fact, according to some sources, there have been instances when intelligence agents actually turned away nuclear material and refused to get involved in potential cases.

There are clearly a number of possible explanations for the apparent lull in "significant" nuclear smuggling cases since the beginning of 1995. I believe that the actual explanation is likely some combination of all of the above suggestions. However, I would like to reiterate that while progress has been made toward reducing the potential for nuclear smuggling, it would be irresponsible to presume that the threat has gone away. If we believe that there are individuals, sub-national groups, or nations that are interested in illegally obtaining weapons-usable materials, we must acknowledge the possibility that attempts are being made to gain access to this material. As discussed above, smuggling cases involving non-weapons-usable nuclear materials continue to occur, suggesting means and methods that might be used to smuggle weapons-usable materials as well.

In addition, I would like to take this opportunity to suggest that perhaps we need to redefine the very term "significant case." In the past, "significant case" has been used to mean the smuggling of weapons-grade, or at least weapons-usable, nuclear materials. I believe it would be useful to analyze more closely a few of the cases involving LEU smuggling, and the smuggling of dual-use nuclear metals, such as zirconium and beryllium. Unlike the seven "significant cases," which involved tiny amounts of material, some of the dual-use and LEU cases involved hundreds of kilograms of material. Where is this material going? Who are the buyers? One reason a smuggler might sell these materials on the black market, as opposed to the legitimate market, is to avoid national export control regulations with their requirements for international safeguards. LEU is not weapons-usable, but it is that much closer to weapons-usable material than natural uranium. If we only consider cases involving HEU and plutonium to be significant, then we're putting the theft of two capsules of cesium-137 in the same category as the theft of 100 kg of LEU.

Thank you for your attention. I would be glad to answer any questions, and I would welcome your comments and thoughts regarding these explanations for the state of nuclear smuggling over the past few years.

I am using the term "NIS" to mean all fifteen of the Newly Independent States of the former Soviet Union: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

Rens Lee has written and spoken about the "visible nuclear black market" as opposed to a possible, more sophisticated "shadow market" in a number of articles and presentations on nuclear smuggling.

References:

Interview with the head of the Urals Customs Division Nikolai Cherepanov, "Na Tamozhne Net Realnogo Kontrolya Radioaktivnykh Materialov," Yadernyy Kontrol, August-September 1997, pp. 29-30.

This case has been reported on in two Russian regional newspapers: Viktor Riskin, "Mechenyye Izotopy," Chelyabinskiy Rabochiy, 6/26/97, p.2 and Dmitryy Zobkov and German Galkin, "Tamozhennyy Post ñ Na Yadernom Obyekte," Aktioner (Chelyabinsk), 10/31/97, p. 1; both in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

Gulnara Bekturova, "Ukrast Uran? Net Nichego Proshche," Kazakhstanskaya Pravda, 5/14/97, pp. 1, 3; in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

Vladimir Bogovitskiy, "V Ust-Kamenogorske Zavershilsya Sudebnyy Protsess Po Delu O Khishchenii Yadernogo Topliva I Redkhikh Materialov, Panorama, 2/21/97; in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

Maria Soloveva and Mikhail Kalinin, "Prestupniki Mogli Pogruzit V Samolet Dazhe Atomnuyu Bombu," Kommersant Daily, 12/3/96, p. 10; in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

"Doslovno. Gosatomnadzor Rossii: Obnaruzheno Propazha 145 Gramm Urana S Obogashcheniyem 90 Protsentov," Voprosy Bezopasnosti, No. 16, 10/27/97; in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

"Krast Uran Ne Nuzhno, On Togo Ne Stoit," Segodnya, 3/10/93, p. 7 and Ashura Radzyavichyute, "Uran Byl Ukraden S Ignalinskoy AES," Diena (Riga), 6/13/97, pp. 1,4; both in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

"Confiscated U May Be Part Of A Lost Fuel Assembly," Nuclear News, 2/95, p. 63; Donatos Stravinkas, "V Vasiginase Naydena Chast Ukradennoi S Yadernym Toplivom," Golos Livy, 3/14/96, p. 2; "Police Find Some of Nuclear Fuel Stolen From Ignalina," Interfax (Moscow), 10/31/96 (FBIS-SOV-96-212); and Ashura Radzyavichyute, "Uran Byl Ukraden S Ignalinskoy AES," Diena (Riga), 6/13/97, pp. 1,4; all in the NIS Nuclear Smuggling Database, Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA.

QUESTIONS AND ANSWERS:

C. Olinger: Did they track the end use of dual use materials?

E. Ewell: They did set up a sting, and tracked where the materials ultimately went to. There is some doubt about the press reports.

R. Lee: With respect to the Ulba criminals, what was their marketing plan?

E. Ewell: They were giving material to a middle man, out of Novosibirsk, and were still trying to find real markets.

N. Dellenbach: What materials are the threat for you?

E. Ewell: They're on the dual use supplier list; for example, titanium, tungsten, beryllium, platinum, zirconium.

L. Koch: Add ^{6}Li to the dual use list.

E. Ewell: Yes.

Development of the Unauthorized Transfer Prevention Program of Nuclear Materials in Ukraine

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ABSTRACT

Last year there was developed a project of "Unauthorized Transfer Prevention Program of Radioactive Materials in Ukraine till 2001". The main objective of this Program is the prevention of any illegal transfer of nuclear materials on the territory of Ukraine. Among the measures planned in the Program, (1) development of all the necessary normative-legal acts, which regulate the activity of legal persons connected with the prevention of unauthorized transfer of nuclear materials, (2) technical assistance and modernization of the equipment and instruments of Main Expert Organization, (3) development of modern techniques for the accounting, control and physical protection of nuclear materials, (4) realization of measures against any unauthorized transfer of nuclear materials at the borders of Ukraine, (5) informational-analytical support of measures on the prevention of unauthorized transfer of nuclear materials, (6) training of the experts of law-enforcement organs and other legal persons, involved in the prevention of illicit trafficking of nuclear materials, (7) international cooperation on the prevention of unauthorized transfer of nuclear materials.

1. INTRODUCTION.

The numerous incidents, connected to the potential sale of nuclear materials and other radioactive sources through non-state channels and have taken place for the last years all over the world, show clearly, that such sorts of materials are available, some persons are ready to sell them and there are persons, ready to purchase them. In some cases the confiscated samples appeared to be a nuclear material, including the plutonium or highly enriched uranium, in other cases dangerous radioactive sources, such as ^{60}Co and ^{137}Cs, have been offered on sale. Though the cases of illicit trafficking till now were connected mainly to small amounts of these materials, the consequences of even one successful attempt can be very serious. Therefore for many countries the prevention of unauthorized transfer of nuclear materials has become the priority task.

According to the data of regulating and law-enforcement organs of Ukraine the number of offenses, connected to the smuggling, plunders, unauthorized use of nuclear materials and other radioactive sources, has been recently increasing. On one hand, it is because, after the USSR disintegration, the nuclear structure of former Soviet Union appeared to be fragmented, and the centralized accountancy and control system of nuclear materials and technologies - broken. On the other hand, the crucial economic crisis having affected all republics of the former USSR, including Ukraine, has reduced the financing of nuclear programs, terminated the upgrade of material and technical base, moreover, caused the reduction of people's living scale and the increase of crime. All that, naturally, has increased the risk of plunders of nuclear materials and possibilities of their unattended delivery to the persons and countries tending to the creation of nuclear weapons. Furthermore, Ukraine is a country with very high density of transit, direct and converse streams of

cargoes and passengers. As a result, the probability of unauthorized transfer of nuclear materials through the borders of Ukraine is essentially increasing.

One of the major dangers of unauthorized use of nuclear materials in Ukraine is the possibility of creation of nuclear explosive devices, blackmail and other socially-dangerous crimes by terrorists and organized crime. All this determines the priority of development of the Unauthorized Transfer Prevention Program of Radioactive Materials in Ukraine.

The main directions of the Program are:

- prevention - improvement of appropriate infrastructures in the legislation, the physical protection, the accounting and control of nuclear materials, the control and safety of radioactive sources and the control for export/import;
- responding - detection and respond on the nuclear materials transfer on the territory and through the borders of Ukraine and analysis of the seized nuclear materials, and also development of the unauthorized transfer database;
- training of the personnel - training in the field of as the prevention as the responding;
- information exchange - in the case of an illegal transfer of nuclear materials, using the developed database, the reliable and deserving confidence information can be presented duly to IAEA and mass media.

2. THE PREVENTION OF UNAUTHORIZED TRANSFER OF NUCLEAR MATERIALS.

The warranty against a risk of the unauthorized transfer of nuclear materials used to be considered the safe management of fissile materials. Therefore, the major premise for prevention of an illegal transfer of nuclear materials in Ukraine is the availability of an effective system on accounting and control of nuclear materials. The given Program concentrates all the gains on strengthening of the national control system and acceptance of measures, which should prevent or constrain an unauthorized use or management of such the materials.

The national accounting and control system bases upon the legislation of Ukraine and regulations, which include the modern norms and meet to the obligations of the state implying from the international agreements and conventions, signed by Ukraine. The national system provides also the measures at a state level on prevention, detection and constraining of any unauthorized activity. As for the nuclear materials, the procedures with the purposes of physical protection, accounting and control over export/import are strongly required.

2.1. The legislation and regulations of Ukraine.

A basis of the reliable national control system is appropriate legislation and regulations. In Ukraine, where the convention on the safeguards with IAEA operates, the Agency is obliged to check up the availability of nuclear materials, set under the safeguards, and Ukraine, in particular, is obliged to inform IAEA, if the loss of a nuclear material had occurred or could take place.

The gradual association of Ukraine to the international agreements and conventions as the state, which is not having the nuclear weapons, has induced Ukraine to accept the program of it's legislation improvement. Such the development is conducting on the principles oriented to set up

the responsibilities of regulatory organs, facility operators and separate persons for the realization of measures on both non-proliferation and safety, which satisfy to the international norms and procedures.

Ukraine is going to create the full nuclear legislative system, which includes as the nuclear non-proliferation as the nuclear safety. The laws, decrees and regulatory norms would involve the positions concerning:

- licensing of all nuclear activity, including the sanctions and measures of punishment;
- the responsibilities of managers and separate persons of operating organizations, including the requirements to operator systems and procedures in order to prevent the withdrawals and proliferation;
- functions and responsibilities of an independent and competent state regulatory organ, including organizational and management systems to guarantee high safety and non-proliferation.

At present, the Law of Ukraine "About the use of nuclear energy and the radiation safety" is already accepted. Furthermore, the following Decrees of the Cabinet of Ministers are approved as well:

- "An ordinance about the state system of the accounting and control of nuclear materials";
- "An ordinance about the order of control on export, import and transit of goods, which concern the nuclear activity and can be used for the creation of nuclear weapons";
- "The Order of interaction of the executive organs and involved legal persons in the case of detection of an illegal transfer of radioactive materials".

At the same time, the normative-legal base existing in Ukraine is insufficient for effective prevention of an unauthorized transfer of nuclear materials and requires further improvements. For this purpose in the Ministry of Environment Protection and Nuclear Safety the interdepartmental working group would be created in order to support the normative-legal and scientific-methodical measures of the Program.

2.2. The physical protection of nuclear materials.

The physical protection against both plunder or unauthorized diversion of nuclear materials and the acts of sabotage of separate persons and groups at nuclear facilities is a national and international problem. As well as the majority of states, for the creation and support of the physical protection system Ukraine used the INFCIRC/225/Rev.3 document. The objective of regulations and procedures concerning the physical protection is the prevention of any attempt of plunder and fast detection of actual plunder.

The physical protection of highly enriched uranium and plutonium has especially high priority. Last year in the Scientific Center " Institute of Nuclear Research" with assistance from the American side the improvement of physical protection of the Research Reactor WWR-10Ì (10 ÌWt of thermal power) was completed. As a fuel for the reactor both single and triple assemblies (either WWR-Ì2 with 36% or WWR -Ì5 with 90% enriched uranium, respectively) can be used. The structure of the fuel is UO_2-Al. Up to 13.2 kgs of 36% enriched uranium are loaded in the reactor

simultaneously. The fresh fuel is stored in the special storage and the spent one - in the cooling pool located near to the reactor. Except for the fresh and spent nuclear fuel the Institute possesses small amounts of natural uranium and ^{233}U, ^{235}U, ^{236}U, ^{239}Pu, ^{232}Th enriched isotopes, which were used for scientific researches. In the nearest future the same improvements of physical protection of nuclear materials storage of the first and second categories, located in Kharkov and Sevastopol, are planned also to carry out with the kind assistance from the American side.

2.3. The accounting and control of nuclear materials.

The main approach in preventing of nuclear material plunders is the development of reliable State Accounting and Control System (SACS), which recognizes the complementary character of the accounting and control of nuclear materials and the regulations and procedures of physical protection. The accounting and control of nuclear materials pursues the objective to obtain the information where the whole fissile material is placed and confirm this information by periodic inventories.

The legal basis of SACS development and operation is the Law of Ukraine "About use of the nuclear energy and radiation protection". The 67th article says that the SACS together with the State Export-Import Control System of nuclear materials, equipment and technologies forms the state safeguards system, which includes a complex of technical and organizational measures and is applied to all nuclear materials in Ukraine, being under its jurisdiction or control. In the end of a year before the last year the Decree of the Cabinet of Ministers of Ukraine "Regulations of the State Accounting and Control System of Nuclear Materials" was approved. In the Regulations all the responsibility of Operators (licensees), which use, transport or store the nuclear materials, and also executive organs, which inspect this activity to support the SACS, is well defined. The development of normative documents of a lower level, regulating state inspection of the accounting and control of nuclear materials and also procedures of measurements, is now carried on.

2.4. The export/import control.

By accepting the Decree No. 302 of March 12, 1997 of the Cabinet of Ministers of Ukraine "On approval of the Provisions for procedure of control over export/import and transit of products (items) associated with nuclear related activities and which can be used for nuclear weapons production", Ukraine has transformed the national legislative field in accordance to the requirements of the Group of Nuclear Suppliers. The objective of the state export and import control is to prevent the unauthorized transfer of nuclear materials through the borders of Ukraine. Within Ukraine this control regulates the management of such the materials and their usage by means of the legislation and the SACS. All mentioned above measures in the field of the legislation, physical protection, accounting and control of nuclear materials are links of a chain of an effective export/import control. In addition to the systems and procedures specially used in the nuclear activity (for example, SACS), in the nuclear export and import control the usual components of the state infrastructure, such as police and customs, are used as well.

3. THE RESPONDING ON UNAUTHORIZED TRANSFER OF NUCLEAR MATERIALS.

The national competent organs (or the mass media) first detect and investigate cases of an unauthorized transfer of nuclear materials. In Ukraine some progress has been achieved in the development of guidelines for the national organs, especially for the Border Service, on the

procedures, which should be applied in the event of nuclear material illegal transfer detection, and on proper responding measures at such detection.

3.1. The expertise of the seized materials.

According to the Ordinance of Ukrainian Government the Main Expert Organization, which should define the characteristics of all nuclear materials seized from an illegal transfer, is the Scientific Center "Institute for Nuclear Research". In the case of an unauthorized transfer of nuclear materials or a suspicion of such transfer and on inquiry of national competent organs the Institute for Nuclear Research conducts the expertise of the seized material. The Scientific Center possesses some possibilities and practical experience to analyze various nuclear materials.

And though the Scientific Center has the group of competent and high skilled experts, moreover several experts have been trained in Los-Alamos National Laboratory, some equipment for the gamma-spectroscopic analysis and well-developed techniques, nevertheless, in order to carry out the expertise at a high modern level as the modernization of already existing devices and instruments as the new equipment are certainly required. Furthermore, it is quite possible to imagine such the cases, when gamma-spectroscopic measurements will not be able to ensure the reliable information on the nuclear nature and properties of the seizes material. Therefore, it appears to be of vital importance to develop both passive and active neutron techniques and equipment. To tell the truth, till now we had not come across a case of plutonium smuggling. However, we had already to conduct the expertise of uranium in scrap-form and nuclear fuel rods and pellets for the Research and Power Nuclear Reactors. But who knows, what cases are we facing hereafter?

It would be great, if our laboratory could analyze the materials at any stage of the nuclear fuel cycle. It is very desirable also to determine the chemical nature of main components, the nature and content of both minor elements and chemical or radiological micro-elements. Such the measurements can give the information on a way and time of production of the seized materials, which appears to be very useful for the investigation of material origin. Until now for obtaining such information we used to rely only on the long-term practical experience of our experts.

From our point of view, also it seems to be important to create the mobile laboratory in order to study the most dangerous cases at a place of incident. At least, there is an obvious necessity in it at first, until the competent organs and experts on places will not be enough trained and accumulate sufficient practical experience.

4. THE TRAINING OF PERSONNEL.

The development of the SACS requires the training of both SACS and facilities staff. With kind assistance from U.S. Department of Energy, Sandia and Los-Alamos National Laboratories last year in the Scientific Center "Institute for Nuclear Research" a number of training courses on as the accounting and control as the physical protection of nuclear materials were conducted. The objective of the courses was to help in the development of modern SACS in Ukraine and familiarize the specialists, involved in the creation of complex state protection systems of nuclear facilities, with the modern concepts and technology. At the same time, no training course for the experts on unauthorized transfer of nuclear materials, which takes into account the aspects of crime detection, has been planned.

5. THE UNAUTHORIZED TRANSFER DATABASE AND INFORMATION EXCHANGE.

Because of the illegal transfer cases in Ukraine it is supposed to create the database for obtaining a reliable common picture in the field of unauthorized transfer of nuclear materials. The main function of this database is to provide the reliable, exact and duly information about all the cases of illegal transfers at three levels: the state, IAEA and public. Such database could facilitate to Ukraine the task of definition, what cases of the unauthorized transfer of nuclear materials concern it's own interests. Besides, the database can help to present the timely and reliable information about the cases of any illegal transfer to mass media.

6. FUTURE OUTLOOK AND PERSPECTIVES.

On implementing the discussed Program, we hope that (1) customs checkpoints on the borders of Ukraine will be equipped with radioactive material detection instruments, (2) the National Coordination Center on prevention of illegal transfers and responding on them will be created and, at last, (3) the Main Expert Organization will be equipped and the experts will be trained enough to expertise the materials at any stage of the nuclear fuel cycle. As far as we know, there are a number of proposals, in particular from the USA, EC, Finland and Japan, to provide the technical assistance for Ukraine in this area. We also hope, that in the nearest future the modernization of Ukrainian systems of the accounting, control and physical protection of nuclear materials and facilities will be successfully completed. All that could greatly reduce the number of cases of nuclear material illicit trafficking in Ukraine.

QUESTIONS AND ANSWERS:

A. Weber: Was the described case the only case?

V. Kyryshchuk: I told about it to illustrate the use of the mobile laboratory.

A. Weber: Are the number of cases increasing or decreasing?

V. Kyryshchuk: Increasing, to my knowledge.

The Potentials of the Institute of Nuclear Physics in Fissile Materials Control in Uzbekistan

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QUESTIONS AND ANSWERS:

E. Vergino: Have you considered submitting proposals to the STCU, now that Uzbekistan is part of it?

B. Yuldashev: Yes, we have recently learned that Uzbekistan is now part of STCU and we are preparing a proposal for application.

E. Nadler: Any smuggling incidents?

B. Yuldashev: I haven't heard of any. Sometimes Customs detects nuclear materials, we are working with them on this.

N. Reuter: Who analyzes any seized material?

B. Yuldashev: The Committee of Standards and Metrology usually sends material to the Institute of Nuclear Physics. Final conclusions will come from the Institute of Nuclear Physics.

The Export Control System in Kazakhstan

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Kazakhstan is a mineral rich country with huge reserves of oil and gas and deposits of gold, copper, zinc and many other minerals. 25% of all uranium in the world today is in Kazakhstan. Because of its large uranium deposits and because Kazakhstan was one of the centers of the nuclear weapons program for the former Soviet Union, we inherited the vast nuclear legacy of the former Soviet Union. We have dealt with this legacy first by getting rid of and destroying all nuclear weapons on our territory. In 1992 the year Kazakhstan gained independence, we signed the Lisbon Protocol. In 1993 Kazakhstan joined the Non-Proliferation Treaty and entered into Safeguard Agreement with IAEA. Today we are working to keeping nuclear materials within our country safe and ensure that any materials exported from our country will be used in peaceful pursuits.

The task of controlling exports has become more difficult due to the expansion of trade and economic ties in Kazakhstan. Increased economic activity has increased the demand for nuclear materials and dual-use materials from Kazakhstan.

Nuclear export in Kazakhstan is primarily determined by the structure of the nuclear fuel cycle. Kazakhstan mines produced 1/3 of the uranium in the former USSR, and about 85% of fuel pellets for soviet reactors were manufactured at the Ulba metallurgical plant in Ust-Kamenogorsk. Rare and rare earth elements, alloys which are in the lists of dual-use materials were also produced in Kazakhstan. For example, Kazakhstan monopolized the production of beryllium, tantalum and niobium.

In the past the entire nuclear fuel industry was controlled by the Ministry of Medium Machine Building. In January 1992, after the collapse of Soviet Union a National stock-holding company, called "KATEP" was created. This company combined about 30 enterprises of the uranium mining and milling industry of Kazakhstan. One of co-founders of "KATEP" was the Atomic energy complex in Aktau. In 1997, by the Decree of the President there was established the "Kazatomprom" company which fully controlled by the State. "KATEP" is under this company now.

Nowadays, practically all uranium concentrate from Kazakhstan is exported to the USA, and fuel pellets go to Russian plants. Taking into account that both countries are members of the "Nuclear Club". We could say that there is not a big problem with export control of nuclear materials to date. But with the expansion of new markets stricter export controls will certainly become a necessity.

The purpose of nuclear export controls are well known. Controls are used to prevent the use of exported materials in the development of nuclear explosive devises. In this connection, all exported materials should be under the control of an international society, and countries importing materials should take careful measures to prevent use of nuclear materials in military programs.

Therefore the procedure for license issuing requires that the importer prove their ability to control exported materials. This means that nuclear materials will be protected under IAEA safeguards and that physical protection of materials will be ensured by an accounting system which meets of

international standards. Additionally, re-export of nuclear materials from Kazakhstan will take place only when written permission is granted by authorized bodies of the Republic of Kazakhstan.

In connection with preparation of the Republic to join to the Nuclear Suppliers Group additional measures taken. For example, nuclear materials may only be exported to countries which have formal agreements with the IAEA regarding full scope safeguards.

In exceptional cases, nuclear materials might be exported to countries without IAEA agreements in place, however, permission would be granted only if Kazakhstan organizations were completely confidant that the imported products would be tightly controlled by the international society.

Nuclear export from Kazakhstan should not increase the risk of nuclear weapon proliferation or the development of any nuclear explosive devises. We believe that comprehensive nuclear export control can be implemented only with full state control of all nuclear activity within the territory of Kazakhstan. Therefore the government control of all nuclear materials was written into as law under the "Law of atomic energy usage," which was adopted in April 1997.

Other laws pertaining to State control of nuclear exports were included in the "Law of export control of arms, military equipment and dual-use products" adopted in June 1996.

Today the following system exists for licensing the export of nuclear materials. The exporting enterprise submits an application to the Ministry of Energy, Industry and Trade. First a determination must be made as to whether the materials are under proper government control. Once this is established government authorities must issue a decree granting permission for export. After this decree is issued the Ministry of Energy, Industry and Trade issues an export license.

Approval of the Atomic Energy Agency is required during each step of the license procedure.

This complicated procedure is required by Law and must be followed even in cases where a more streamlined approach would be preferable. For example, nuclear installation are currently required to undergo all of the above mentioned bureaucratic procedures, even for sample materials being shipped to IAEA laboratories for testing.

The Atomic Energy Agency requires that all exports are reported five days before shipping. Another problem in the absence of mechanism to follow-up on shipments and confirm that they actually took place. There is another problem with tracking material after export from Kazaklhstan and identifying the actual end-user. A bilateral agreement with other countries would be useful in helping us resolve this issue.

Kazakhstan should be confidant that importing organizations have full legal rights to perform work with nuclear materials and that the proper government authorities are aware of their intent. In other words, Kazakhstan must be sure that the import operation is approved by the State.

One weakness which should be pointed out is a lack of communication between state borders and the organizations which control nuclear export.

There is currently no authorized system for tracking exported nuclear materials. Export licenses are issued and materials are shipped, however, without a computerized system the Government is not able to account for exported materials with appropriate accuracy.

Kazakhstan has established all of the necessary government organizations for control of nuclear materials. Laws have been passed creating a legal basic for export. The system for controlling export has been put into practical use and is functioning.

But we still have a number of technical and organizational problems. Resolution of these problems would greatly improve the effectiveness and efficiency of our system.

Among the recent developments in Kazakh-American relations worth to mention documents signed for the BN-350 nuclear materials program during the visit of the US by the Kazakhstan President Nazarbayev N. A. in November last year. This program commits the Kazakhstan Ministry of Science-Academy of Sciences and the US Department of Energy to undertake non-proliferation initiative involving a multi-year effort to secure and place into long-term storage plutonium bearing spent nuclear fuel. Kazakhstan and the US previously worked together to remove 600 kilograms of highly enriched uranium from Kazakhstan to the United States under project Sapphire. This new effort will be the largest nuclear material security program undertaken by the two countries and a result of a highly collaborative work between Kazakhstan and US technical and diplomatic officials and is an excellent example of our mutual relationship.

International Cooperation

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There are numerous programs providing assistance in the former Soviet Union, many of which were discussed at this meeting. These include programs designed to: preclude the spread of nuclear materials (MPC&A); redirect the weapons expertise to more commercial, or at a minimum, non-weapons related, science/technology research (ISTC/STCU, IPP); and help reduce the threat by helping to dismantle some of the facilities (CTR). These programs typically provide assistance either directly to the former weapons facilities, institutes or to the scientists. There are also international cooperative efforts whose goal it is to provide training and technical assistance to law enforcement or the governments. The key points and questions are summarized below (key issues in **bold**)

- International Law Enforcement Academy
  - Provides the following training and information:
    - nuclear threat
    - smuggling profiles
    - nuclear scams and illicit trafficking
    - counter smuggling, including protection, response, detection
    - hazards
  - Have found that mid-level law enforcement officials find the profiles of individuals useful
  - US participation coordinated by FBI, international participants identified by their governments
  - Do not provide specific details on the detection of contraband, this is done through Project Amber for customs officials
  - Specific attempts by governments is provided by the DOD at a counter-proliferation seminar for high level officials
- Technical Cooperation (ITWG)
  - Brings together technical community and law enforcement to discuss forensic analysis leading to attribution
  - **Attribution dependent upon a technical data base, containing assessments by experts, and both civilian and weapons information**
  - Planning an international forensic exercise, not to qualify law enforcement officials but to assess which analysis techniques are most useful

- Most likely that if an event were to occur that the case would be analyzed on a bilateral or trilateral basis and not by the 18 nations involved in the ITWG

- Technical issues
  - Analysis is not sufficient, need to know what to look for
    - Karlruhe has been working with the Russians to exchange information on materials and characterization techniques
    - **Need a data base of information**
  - Bochvar is developing information on safeguards, methodology, forensic database for nuclear materials
  - Czech Republic, Hungary, Bulgaria are working together to develop the technical capability to ID nuclear materials
  - IAEA addresses import/export control in the NIS, provides forum for members to share expertise
- Forensics
  - What do you look for?
    - Fibers
    - Particles
    - Chemical signatures
    - Biologic material
  - US exercise provided information on
    - Response time
    - Analysis time

International Training in the Prevention of Nuclear Smuggling

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The increased interest in trafficking of fissile nuclear materials has elicited a common truth: countering the smuggling of fissile nuclear material is an international problem and requires an international solution. While combating illicit trafficking in nuclear materials is multi-departmental and multi-national, the problem is inherently one dealt with by the law enforcement community. Therefore, the law enforcement community has taken the lead in efforts to establish programs and instill international cooperation to combat criminal activity involving illicit trafficking in nuclear materials. In the spirit of this cooperation, the International Law Enforcement Academy and the Department of Defense (DOD)/Federal Bureau of Investigation (FBI) Weapons of Mass Destruction (WMD) Counterproliferation seminar were created.

The ILEA grew out of the growing realization that crime, particularly financial and organized crime, is becoming increasingly international. Additionally, the economic situation in many countries in central and eastern Europe is extremely fragile and threatened by increasing criminal activity. The United States and the international law enforcement community determined it was in their best interests to provide assistance to the police services of these countries in an effort to deter this criminal activity. In this vein, the ILEA was established to provide law enforcement training to mid-level law enforcement officials from central and eastern European countries.

The ILEA began operating in April 1995, the result of a cooperative effort between the governments of the United States and Hungary. The US Department of State provides funding for the academy, the FBI administers the program, and the government of Hungary provides the facilities and manpower for day to day operations. The ILEA program is offered five times a year, typically training 50 students from three different countries in each session. The ILEA training is structured similar to the US FBI National Academy. It is an eight week program consisting of personal and professional development courses. The focus of the program is leadership, human rights, ethics, rule of law, management of the investigative process, and other contemporary law enforcement issues.

In the first course, "nuclear crime" was not a part of the ILEA curriculum. Student's input from the first course prompted an eight hour block of instruction on "Nuclear Crime" to be added to the curriculum. The Department of Energy, Office of Non-Proliferation and National Security, has been responsible for this instruction segment since the Academy's third training session. The instruction on "Nuclear Crime" covers five general topics: nuclear threats, illicit trafficking in nuclear materials, nuclear material scams, counter nuclear smuggling actions, and nuclear material hazards. The section on nuclear threats highlights the Threat Credibility Assessment Program developed by the DOE to assess nuclear threats against the United States and its interests. The section on illicit trafficking in nuclear materials presents information on significant cases of nuclear smuggling, trends in the illicit trafficking arena, and general characteristic of the typical nuclear smuggler. Nuclear material scams is a popular block of instruction due to the prevalence of nuclear material scams encountered by law enforcement. The block of instruction on countering nuclear smuggling presents a typical program or plan for an integrated governmental effort to combat illicit

trafficking in nuclear materials. A presentation on nuclear smuggling hazards rounds out the instruction.

The instruction on "Nuclear Crime" has generally been well received by the students. Interest in this block of instruction directly correlates to the students job in law enforcement. For those students who are responsible for violations of nuclear crime within their countries, interest is high, while that of the other students is typically professional curiosity. Student generally are most interested in the instruction on nuclear threats, nuclear material scams, and lessons learned from actual smuggling cases.

Countries that have sent students to the ILEA include: Albania, Bulgaria, the Czech Republic, Hungary, Kyrgyzstan, Lithuania, Moldova, Russia, Slovenia, Belarus, Croatia, Estonia, Kazakhstan, Latvia, Macedonia, Poland, Slovakia, and Ukraine. Consistent with the international flavor of the academy, instructors from Canada, Great Britain, Germany, Hungary, Italy, Ireland, Russia, and the United States have participated. Other countries contemplating involvement in this cooperative effort include Austria, Belgium, France, the Netherlands, Spain, Sweden, and Switzerland.

The DOD/FBI WMD Counterproliferation seminar focuses on the international counterproliferation regime, of which countering illicit trafficking in nuclear material is a part. This seminar is structured for senior level government officials from southern tier countries. Representatives from only one country participate for any given seminar. The DOD/FBI program consists of basically two parts. The first consists of a in-country assessment of the country's needs prior to the actual seminar. This gives the instructors an opportunity to tailor the instruction to the specific needs of the country participating. The second part consists of the seminar itself. An eight hour segment on "Nuclear Crime," similar to that at the ILEA, is presented. Included in this seminar are two tabletop exercises. One addresses crisis management during a WMD event and the other issues tied to a nuclear smuggling event.

Kazakhstan (June 97) and Uzbekistan (August 97) have participated in the two DOD/FBI WMD Counterproliferation seminars held to date. Representatives from Kyrgyzstan will be attending a seminar in late February 1998.

The Department of Energy, Office of Non-Proliferation and National Security, also participates in a number of other cooperative activities in the area of combating the illicit trafficking in nuclear materials. The DOE represents the US government in the INTERPOL Environmental Crime Working Group on "Illegal Activities Involving Real or Purported Radioactive Materials." The DOE has also provided ad hoc training and assistance in support of other Department of State, Customs, IAEA, and FBI programs and activities.

The above discussion highlights just two examples of the on-going international cooperative efforts to address illicit trafficking in nuclear materials. However, the ILEA and the DOD/FBI WMD Counterproliferation seminar are excellent examples of well thought out programs that emphasize the strengths and benefits of a cooperative effort to address an international problem.

QUESTIONS AND ANSWERS:

I. Vasiliev: Who finances this work?

S. Cantlin: For the ILEA activities it is the State Department, otherwise it is DOE.

S. Erickson: What is the source of information?

S. Cantlin: It is derived from LEA information which is given to us.

D. Crane: Please comment on the threat analysis that the National Laboratories give?

S. Cantlin: Liaison is with FBI and U.S. Customs Service, so if they went technical assessment, they request it and information from the National Laboratories is passed back through DOE to law enforcement.

J. Ford: To add more detail, I have participated in ILEA courses. They have had two table top exercises, one with the FBI and one with National Defense University on nuclear smuggling.

I. Vasiliev: Does your Academy study those cases about which Ewell spoke? Cases where governments engage in that manner of contraband, not individuals engaging. Simply furnishing a trivial profile of an individual smuggler is not useful to the education of the professional fighter of smuggling. Do you study methods of concealment under quasi-legal shipments? What would you suggest?

S. Cantlin: Yes, there is instruction on the types of cases mentioned yesterday by Ewell. From the standpoint of the mid-level law enforcement officials, the profile of a smuggler is important to counter those activities. At the senior level, issues of a governmental nature are addressed (for example, policy), such as at a DoD/FBI counter-proliferation seminar vs. an ILEA briefing. We don't go into specifics regarding routes, containers, etc. For Customs, this is part of Project Amber.

V. Brovkin: How does one get enrolled?

S. Cantlin: The instructors are picked by the FBI; the students are picked by their representative governments.

The Role of the Nuclear Smuggling International Technical Working Group in Developing Nuclear Forensic Capabilities

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A consensus has been emerging during the past several years that illicit trafficking of nuclear materials is a problem that needs a more focused international response. One possible component of a program to combat illicit trafficking is nuclear forensics whereby intercepted nuclear materials are analyzed to provide clues for answering attribution questions. Recognizing the potential importance of such a nuclear forensics capability, the P-8 countries have encouraged technical experts to evaluate the role of nuclear forensics in combating nuclear smuggling and possibly developing mechanisms for international cooperation. Upon the recommendation of a P-8 experts group, an International Conference on Nuclear Smuggling Forensic Analysis was held in November, 1995, at Lawrence Livermore National Laboratory to investigate technical cooperation on nuclear forensics.

Participants at the International Conference included scientists, law enforcement and intelligence experts from 14 countries and organizations. This particular mix of technical experts provided a unique forum for this type of discussion. All participants were invited to make presentations, and the format of the Conference was designed to encourage open discussion and broad participation. The agenda for the first two days of the Conference were designed to set the stage for the third day which focused on possible mechanisms for future cooperation.

The initial talks set the context by describing the overall nuclear smuggling problem and describing the framework for conducting nuclear forensic investigations. Nuclear forensics is the process by which intercepted materials are analyzed to provide clues for answering attribution questions, e.g. where the material came from, where legitimate control was lost, and who was involved. The forensic process begins with the detection of the incident and an on-site evaluation; it concludes by identifying attribution indicators in the interdicted nuclear material and its associated surrounding environment. Then an attribution assessment is formed by integrating all the relevant technical and other sources of information about the incident into a consistent and meaningful interpretation. Upon establishing this general framework, presentations were then made that described real-world experience in analyzing seized nuclear materials. Law enforcement officials then described the on-site crime scene issues that are encountered during investigations. They emphasized the importance of receiving input from technical experts, especially in developing protocols for first responders that address environmental, safety and public health concerns, as well as approaches to collecting evidence. Seven talks were given on techniques and methods for characterizing bulk samples of nuclear materials as well as associated non-nuclear signatures. These talks provided the basis for the participants to evaluate the feasibility for making forensic interpretations of technical analyses. The important of data sets was discussed at some length, including the limitations on developing and using such data sets in the international arena. Conducting international round robins was identified as a possible important means of addressing the feasibility question. It was also stressed that nuclear forensics is more complex than a straightforward characterization. Characterization alone establishes the nature of the material, but attribution identifies forensic

indicators that point to relationship between material characteristics and illicit activity. The forensic approach is also cost effective. The experimental design should be adapted to each specific incident rather than executing a predescribed comprehensive analytical procedure.

The Conference culminated with plans for a Nuclear Smuggling International Technical Working Group (ITWG). The Conference identified nuclear forensics as a new need, and the goal for the ITWG would be to continue the progress made at the Conference. The primary purpose of the ITWG would be at provide for technical cooperation and collaboration on the development of nuclear forensics and thus help to combat nuclear smuggling. The first ITWG meeting was planned to be held at Karlsruhe in early 1996. The initial focus would be to produce a report for P-8 countries that summarized the current status of nuclear forensics.

The first ITWG meeting was hosted by the European Commission's Institute for Transuranium Elements in Karlsruhe. This meeting helped establish the future course for the work of the ITWG. Prior to the meeting, drafts of status reports and a terms of reference were provided to all participants. The terms of reference was approved, and the draft status reports on identifying and prioritizing techniques and methods for forensic analysis were discussed, revised, and then approved. Future plans for ITWG activities were also laid out, with special emphasis on an international exercise. Participants at this meeting reaffirmed that the most effective means of international cooperation on developing nuclear forensics is informal communications and cooperation among cognizant experts. A key is personal interactions and experience with one another and political endorsement of these interactions. It was also again noted that nuclear forensics serves different constituencies: Law enforcement, nonproliferation, and public health/safety/environment. The primary goal of the ITWG is to advance the international capability for nuclear forensics to meet the needs of all these constituencies.

Subsequent to the ITWG meeting, the Status Report was published and distributed in March, 1996. This 26 page report is entitled "Status of International Cooperation on Nuclear Smuggling Forensic Analysis;" its subtitle, "A report on recent international progress for enhancing nuclear forensic capabilities for cases of illicit nuclear materials" accurately summarizes its contents. It still represents the most comprehensive statement of the approach and methods for conducting nuclear forensic investigations. In the following month, April, 1996, the Moscow P-8 Summit on Nuclear Security agreed on the need for international cooperation on a program to combat illicit trafficking of nuclear materials, and it specifically identified nuclear forensics as one of the elements of the program.

The second meeting of the ITWG was held in Obninsk, Russia on December 2-4, 1996. The meeting was hosed by Minatom of Russian, with support from DOE and LLNL, IPPE in Obninsk, and ITE in Karlsruhe. Participation was excellent with 57 attendees from 15 countries and 2 international organizations. The meeting agenda was designed to take the opportunity to have many Russian experts participate and give presentations. The Russian talks on policy and technical steps for addressing nuclear smuggling included the following: Minatom on MPC&A and additional security framework, VNIITF and VNIIEF on analytical capabilities for specific R&D proposals, VNIINM on the development of a forensics laboratory and a new forensic database, IPPE on their capabilities for nuclear forensics, the Khlopin Institute on detection methods, and a number of talks on policy and law enforcement roles (Customs, Internal Affairs, Procurator General). In addition to these talks, updates were given on U.S. and European Commission activities since the previous ITWG meeting. The FBI and London Metropolitan Police also made

presentations on their law enforcement protocols for forensics at crime scenes. A panel discussion was used to update the group on the status of the interlaboratory exercise, and to further define the plans for this effort. Packaging and shipping of the nuclear materials was again emphasized as a key issue that was slowing progress in starting the exercise. The need to develop a more comprehensive terms of reference was also identified, and the ITWG agreed to discuss at the next meeting the possibility of expanding to other technical areas relevant to illicit nuclear trafficking.

The proposed new draft of the terms of reference sparked a spirited debate at the third ITWG meeting which was held in Como, Italy, in June, 1997 (the meeting was fully hosted by the Landau Network-Centro Volta and Unione Scienziati per il Disarmo). The comments were then incorporated into a new version that was produced after the meeting. These newly adopted terms of reference more fully describes the ITWG's purpose, the need to avoid duplication, its general activities, and a "reporting relationship" to the P-8. The general activities of the ITWG include evaluating present capabilities for combating nuclear smuggling, identifying technical needs, recommending to participating countries steps for future improvements, and recommending new cooperative measures. A major objective for the ITWG is to make recommendations and conduct studies that may lead to new agreements between governments and organizations. An overall goal is to provide for a more effective and uniform approach to combating nuclear smuggling. The terms of reference also specify the rights and responsibilities of the ITWG participants. For example, participants should receive the support of their national government or organization to attend the ITWG meetings. The work of the ITWG is expressly for the benefit and use of the participating governments and organization, and accordingly, participants are responsible to ensure that ITWG discussions are not shared with the general public. Finally, the terms of reference outlines the organization of the ITWG regarding the expertise of the participants, the nature of the meetings, and the organization and communications regarding the meetings themselves.

From the very beginning of the ITWG, it has been explicitly stated that although the initial focus of this group was nuclear forensics, it should remain open in the future to expanding its work into other associated elements of a nuclear smuggling program. Two key criteria should be met before doing so: The new ITWG work avoids duplicating pre-existing cooperative technical efforts, and it is supported by the P-8. One of the agenda items for the Como meeting was to discuss possibly expanding the work of the ITWG to include radiation detection at borders and checkpoints. Several talks were given on radiation detection systems and its role in combating nuclear smuggling. The group concluded at the end of the meeting that the ITWG focus should continue to be on nuclear forensics in order to better ensure good progress, and that expansion into border detection systems was premature.

The terms of reference includes a specific delineation of the technical elements of nuclear forensics. The following comprises the section on "Technical Elements for Nuclear Forensics:"

The primary goal for nuclear forensics is to develop a preferred approach to nuclear forensic investigations that is widely understood and accepted as credible. The preferred approach should continue to evolve and improve based on further experience and developments. The description of the preferred approach should include a listing of technologies along with a specified approach to interpretation of the data. Success in meeting this goal would provide the basis for the international community speaking with one voice regarding the technical evaluation of illicit trafficking cases.

The technical elements for the ITWG's work on nuclear forensics include:

- Development of protocols for collection and preservation of evidence that meets the requirements of specialized laboratory measurements; in addition, also develop protocols for laboratory investigation
- Evaluations and recommendations regarding technical equipment for initial hazard evaluation and on-site assessment of nuclear material composition
- Prioritize techniques and methods for forensic analyses of nuclear and non-nuclear materials associated with illicit nuclear materials trafficking in order to answer questions regarding source attribution, route attribution, and intended use of the nuclear materials.
- Development of forensic databanks to assist in the interpretation of analytical results
- Formulate and execute interlaboratory exercises to evaluate and improve the effectiveness of forensic techniques and methods
- Facilitate technical assistance to countries (including non-P-8 countries) in response to specific requests; requests for assistance may also be accomplished using other bi-lateral or multi-lateral agreements

The relationship between the P-8 and the ITWG was further delineated at a meeting of the Non-Proliferation Experts Group (NPEG) on November 17, 1997, in Vienna. This meeting was held to kick off a new development for the NPEG in which the original

P-8 countries are expanding to include new adherents. The initial part of the meeting included a discussion of past and current NPEG activities. The ITWG represents part of the NPEG's past activities, and so a summary of the development of the ITWG was given for these new adherents. This NPEG meeting was very successful in terms of attracting a high degree of participation and setting the stage for enhanced international cooperation. With regards to the ITWG, the meeting provided a firmer linkage between the ITWG and the NPEG. It also provided a forum for encouraging broader participation in the ITWG, and several suggestions by the NPEG for future ITWG tasks will significantly broaden its technical agenda. These developments will require further organizational adjustments by the ITWG in order to make significant progress. The groundwork for doing so was already established at the last ITWG meeting in which the idea of forming task groups to address specific issues was identified as a new approach to conducting much of the work by the ITWG.

In summary, since its inception two years ago, the ITWG has made significant strides in developing an international group that is collaborating on developing nuclear forensics. It is the only multi-national group that is defining and developing the technical elements of nuclear forensics, and its work in doing so was explicitly endorsed at the P-8 Denver Summit in June, 1997. This P-8 support provides the foundation for the ITWG, and continued future support by the P-8 countries is vital to the continued work of the ITWG.

QUESTIONS AND ANSWERS:

R. Lee: By source of material do you mean where it was produced?

S. Niemeyer: Yes. Various elements and isotopes are signatures.

J. Immele: The protocol is expanding to 22 countries. Are they all going to participate in nuclear forensics?

S. Niemeyer: Some already are in ITWG. Details are not yet established. June 1998 is the planned date for the NPEG meeting.

J. Ford: Before this can be useful, you need to pull together a data base.

S. Niemeyer: Bochvar and the European Union are working on a data base on the civilian side. There is nothing on weapons material.

E. Nadler: With respect to seized material, was it ever analyzed outside of the country where it was seized?

S. Niemeyer: Not to my knowledge. ITWG does connections, not actual working on given cases. That would be more of a bilateral nature.

L. Koch: Let me add, some of the Prague material was analyzed by us. The Munich material was analyzed by us and by Bochvar.

Combatting Fissile Materials Smuggling Workshop #5
3–4 February 1998

International Co-operation in Nuclear Forensics

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ABSTRACT

The Institute for Transuranium Elements has been asked to assist in the analysis of seized nuclear materials and in upgrading the technical capabilities of middle and eastern European states. In the framework of the Nuclear Smuggling International Technical Working Group the Institute contributed in identifying relevant techniques, their implementation and in the demonstration of their capabilities.

INTRODUCTION

Since 1992 the Institute of Transuranium Elements was requested by the European Commission Safeguards Directorate and German authorities to characterise more than 20 different seized nuclear materials to such an extend that their origin and intended use could be traced. In the previous 20 years there were only a few cases where we had to analyse nuclear material of unknown origin. Now - in the new situation we had to

- develop a methodological approach
- come up with more specific nuclear forensic analytical methods
- establish - in co-operation with international partners - a databank from archive information
- support - in the framework of TACIS/PHARE - middle and east European states in their endeavour to set up own nuclear forensic capabilities
- participate - last but not least - in the Nuclear Smuggling International Technical Working Group.

EXPERIENCE IN NUCLEAR FORENSICS

Despite stringent physical protection measures nuclear material has been diverted from plants, laboratories or during transport. So far, border control by customs failed to prevent smuggling. If nuclear material was seized by law enforcement, it was found by chance or when offered to undercover agents. For such cases we got only hints where the material might have originated, which had to be substantiated by in depth investigation at the Institute.

The seized materials ranged from easily identifiable nuclear fuel pellets to oxide or metal powders of varying U-235 enrichment and Pu content (see table 1). In order to verify the identity of nuclear materials we have developed several analytical techniques in the past. They formed the basis of the nuclear forensic methodology that was applied in the above mentioned instance [1]. The investigations followed the principle of diagnosis, by which the progress of the examination is

guided by the results of the proceeding analyses. For the interpretation of analytical results one needs access to archive information in order to compare the results with material or nuclear properties of former known productions except for self explaining results such as age, enrichment, neutron hardness, etc. The approach is illustrated below for one case. Other examples have been described earlier [2].

In 1994 we received a sample of UO_2 granulate with an U-235 enrichment of 87,8 w/o. From our expertise of material properties and impurities we concluded: "To our knowledge a fuel of such material is being developed for fast breeders e. g. BOR-60, were UO_2 granulates of different mesh-size vibrated into pins. The fuel is still in development and for the time being tested in other fast reactors in Russia- then however, with a different enrichment". A few months later about 2 kg of the same material was seized in Prague. Comparison of the analyses confirmed the identity. In 1997 two pieces from a fuel assembly (the middle and upper part) were found in a metal scrap deposit, which contained UO_2 particles of the same type as was confirmed by SIMS analysis. The assembly was of the BN-600 type and the U-235 enrichment of up to 90% appropriate for an irradiation test in BR-10 at Obninsk.

This example illustrates the variety of analytical techniques needed to determine the intended use and the process used to fabricate the fuel: TIMS, EMS, GDMS, SIMS, but also the importance of a database to reveal interdependencies between cases, not mentioning the traces on the material surfaces pointing to the type of installation where the material was treated.

INTERNATIONAL CO-OPERATION

Investigations on nuclear material illicit trafficking across borders demands international co-operation. Most of the material analysed by the Institute had been produced in the former Soviet Union but was not necessarily diverted inside Russia. From the beginning we therefore had a close co-operation with Russian authorities, which resulted into two main ongoing projects:

- setting up of a databank and
- upgrading of the forensic laboratories at the Bochvar Institute.

Both activities are financed under the TACIS programme.

The common databank of the Bochvar and the Transuranium Institute [3] is further expanding. Since the type of archive data available differ according to the specification used at that time, we will organise a workshop to recall the underlying corresponding analytical techniques. For a current case one has to determine such parameters of a nuclear material that are filed in a database and hence one has to use the appropriate analytical techniques. For this reason the two laboratories in Moscow and Karlsruhe have to be upgraded.

The scope of nuclear forensic is much wider than discussed above. In the **Nuclear Smuggling Technical Working Group** several deficiencies were quickly recognised which however are common for classical forensics [4, 5, 6].

- analytical techniques for smuggling route forensics and geolocation
- protocols for seizure to preserve evidence.

To bring the quality of nuclear forensics to a comparable status in different states

- applied analytical techniques for nuclear material characterisation had to be inventorised [7, 8]
- in a round robin test the capabilities of nuclear forensics have to be demonstrated
- instrumentation for the detection of nuclear material has to be identified and evaluated [9]
- a model of an action plan for nuclear forensics has to be developed, which integrates different law enforcement services considering - of course - the legal situation of a particular state.

There are agreed ongoing actions:

During a meeting of P-8 "Welcoming new adherents to the programme on combating illicit trafficking" on the premises of the IAEA (November 17-18, 1997) it was agreed to expand the ITWG and take up as a new task to inventorise the equipment that is used for this purpose.

For the round robin test on Pu-material 6 laboratories will participate. The material will be shipped soon.

In its FONSAFE programme the Institute for Transuranium Elements is setting up support programmes to upgrade the technical capabilities in identifying unknown nuclear material in Bulgaria, Czech Republic, Hungary and Ukraine. Other countries have expressed their interest and will be included. The projects foresee upgrading of equipment, training, joint exercises within the country and between the state laboratory and the Transuranium Institute. The use of the Transuranium Institute laboratories and the database for joint analyses of seized material is provided.

References

[1] *L. Koch,* Fingerprints of Nuclear Materials and how they can Reveal Orogin and Intended Use, Proceedings to the VIII. Amaldi Conference "Overcoming the Obstacles to Peace in the Post-Cold War Era" Piacenza (Italy), October 5-7, 1995

[2] *L. Koch,* Identification of Nuclear Material of Unknown Origin EUR 16290 - Proceedings 17th Annual Symp. pp. 195-198, 1995

[3] *Yu. Dolgov, Yu Bibilashvili, N. Chorokhov, L. Koch, R. Schenkel, A. Schubert,* Case Studies with a Relational Database System For Identification of Nuclear Material of Unknown Origin, Proceedings to the NMPC&A International Conference, Obninsk, (Russia), March 9-14, 1997

[4] *L. Koch,* Status Report to Identify and Prioritise Techniques and Methods for Forensic Analysis regarding source attribution and intended use of nuclear material, 1. ITWG meeting, Karlsruhe (Germany), January 31 - February 1, 1996

[5] *L. Koch,* Action levels of forensic analysis, 2. ITWG meeting, Obninsk (Russia), December 2, 1996

[6] *L. Koch,* Identifying the origin and intended use of seized samples of illicit trafficking of Nuclear Material, 3. ITWG meeting, Como (Italy), June 10-11, 1997

[7] *L. Koch, S. Niemeyer,* Status of International Co-operation on Nuclear Smuggling Forensic Analysis, Report prepared for P-8 meeting, Moscow (Russia), 1996

[8] *L. Koch, M. Betti, J. Dolgov, K. Mayer, I. Ray, A. Schubert, A. D. Stalios, M. Wallenius,* Nuclear Forensics in Nuclear Material Safeguards, Paper presented at the 19th Annual Symposium on Safeguards and Nuclear Material Management, Montpellier (France), 13-15 May 1997

[9] *Sara C. Scott,* LANL In-field nuclear forensic: Overview of Applicable Instrumentation, paper presented to 3 ITWG meeting, Como (Italy), 1997

Table 1. Types of seized nuclear materials

Physical Form	Fissile Material	Quantity (g)	Intended use
UO_2 pellets	~2% U-235	40	RBMK fuel
UO_2 pellets	~2,4% U-235	900	RBMK fuel
UO_2 pellets	~2,5% U-235	1100	RBMK fuel (recycled)
U metal rod	U-nat	4300	fuel for Pu-production
UO_2 pellets	U-nat	330	CANDU fuel
Powder	U-nat	2000	Yellow cake
Powder	U-nat	5000	U_3O_8
UO_2 pellets	~3,6% U-235	20	VVER 440 fuel
UO_2 pellets	~4,4% U-235	900	VVER 1000 fuel
Ceramic Pins	88,9% Pu-239	0,2	Ionisation sources
UO_2 granulate	87,8% U-235	0,8 (2000)	FBR-test fuel
Pu/Ga metal powder	99,75% Pu-239	6	weapon
PuO_2/UO_2 powder	87% Pu-239	560	MOX-test

QUESTIONS AND ANSWERS:

A. Weber: Where did the LEU fuel pellet come from?

L. Koch: That has not yet been concluded.

E. Nadler: Did they actually bring a fuel assembly that was cut?

L. Koch: Yes, the fuel was out. Material which was still attached matched that of the Prague case.

E. Nadler: Where did you get the assembly?

L. Koch: Scrap.

LLNL Forensics Science Center

"Domestic Nuclear Smuggling Exercise"

Brian Andresen
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ABSTRACT

During the summer of 1996 a mock nuclear smuggling exercise was carried out. The objective of the interlaboratory "Domestic Nuclear Smuggling Exercise" was to demonstrate analysis capabilities and to identify future research and development requirements for both infield and laboratory-based techniques. Emphasis was placed on timely coordination of various laboratories to characterize a mock nuclear contraband sample prepared by the Lawrence Livermore National Laboratory's (LLNL) Forensic Science Center. Several laboratories obtained samples from the mock intercepted contraband container including small metal chips, granular and powdered materials, paper, plastic, and fibers. Both infield and laboratory-based analysis techniques were used to characterize these samples within the two week time period allowed for the exercise. During the course of the exercise, reports were provided to Forensics Science Center of findings obtained over selected time periods. The final objective of the exercise was also to determine the types of analysis techniques available, the capabilities provided by U.S. laboratories for the characterization of unknown materials, and conclusions that can be provided during a set time period.

INTRODUCTION

In response to the potential threat from the criminal trafficking of nuclear materials into and out of the United States, the Department of Energy has identified three programmatic goals associated with countering illicit nuclear material transactions: (1) prevention, (2) reaction (evaluation and interdiction), and (3) neutralization. Activities in all three areas are on-going to promote these goals. These activities support a number of decision-maker communities, including policy, law enforcement, and national security offices.

Prevention activities primarily provide the policy community with measures to address the issues encompassing inadequate weapons oversight and poor material control. Reaction activities support agencies that respond to instances of illegal trafficking in nuclear materials; these activities include in-field assessments, forensic analysis, and related activities to protect first responders and the public. Neutralization activities address root causes in cases where nuclear proliferation is likely and national security may be threatened.

The ability to perform an "attribution and route assessment" for a specific nuclear smuggling incident also addresses DOE's goals in the prevention, reaction, and neutralization areas by providing vital information needed to assess the degree of threat surrounding a particular incident and to choose an appropriate response. Attribution assessment is the process by which questions of attribution are answered as completely as possible for a given incident in a timely manner. Attribution questions include:

- What is the source of the illicit material?
- At what point was legitimate control of the material lost?
- Can the route characteristics identify the participants?

While attribution questions are very difficult to answer, even partial answers can enhance U.S. response to a serious smuggling incident, since it is crucial to determine whether a particular incident constitutes a threat to national security. Answers to these questions require more than a simple characterization of material from a nuclear smuggling incident. Characterization establishes only the composition of the material. Attribution and route determinations utilize forensic indicators in the nuclear material or in its associated package which point to material uses and locations where illicit activity may be occurring.

BACKGROUND TO THE DOMESTIC NUCLEAR SMUGGLING EXERCISE

The "Domestic Nuclear Smuggling Exercise" was initiated and carried out to address three DOE programmatic goals: (1) to evaluate interdicted nuclear materials and contraband in order to assess the magnitude of the associated incident from both a public health and international incident perspective, (2) to exercise DOE's capabilities to perform ultratrace and detailed analyses that provide unique data and forensic clues, and (3) to interpret the data to determine the origin and route that the nuclear materials in the incident may have taken prior to its interdiction.

It is impossible in one exercise to address the full breadth of potential nuclear materials smuggling scenarios and challenges associated with the programmatic goals above. Therefore, this first "Domestic Exercise" was performed with the more moderate goal of exercising and assessing the existing U.S. capabilities needed to perform a forensic analysis of an unknown sample. This exercise utilized a mock-smuggled package containing nuclear material and other materials. The mock contraband package was assembled in the plutonium facility at LLNL. Only the sample preparation group, which consisted of six individuals and the exercise coordinator (BDA), knew what the package contained; these individuals did not take part in the subsequent technical characterization or interpretation. All others scientists participated in the exercise as a "blind test".

The Domestic Nuclear Smuggling Exercise included both nuclear and non-nuclear forensic analyses in order to establish and demonstrate: (1) lines of communication between different laboratories throughout the U.S., (2) the process for sample handling and splitting SNM, (3) the optimum forensic methods to be applied for the simultaneous characterization of nuclear materials and non-nuclear materials, and (4) the rapidity with which technical results could be interpreted to address attribution questions and other questions related to national security and the public safety of first responders.

This exercise provided a test bed for determining which analytical techniques are most useful for a rapid response when important questions are asked concerning confiscated contraband materials. The results of the analyses performed at different laboratories were compared for consistency, providing an example of the range of results that could be expected in a real incident. The exercise was also intended to provide an example of the process required for rapid analysis and interpretation of data, the diversity of interpreted technical information that can be reported as a function of time, and the procedures needed for reporting these findings in a timely manner to

authorities.

A key aspect of this exercise was the participation of 9 DOE laboratories and the U.S. FBI. For the purpose of the exercise and technology evaluation, the Forensic Science Center served as a liaison between the participating organizations. The LLNL Isotope Sciences Division also served as the receiving laboratory to take initial control of the contraband sample and subdivide the components in the package for shipment to all the other participating laboratories, where further forensic investigations were performed. This division of activities among the participating organizations simulated the response of a viable network of U.S. laboratories that could quickly perform diagnostic forensic analyses, report the data to a Consensus Team, and rapidly derive one consistent interpretation of the information and confidently report this to the appropriate authorities. All activities in this exercise were to be in concert with the needs, guidelines, and objectives of the FBI and its nuclear smuggling analysis team.

PARTICIPATING ORGANIZATIONS

A consortium of participating laboratories was assembled for this exercise. The team members included participants from Argonne National Laboratory, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratories, Savannah River Technical Center, McCrone Associates, Valecitos Nuclear Center (General Electric), and the National Institute of Standards and Technology.

The cumulative capabilities and expertise among these organizations, relevant to this exercise, included extensive knowledge of nuclear materials production and the design of nuclear weapons, expertise in the handling and detailed characterization of special nuclear material (SNM), forensics, and advanced analytical techniques that include the detection of forensic signatures in bulk materials and particulates. Specific areas of expertise include trace, bulk, and environmental analyses, knowledge of radiochemical and environmental signatures, and forensic science. In addition, some of the DOE laboratories have operating facilities for the proper receiving, handling, and analysis of large quantities of nuclear materials. Furthermore, from other programmatic activities, these organizations have established connections with relevant government authorities including law enforcement, Customs, and the State Department.

THE NUCLEAR SMUGGLING SCENARIO - BACKGROUND

A fictional scenario was hypothesized in which nuclear material was interdicted by U.S. authorities. An actual sample and container, consistent with the scenario, were constructed (by the sample preparation team at the Forensic Science Center) to serve as the interdicted package (Figures 1 and 2). In the exercise it was presumed that immediate personnel safety issues, such as the absence of explosives, had already been satisfied prior to the receipt of the package at LLNL's Isotope Sciences Division laboratories, where the package was transported for initial forensic screening and sample split. In addition, the preparation and analysis of the mock smuggling package in this exercise took into account the following issues:

- The mock sample did not contain plutonium. However, the contraband package did contain pieces of highly enriched uranium (HEU) metal.

- Before the package was opened, it was initially characterized for potential health hazards. SNL (Albuquerque) and LLNL performed initial spectral screens and radiographic scans on interdiction day.
- Foreign soil, newspaper, tape, plastic vial, plastic bags, and a metal pipe were included with the HEU to more closely mimic the variety of materials that could be associated with a smuggled sample.
- Following the initial screening and opening of the package, samples were handled in a manner that protected valuable forensic indicators. These indicators range from low level environmental clues (trace elements on the HEU surface, fibers, biologicals, etc.) to major and minor isotopic components and metals in the bulk HEU alloy.
- A sample handling protocol was developed at LLNL's Isotope Sciences Division for the nuclear and non-nuclear components associated with the mock sample. Special care was employed from the earliest point (all sampling performed in double lined glove boxes) to preserve all valuable forensic information as nine representative samples were prepared and packaged for shipment.

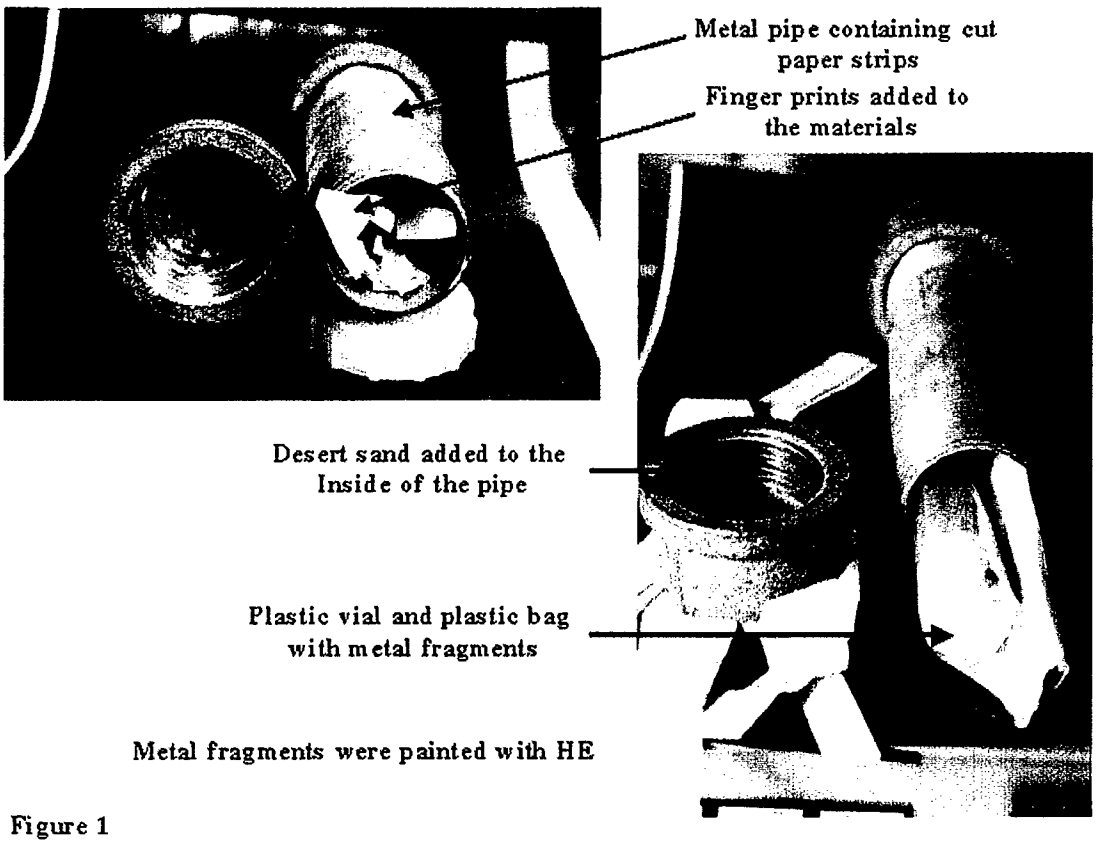

Figure 1

INTERDICTION DAY

At LLNL on "interdiction day" the technical participants helped a law enforcement representative screen the contraband materials and collect appropriate samples for forensic analysis. The nuclear material was then split and sent to the participating network of laboratories for analysis. Federal Express overnight delivery was utilized. LLNL was able to send highly enriched uranium (HEU) samples by this means. Samples were tracked to each laboratory, where the delivery and time of receipt were recorded and logged. The technical participants subsequently performed their own screening activities and other timed analyses "blind" (without knowing the nature of the sample in advance). Participants at each laboratory also had to address their own issues of shipping, communication, and chain-of-custody. The overall experience led to some new sample handling protocols as well as an enhanced understanding of the challenges of the overall sample handling process.

DATA INTERPRETATION

Results of each laboratory's analyses were to be communicated back to the exercise coordinator at the Forensic Science Center at 12 hrs, 24 hrs, 48 hrs, 96 hrs, and one week. A final report was due exactly two weeks from the date the samples were received. The exercise concluded October 1996 with a "consensus meeting", at which one or more technical representatives from each participating analysis laboratory contributed to the final conclusions concerning the identification of the unknown contraband sample. Lessons learned, future needs, and conclusions to the exercise were also discussed at the consensus meeting.

CONCLUSION

In conclusion, this exercise clearly revealed that if illicit nuclear materials were to be interdicted within U.S. borders, the U.S. laboratories participating in this exercise would constitute an effective network for the timely, expert analysis of the materials and interpretation of the results. Since other programs utilize the facilities and competencies comprising the network, it is important to continue to exercise the network. Future exercises should be designed to be increasingly realistic and challenging. An international exercise utilizing U.S. and other well-established laboratories should also be set up in the near future. By regularly exercising the system, readiness will be maintained.

QUESTIONS AND ANSWERS:

G. Lyle: Who decided what type of diagnostics, from passive to active, were used?

B. Andresen: Each Laboratory had its own procedures.

A. Weber: Ever seen any red mercury, or osmium?

B. Andresen: No.

L. Koch: Did you x-ray to show that it wasn't booby-trapped.

B. Andresen: Yes. Also we first sniffed for high explosive and chemical weapons.

Preventive Steps

Major Vincent J. Jodoin
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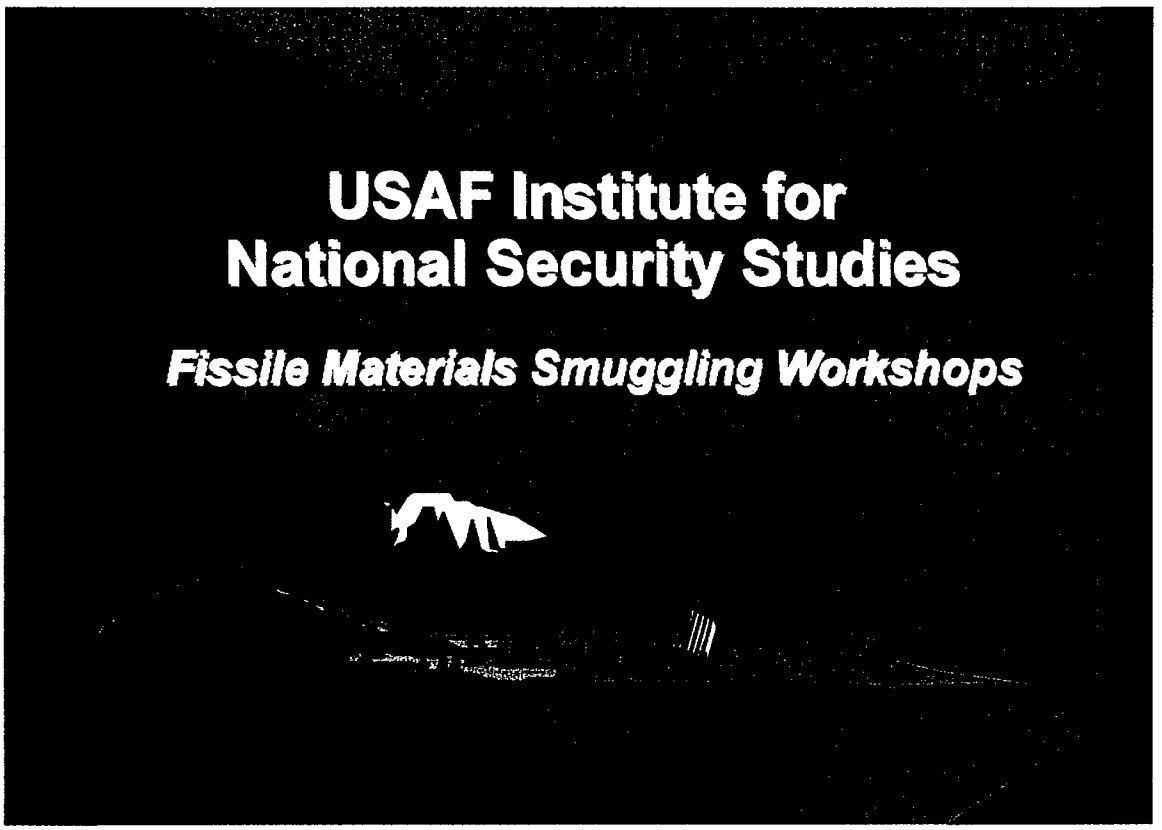


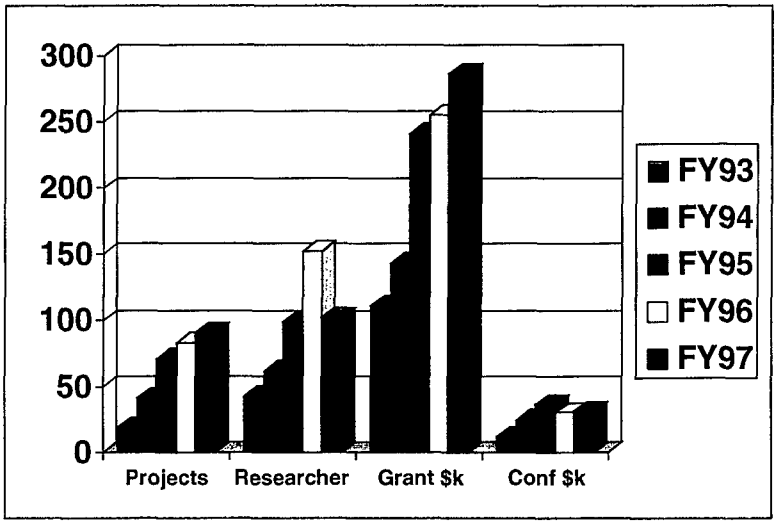
Mission of the Institute

To promote national security research for the Department of Defense within the military academic community, and to support the Air Force national security education program.

Background

- **Started in 1992**
- **Initially a research arm for AF/XONP**
- **1st 5 yrs: 310 projects, 458 researchers, $1,102,000**
- **Researchers located worldwide at over 30 schools:**
  - **§ Service Academies: USAFA, USNA, USMA**
  - **§ ISS: ACSC, ACGSC, NPS, AFIT**
  - **§ SSS: National, Air, Army, and Navy War Colleges**
  - **§ 20+ civilian universities: National Defense Fellows**

INSS Growth Chart



Sponsoring Agencies

- HQ USAF/XONP
  - Policy Division, Nuclear and Counterproliferation Directorate
- HQ USAF/XOI
- Defense Special Weapons Agency
- Army Environmental Policy Institute
- OSD Net Assessment
- On-Site Inspection Agency

INSS Research Topics

- International Security Policy
- Arms Control/Counterproliferation
- Air Force Planning Issues
- Regional Security Policy
- Revolution in Military Affairs
- Information Warfare
- Environmental Security
- Space Policy

Fissile Materials Smuggling Workshop Series

- 5 June 1995: INSS, USAF Academy, CO
- 5 December 1995: CCP, National Defense University, Washington, DC
- 25-26 June 1996: SSI, Army War College, Carlisle, PA
- 9 July 1997: Ridgway Center, University of Pittsburgh, PA
- 3-4 February 1998: Lawrence Livermore National Lab, CA

Vision

Be the Air Force institute of choice for promoting, coordinating, and disseminating vital national security research that influences DOD policy development

QUESTIONS AND ANSWERS:

Opening remarks mentioned that although the panel is titled "Preventive Steps" the papers cover both prevention and response.

George Anzelon started the panel with his talk on "Countering Illicit Trafficking in Export Controlled Commodities." He pointed out that there is a range of ways for getting around controls. He posed the question, "Should we care about non-weapon usable material?" He answered his own question by arguing that we should be concerned, but to a lesser extent. He noted the difference between trafficking in components versus materials. He noted that those trafficking in materials can be more organized, are faced with less moral barriers and lesser penalties. With this he challenged the group as to whether we should include this topic in further workshops.

Questions asked of George Anzelon included, "What about dual-use technology?" Custom's Amber program was mentioned as well as current nonproliferation policy objectives. Also asked was, "Are allies trading with rogue states?" The increase in international norms was pointed out.

Neil Shannon followed with a review of efforts taken by U.S. Customs against the smuggling of fissile material. He pointed out that Customs' role goes as far as detecting radioactive material and that nuclear experts are called in when unexplained radiation is found. He gave a quick overview of project Amber. He discussed Customs' role in anti-terrorism as well as their role in checking exports. He stated that Customs agents are the "last line of defense" when stopping the

isotope identification equipment supplement this individual-issue item. He said that Customs has worked with DOD especially in the realm of funding.

Questions asked of Neil Shannon included, "Is foreign training the same?" It was stated that there were similarities and that ideas were being exchanged between countries. Also asked was, "Are all entry points watched and how sensitive were the detectors?" The answer was there is national coverage and the sensitivity was around 7-8 microroentgen per hour. A question was asked about the difference between DOD's programs and Amber to which the answer was basically that they applied to different years and different countries that participated. He was asked, "How many specialists use the equipment?", to which he answered 17,000 in Customs, 6,000 using equipment plus special agents. A statement/comment was made that the detectors used are gamma only detectors and that with shielding the fissile material would not be detected since neutrons would not be detected. The response was that the detector was chosen because of its simplicity and that it is supplemented with more sophisticated isotope identifiers. The final question asked was, "Are the portal monitors gamma only detectors and are they at every site?" The answer was they were gamma only and they are not at every border crossing. It was added that neutron detectors are hard to make small and inexpensive since small is less sensitive.

Maurice Eisenstein presented a paper on the preparedness of the U.S. to respond to a WMD terrorist act. He stated that it is an order of magnitude harder problem and is therefore ignored. He warned of the trend towards terrorist attack without warning. These weapons cause more casualties than terrorist weapons of the past. He also mentioned the threat from conventional bombs laced with radioactive material. He pointed out that civil defense has disappeared and that we are not organized at the local level. The question of the role of the National Guard was raised.

A question asked of Maurice Eisenstein was about a Spring scenario in Warsaw with the Army to test the city's response. It was also pointed out that the new threat is problematic since there is no warning that its WMD.

Tom Jourdan reviewed the FBI's role in the orchestration of the U.S. law enforcement response to a nuclear event. He identified the different organization roles and their contributions to the response efforts. He reviewed some likely targets. He explained the problems associated with defining WMD in the legal context.

Questions asked of Tom Jourdan included, "Why don't the target lists mention subways or large city buildings like the targets of the Aum Shinrikyo or World Trade Center attacks?" He stated that the lists were not meant as being all inclusive. There was another question concerning the definition of WMD based on destructiveness as opposed to the type of material used.

William Emerton gave the final presentation of the panel on forensic scene management in response to a WMD event. He was able to point out the procedures used in the United Kingdom. He stressed the importance of police control after the event. He, too, distinguished between nuclear, biological, and chemical events and weapons of mass destruction events. His major points stressed the compromise between the efficient gathering of evidence while mitigating the effects of the event.

Illicit Trafficking of Export-Controlled Nuclear Commodities

George Anzelon
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Livermore, CA

My remarks today will be taking us a little bit away from the main focus of this workshop. So far, we chiefly have been discussing the risk that theft of direct-use nuclear materials might put a nuclear-explosives capability in the hands of dangerous actors with little or no warning. But in this talk, I'd like to examine a different, complementary threat that also could erode existing barriers against proliferation, albeit on a somewhat longer time scale. I'm speaking of the potential for newly widespread illicit transfers of *indirect-use* commodities, like maraging steel, gas-centrifuge power supplies, heavy water, or high-purity calcium, which could contribute to the success of proliferating states' indigenous efforts to produce fissile materials and nuclear weapons.

Non-SNM Illicit Transfers in Perspective

Such "non-SNM" transfers certainly cannot confer nuclear weapons capability as quickly or with as little warning as clandestine acquisition of direct-use nuclear material. Nevertheless, we should bear in mind that proliferating states known to date have based their nuclear weapon programs on *indigenous* production fissile material. In the face of an evolving system of multilateral nuclear export controls, recent proliferating states have generally have needed on the order of a decade to acquire a weapons-scale production capability to enrich uranium or to produce and separate plutonium. Export controls have made nuclear proliferation more time-consuming and visible than it otherwise would have been, in some cases even buying time for the course of proliferating states to be reversed through diplomacy, coercion, or internal political developments. But with the collapse of the Soviet Union, the same factors that made fissile material smuggling a plausible threat (hard times at scientific institutes, porous borders, etc.) also threatened to open the gates for proliferators to more easily acquire the materials, equipment, and technology they need for indigenous production of weapon materials.

No one transfer of nuclear-related equipment or nonnuclear material could carry the impact of a single transfer of a weapons-meaningful quantity of plutonium or HEU. Nevertheless, the integrated effect of such transfers could be great. If wholesale gaps were to develop in the effectiveness of export controls, the time-scale for building an indigenous nuclear weapon program might be shortened from the usual figure of 10-15 years to a much smaller figure—say, 3 to 5 years—and the implications would be alarming.

Challenges

Several challenges confront post-Soviet controls on transfers of proliferation-sensitive nuclear and dual-use goods:

- Nuclear and industrial infrastructure under severe economic pressures
- Porous borders

- Technological cooperation with countries of concern
- Lack of nuclear export control knowledge
- In some cases, little access to technical support

What can we do?

There are possible measures to address the problem. These include:

- Helping NIS governments conduct a careful review of export license applications from a technical perspective and from and end-use/end-user perspective
- Helping NIS governments inform industry of export regulations and procedures
- Help build professionalism in NIS border guards and customs services
- Help to increase the technical knowledge accessible by customs officials
- Cooperate in investigation and prosecution of violators

At the same time, we must recognize that such efforts can be difficult, especially in cases where a government has little control over criminal activities. There are no quick fixes to problems like corruption. Furthermore, while technical devices can help detect HEU and plutonium there are fewer prospects for technology to aid in the detection of the broader spectrum of nuclear-sensitive equipment. Moreover, it is unrealistic to expect to train customs officers and other non-technical personnel to recognize such equipment.

Recommendations

1. We should help NIS countries develop capabilities for effective review of export licenses.
2. There are several US programs (e.g., the DOD/USCS and DOD/FBI counter-proliferation programs, the DOE "Second Line of Defense" program, and others, aimed entirely or in part at countering illicit trafficking of weapons-usable fissile materials. We should look for opportunities to integrate into such programs some relevant training on stopping illicit transfers of nuclear-related and dual-use goods. Such course materials could be incorporated in training for foreign customs officers, border guards and police.
3. We should encourage links between NIS enforcement officials and local (or regional) technical experts.

QUESTIONS AND ANSWERS:

C. Ficek: Are we helping in any way with Russian Customs laws? Is there any work with our allies, who are sometimes part of the problem?

G. Anzelon: On paper there is improvement in control of nuclear commodities, and tremendous will to do that, especially with the example of Iraq, which showed the importance of dual use considerations.

V. Jodoin: It is easier to trade in stuff 1-2 steps away from the application; there is less of a moral barrier.

G. Anzelon: Yes, it is easier to delude yourself if you make a plausible arguement that the item will be used for legitimate means.

V. Jodoin: What about SNM?

G. Anzelon: I hope that the average scientist / businessman will be more worried about the immediate consequences.

U.S. Customs Service Interdiction of Fissile Materials

Neil Shannon
U.S. Customs Service
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One of the most significant challenges U.S. Customs now faces is the menace posed by the proliferation of nuclear materials, weapons of mass destruction, and their associated technologies. As a consequence of the breakdown of the Soviet State, a vast "supermarket" of nuclear materials has become potentially available. As a result, pariah states who have historically trafficked in weapons of mass destruction, may increasingly threaten the security of the world community.

In sponsoring a bill designed to address this growing danger, Senator Sam Nunn testified that, we must now be prepared to protect our borders against nuclear weapons that will be transported, not only by missile, but also in a suitcase. In taking up that challenge, U.S. Customs is refining and intensifying its existing strategies and developing new initiatives against nuclear terrorism.

Terrorism can be simply defined as the use of violence or destruction to create an atmosphere of fear in a population which reduces the effectiveness of legitimate governments, or provides political or military advantage to the cause of the terrorist.

Terrorism in the 1970s generally involved taking hostages or hijacking aircraft. In the eighties, terrorists began employing car and truck bombs which caused hundreds of casualties. The bombing of aircraft also became more prevalent.

The 1990s have brought forward a new threat as terrorists seek to escalate the destruction of the eighties. The attack on the New York World Trade Center, had it met the bombers' expectations, could have caused in excess of 50,000 casualties. The planned attacks on the New York tunnels could have generated thousands of casualties.

Weapons of Mass Destruction (WMD) offer terrorists a significant capability to inflict high casualties, and inflict great fear in a population. Nuclear weapons are one of three categories of WMD. The other two categories are chemical and biological weapons. The Customs radiation detection program was initiated for several reasons, one of which is to provide a means to combat WMD terrorist activity. This U.S. Customs radiation detection training program focuses on the nuclear weapons threat, and the derivative threat of nuclear weapons components.

Although nuclear terrorism activities are improbable, the potential consequences to persons, infrastructure, and public confidence are so grave, the government must seriously consider the threat. One nuclear weapon deployed by terrorists in a populated area could cause incalculable damage. To understand the importation threat, Customs officers have been trained to confront the most likely scenarios.

There are three types of nuclear weapons which concern U.S. Customs officers. Two of the weapon types produce a nuclear explosive yield, and require Special Nuclear Material (SNM) as a component. SNM is defined as Uranium-235, Uranium-233, and Plutonium. The third type of

nuclear weapon does not produce a nuclear explosive yield. These weapons are listed in descending order of destructive efficiency, and in ascending order of probability of terrorist use:

1. A military nuclear warhead- These weapons have been designed by nation-states for the maximum explosive yield for weight, and are characterized by being highly deliverable and reliable. These weapons are highly valued by the nations which produce them, and are, despite reports in the popular press, kept under strict controls. These weapons are known to be stockpiled by the United States, Russia, China, Great Britain, and France. It has also been reported in the press that Israel, India, and Pakistan may possess deliverable weapons. Iraq and Iran are believed to be aggressively pursuing a nuclear weapons capability. These weapons can theoretically be as small as fifty kilograms in weight. Some tactical nuclear weapons can be fired from a 155mm artillery piece. Explosive yields can range from less than the equivalent of 1,000 tons to more than a million tons of high explosives.

2. An Improvised Nuclear Device (IND)- These weapons are more crudely constructed than military weapons, and characteristically would have lower explosive yield to weight ratios. These devices would be more difficult to deliver, and their reliability could be questionable. Constructed without a testing program to validate the design, these weapons would certainly require larger amounts of SNM to achieve a given yield than a military warhead. These devices would still require a significant infrastructure to build, but could conceivably be assembled by an organization less than a nation-state. Much of the process of creating this type of device would involve activity which would be difficult to conceal. Testing detonation explosives, procuring SNM, and highly precise machining of materials all require specific expertise and dedicated facilities. Detection of such an operation is highly probable. Explosive yields would most probably be in the range of 1,000 to 25,000 tons of high explosives.

3. A Radiation Dispersal Device (RDD)- This device requires the least technical expertise as well as most obtainable materials. Any radioactive isotope could be incorporated into this type of weapon, and there is no need for highly regulated SNM. Nuclear waste materials or other less controlled radioisotopes could be dispersed by a small explosive charge causing a significant health hazard in limited areas. Due to the relative ease to obtain and assemble an RDD, this weapon is the most likely device a Customs officer may encounter.

The nuclear explosives listed above could, in the extreme, destroy an entire city, or minimally raze more than a square mile. Infrastructure targets, such as dams, nuclear power plants, seaports, or airports, could be destroyed with one strike. RDDs could deny access to vital locations, such as financial centers, transportation hubs, or food distribution points for a considerable time.

In addition to terrorists, there are individuals who may seek to use nuclear extortion for a myriad of personal or ideological reasons, or for a profit motive. These individuals generally lack the resources, organization, or technical ability to mount a credible threat. Nonetheless, a technically competent individual could potentially build an RDD.

The most likely scenarios for terrorism would involve an international terrorist group importing an RDD, or the radioactive materials to construct the device. Nuclear waste or contaminated material

from the former Soviet Union would be the most probable source of such material, although a medical facility could provide isotopes capable of creating an RDD.

Another scenario Customs officers may also encounter is the attempted sale of nuclear materials by organized criminals. Even false sales may involve radioactive materials, which can be potentially dangerous.

Terrorists, doomsday cults, and deranged individuals with greater access to WMD technology are making the threat of an importation of a nuclear weapon into the United States a possibility. Perceptions that domestic or international terrorists in the U.S. may be seeking a WMD capability, make importation of radioactive materials more probable in the future.

To confront this threat, U.S. government agencies have been working together and with foreign governments to build a "layered defense" to prevent the smuggling of nuclear weapons or materials. U.S. Customs is an integral part of those efforts.

The first step in this layered process is to **prevent** the movement of radioactive materials beyond the facilities in which they are legally stored. Department of Energy, Department of Defense and Department of State officials have recently made great strides in helping foreign governments to secure deadly radioactive materials.

No security system is fool-proof, however. If criminals are able to overcome the "prevent" layer, it then becomes essential that border authorities are able to **detect and interdict** "loose" nuclear materials. U.S. Customs is playing a major role in this second layer of defense, both internationally and domestically.

Through such initiatives as the Cooperative Threat Reduction, Project Amber, and the DOD/USCS Counterproliferation Program, the Customs Service has helped to train and equip dozens of "high risk" foreign border authorities in detecting and interdicting illicit nuclear materials. Nevertheless, the United States cannot rely solely on enhanced security measures at foreign nuclear facilities or on the seizure of radioactive materials at foreign borders.

Therefore, on the domestic front, U.S. Customs has trained and equipped its own officers to interdict illegal radioactive materials and then to ensure a coordinated response among all government agencies involved. While the prevention of terrorist activities is the primary focus of this new Customs initiative, it should not be overlooked that Customs also uses the detection equipment to prevent the importation of contaminated commercial shipments that threaten the health and safety of the American public.

During the past several years, U.S. Customs Radiation Detection Program has established a defense against the threat of nuclear terrorism. Equipment has been distributed, procedures established, and intelligence exchanged. As we look toward tomorrow and the years ahead, Customs is committed to continuing its work with other governments and agencies to further enhance our anti-terrorism capabilities.

QUESTIONS AND ANSWERS:

J. Kinnison: The training you discussed is for the United States. Is there similar training for other countries?

N. Shannon: Its similar training. Similar equipment is being considered for or has been used overseas. Customs organizations worldwide are exchanging information.

B. Yuldashev: All entry points are equipped with radiation detection equipment? How sensitive is it?

N. Shannon: Yes, all national points of entry are so equipped. It is state of the art. We ran a two week assessment of the equipment, the pocket pager we used passed.

M. Tobin: The minimum detection limit is a few times background. It uses a CsI detector.

E. Ewell: Please differentiate between Project Amber and the DoD / U.S. Customs Program.

N. Shannon: Project Amber is for the Baltics, Poland and the Czech Republic, and Slovakia, whereas the DoD / U.S. Customs program is to assist 25 other nations, primarily in Eastern Europe and the Former Soviet Union (in such areas as export control and radiation detection equipment).

E. Ewell: Is Project Amber over?

N. Shannon: No, the project will run through 1999 with approximately seven more training sites to be completed.

I. Vasiliev: How many specialists in your service are capable of making sensible decisions (regarding nuclear materials)?

N. Shannon: We have 17,000 employees, probably 6,000 inspectors using the equipment (plus special agents). The equipment is primarily used by field inspectors.

I. Vasiliev: Recently it was said that it was impossible to train custom agents to make decisions (regarding nuclear materials) unless the person has a scientific background. Detectors you are using only measure gamma rays, they cannot detect neutrons, so if shielded how will you be able to detect nuclear materials?

N. Shannon: It is easy to use the equipment, so you don't have to be a scientist. We want every port to have an isotope identifier (not display a spectrum), therefore that would also be a simple device.

I. Vasiliev: What is the plan?

N. Shannon: Pagers are out there now.

I. Vasiliev: Two years ago you had ten.

N. Shannon: We've procurred a lot since then.

I. Vasiliev: Are there portal monitors installed, with gamma ray channels?

N. Shannon: Yes, with gamma ray monitors, but not at all border crossings. If shielded, that is a concern, but there are other ways to address that.

J. Immele: That will be the next generation of equipment. The challenge with neutron detectors is to make them compact and easy to use.

I. Vasiliev: If they are compact they are not sensitive nor good for vehicle traffic.

J. Immele: True.

Is the U.S. Ready to Deal with a WMD Terrorist Act?

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The question of whether the U.S. is prepared, or as important, is preparing, to deal with terrorism and WMD can be answered by evaluating a set of assorted U.S. policies and programs that exist or are being developed, some meant to prevent or deter terrorist acts using WMD, other programs seek to mitigate the effects of such acts, and yet other policies and programs meant to manage such crises and their consequences. Notionally, the sum of these policies and programs should represent a defense in depth against terrorist acts, specifically against those using WMD. Much of the discussion at this workshop has dealt with international policies and programs designed to aid in preventing a terrorist nuclear event through the control and safeguards of nuclear materials and existing weapons and their components.

To prevent terrorist attacks, increased funds are being allocated by the USG to improve our law enforcement efforts and intelligence collection against suspected terrorist organizations. Funds are also being made available to harden military and government facilities to mitigate the effects of terrorist attacks. Clearly, the first prioirity for the USG is to prevent, or mitigate, the effects of such events when it can. But there is a question that needs to be raised, namely, how well we are preparing to respond to, or deal with, a real terrorist induced disaster, given the prevention of such an event has failed, not just preparation at the federal level, but in cities and at other potentially high risk locations throughout the U.S.

There are several ways in which a nuclear terrorist event could unfold in the future. If a threat of a nuclear attack occurred here in the U.S., it would generally be expected that the terrorist group making the threat would want to negotiate for some political or economic objectives, suggesting that there may be time available to bring extensive federal resources and capabilities to bare including: threat assessments, detection equipment to help locate a nuclear device or weapon, and various military and medical support groups from a variety of federal agencies. These federal forces will be supported by state and local resources as well, and the entire response enterprise will, in accordance with PDD-39 on counterterrorism, be under the jurisdiction and direction of the FBI. If, in the future, an announced threat does lead to some catastrophic event, therefore, the infrastructure should be in place to deal with it militarily, medically, politically, if in any other way, hopefully successfully. One might conclude that at this point the USG seems to be on its way to developing a useful and probably, effective capability to respond domesticaly to WMD threats by terrorists.

If, however, there is no warning prior to the use of a WMD by terrorists, the problem of managing or responding to a serious nuclear crisis is seen by many as an order of magnitude more difficult, and perhaps impossible to plan for, and thus, appears to have been ignored as an issue by most government jurisdictions, particularly at the local level. This mind set exists not only for a nuclear terrorist event, but also for events where chemical and biological weapons might be used. What tends to feed this attitude is that a WMD event could happen without warning just about anywhere,

and if a nuclear device is used and is powerful enough, it could destroy an entire city, so how do you plan for that? Moreover, since a serious nuclear terrorist event has not occurred to date, how could the cost of preparations be politically justified? This thinking could be short sighted.

First, there may be a trend toward terrorist attacks without negotiations or warning, such as occurred in New York City, in Oklahoma City, at the U.S. airbase in Saudi Arabia, and with the use of the nerve gas sarin in the Tokyo subway. Second, the trend is toward fewer terrorist acts, but for each act producing larger numbers of casual ties, as the cases I have just noted suggest. Third, if the truck bomb used against the New York City Trade Center was indeed laced with cyanide, it is no far fetched to believe that some demented individual or terrorist group would, in the future, lace a truck bomb with radioactive materials, or as terrorist technical sophistication increases, attempt to detonate a crude nuclear device that might give a few tons of explosive yield. While it may be beyond comprehension as to how to prepare for the worst hypothetical event, a megaton bomb without warning, it may well be within the capacity of federal and local governments to rationally plan to respond to future lower level nuclear events.

Unfortunately, that seems not to be the case, given the void in the planning at the local levels, and as of now, no clear support for such planning by the federal government plans exist at the state and federal levels to deal with accidents at nuclear reactors located within their jurisdictions. Federal and state plans also exist for dealing with spills of radioactive materials during transport. Thus, some regions have some capabilities to respond to nuclear related accidents. However, with the demise of the cold war, the diminution of concern for nuclear attacks against the U.S., the Federal Civil Defense Program that once reached down to support local civil defense efforts throughout the U.S. and last housed in FEMA, has disappeared. Current FEMA interests and support appear more focused on natural and industrial disasters and supporting communities in their ability to respond to them, and hardly at all on terrorist induced disasters, and not just nuclear induced disasters but terrorist disasters of any kind.

Not too many years ago, FEMA supplied local agencies with financial assistance, special detection devices, maintenance for those devices, planning and training exercises. The financial assistance paid the salaries of dedicated local civil defense officers who reported to local authorities. All that past FEMA supported nuclear disaster expertise has either atrophied or disappeared. A question then is whether at least some of that capability and expertise clearly not all, should be resurrected, particularly in regions of the U.S. that are both densely populated and could have high political significance as terrorist targets. Clearly, the need for nuclear related expertise in Los Angeles, California, probably a high value target for a terrorist attack, may be much greater than the need in Santa Barbara, California. Upon reflection, it may be possible to justify having a new, but smaller, federal civil defense organization and capability that can coordinate responses among federal agencies, and help major population centers with planning, financial and technical support to respond in the aftermath of any terrorist act with a weapon of mass destruction including nuclear. Most, and likely, all major cities, even those with superior emergency response capabilities to deal with natural disasters, as is the case with LA. County and city, are far from being organized as first responders to effectively deal with an out of the blue terrorist nuclear event in those first crucial minutes and hours before federal support arrives, or for that matter, be able to respond effectively to a major chemical or biological event.

Federal teams led by DoD have been giving week-long classes instructing emergency personnel in major cities across the nation on how to prepare for a WMD terrorist event. Given the complexities for responding to a major terrorist attack without warning, however, this effort which could be worthwhile, is not nearly enough for the localities to then go off on their own.

There are serious questions as to whether first responders, local police and firemen, can recognize what the nature of the event is, or what medical assistance should be given, by whom, and with what priority to the victims. What are the procedures and protocols for a local jurisdiction responding to 10's of caualties, or 100's, or indeed, 1000's. The objectives of the first responders are to prevent further casualties and to ministrer to the wounded, but most first responders in most metropolitan areas do not have either the planning, training, or know how, or the equipment to do either very well, if at all.

Some localities, such as Los Angeles, are struggling with little funding to build their emergency operations to be first responders if a WMD attack should occur. If, as a nation, we are, in the next years, to have some degree of preparation to respond to a terrorist attack out of the blue, cities judged at risk may need more resources, but more importantly, they will need to do much more planning to figure out how to handle such events using existing resources, public and private. Moreover, as we have learned in trying to do civil defense planning in the past, plans will tend to be city and event specific, no one plan will fit all locations or attack scenarios. Planning should start now at local and state levels, and between the federal, state, and local jurisdictions to be ready as soon as possible, but certainly, by the turn of the century.

PDD-39 gives primary responsibility for responding to a terrorist threat involving a WMD to the FBI and the responsibility to support local communities in preparing to respond to such events to FEMA. Unfortunately, FEMA has done little to date to assist localities in this matter. To the extent such support may be forthcoming, it is expected to come from the DoD, assuming DoD can get itself organized. It would seem wiser, however, to reestablish an office of civil defense, perhaps within DoD or FEMA, that has the authority and resources to coordinate response activities among all federal agencies and can actively support localities and states to become as effective as possible as first responders to terrorist induced disasters with WMD, nuclear, chemical, and biological. The Federal Counterterrorism Program, as enunciated in PDD-39 nd implemented by Nunn-Lugar legislation, will go a long way to help prepare the federal government to prevent, mitigate, and respond to terrorist acts using WMD, but it does not yet help fill the void at the local level where a future WMD event without warning may allow hundreds more to become casualties or die while awaiting a response from a 911 call to the federal government.

QUESTIONS AND ANSWERS:

J. Niewodniczanski: In 1999 in Warsaw the U.S. Army will drill on mock terrorist attacks in Warsaw, including the use of explosives. If we can do that through NATO, you should be able to conduct drills in the United States.

M. Eisenstein: We should. Elements of DoD have the know how and capability to respond if given warning. Thus such drills are useful. If there is no warning, however, it is unclear how we should rationally respond to a serious WMD attack by terrorists. Until such procedures are developed for a wide variety of possible scenarios drills may not have much meaning.

R. Schuller: Twenty years ago there were emergency response plans for nuclear plants. These were in remote areas, and it took about one year to have effective response plans to melt-down scenarios. Therefore, if proper attention is paid, the problem becomes tractable quickly.

S. Cantlin: Chemical attack or industrial accident has the same effect. Is there anything to be learned from that?

M. Eisenstein: There are few industrial chemicals that approach the toxicity of a nerve gas. A nerve gas attack will generally require greater protective measures for the first responders as well as new procedures for responding and administering medical treatment than currently in use. In preparing for responding to a serious chemical attack localities should evaluate the utility of using resources and procedures already in place to deal with industrial, chemical or nuclear accidents.

S. Mullen: A comment. A game in CSIS, Wild Atom, was a nuclear terrorist impending event. There was a serious problem coordinating a response even with warning.

M. Eisenstein: In time with more game playing,more drills, and more training many of the problems of coordination among agencies could be minimized, if not eliminated, through new procedures, protocols, improved communications, and indeed new legislation. Each community will decide, based on political and economic factors, its priority for coordination and to what degree.

V. Jodoin: We lost Baltimore in that scenario!

Forensic Scene Management (Nuclear) – A UK Perspective

William J. Emerton
Metropolitan Police Service, Anti-Terrorist Branch
London, United Kingdom

Unlike the United States, where the FBI has legislative powers to investigate certain offenses, the United Kingdom has no similar investigative body. The responsibility for investigating criminal offenses rests with the Chief Police Officer for the area in which the offense is committed.

In the case of a terrorist nuclear incident the Chief Officer would liaison closely with government departments and may be assisted by a National Co-ordinator. The Co-ordinator, working to an advisory group of senior police officers and other government officials, is the Commander of the Metropolitan Police Anti-Terrorist Branch.

In consultation with the relevant Chief Officer of Police, the National Co-ordinator should ensure when required, that along with other responsibilities, the necessary resources are provided to oversee the forensic examination and ensure proper scene management.

This for all practical purposes means the deployment of specially trained officers from the Anti-Terrorist Branch and other forces.

An incident where fissile or other nuclear material is used for criminal purposes by a terrorist or terrorist organization would clearly, therefore, fall within the remit of the National Co-ordinator. It is however important to understand the wider implications for the British Police Service when confronted with such an incident, or from the threat of the deployment of an Improvised Nuclear Explosive Device, whether constructed as such or from explosive attached to nuclear material.

Police action is determined by the United Kingdom emergency planning culture where the Police Service co-ordinates the response to the incident by all other emergency and support services by the adherence to the "All Hazards Approach" doctrine; that is, whatever the incident, the Police co-ordinate, the Fire Brigade are responsible for search and rescue, and the Ambulance Service for the care of victims. (The co-ordination would extend to other supporting services and, in the case of fissile material, to the scientific community called upon to advise and assist.)

This co-ordination extends to the management of the incident scene, where, in the UK the police have primacy for the criminal investigation. However, it is important to emphasize that whilst the primacy is inviolate, the Police Service acknowledges that many disciplines required from the scientific community to effect mitigation, in what will probably be a hazardous environment. Consequently, the police aim is best explained thus: **"To exploit the opportunity to gather evidence without prejudice to the mitigation."** There is however, no change to the existing arrangements for the recovery of evidence, except in this case, the specialist training and equipment required to enable officers to work safely in a difficult and hazardous environment.

QUESTIONS AND ANSWERS:

G. Lyle: AWE, where do they play?

B. Emerton: It is critical for a successful co-ordinated response to involve experts from the scientific community as early as possible. As well as assistance and advice to the Incident Commander, and other specialists, Government will expect expert threat advice and, when available, the results of scientific analysis.

S. Mullen: There is no prohibition for the military to provide assistance to civil authorities?

W. Emerton: No. Many of the contingency plans for dealing with civil emergencies in the United Kingdom rely, through central government, on assistance from the military. Only in the resolution of hostage situations is there a mechanism for a formal handover of responsibility to the military.

T. Jourdan: WMD is what, NBC only?

W. Emerton: There is sufficient detail in current UK law to allow for the investigation and prosecution of suspects involved in NBC incidents, including investigations abroad. We have not considered a need to separately deal with WMD.

Orchestration of the U.S. Law Enforcement Response to a Nuclear Event

Dr. Tom Jourdan
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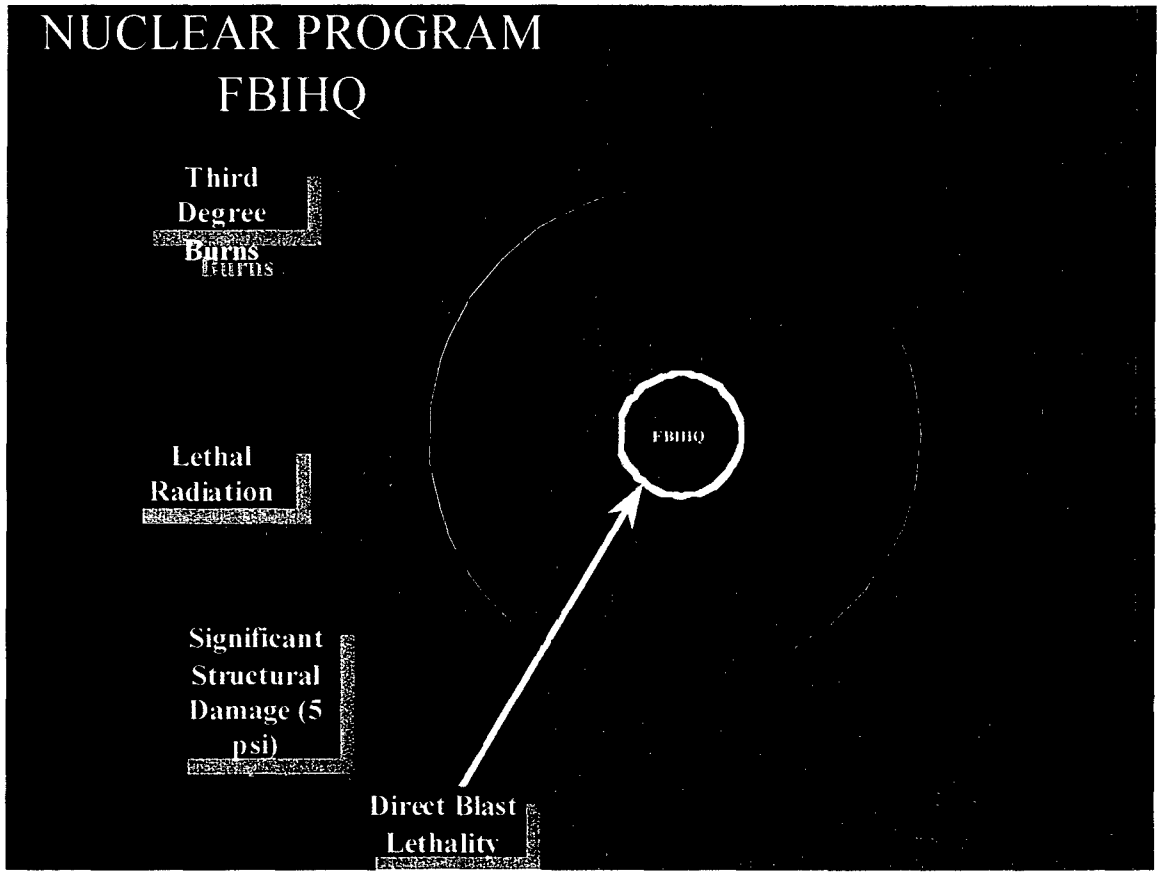

NUCLEAR PROGRAM
-OVERVIEW-

- FBI Responsibilities
  - Nuclear Terrorism
  - Nuclear Proliferation
- Criminal Jurisdiction for Illegal Nuclear Acts
  - Atomic Energy Act
  - U. S. Code Title 18, Section 831
  - U. S. Code Title 18, Section 2332a
- FBI Response / Crisis Management Plans

NUCLEAR TERRORIST ACTS
-DEFINED-

- Detonation of a Nuclear or Radiological Dispersion Device
- Theft of a Nuclear Weapon
- Production of an Improvised Nuclear Device
- Theft of Special Nuclear Material
- Production of a Radiological Dispersion Device
- Theft of Nuclear By-Product Material
- Threat to Do Any of the Above

NUCLEAR PROLIFERATION
-TYPES OF CASES-

- Overt or Covert Purchases to Acquire or Maintain a WMD Capability, to Include:
  - Material
  - Equipment
  - Technology
- Trafficking of Special Nuclear Material

NUCLEAR MATERIAL TRAFFICKING
-FBI STRATEGY-

- Prevent Terrorist Acquisition of Nuclear Materials
- Aggressively Investigate All Allegations of Nuclear Material Smuggling
  - Atomic Energy Act
  - FCI-Proliferation
- Assist Foreign Law Enforcement
- Never Create a Market for Nuclear Material

NUCLEAR PROGRAM
-OVERVIEW-

- FBI Responsibilities
  - Nuclear Terrorism
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- Criminal Jurisdiction for Illegal Nuclear Acts
  - Atomic Energy Act
  - U. S. Code Title 18, Section 831
  - U. S. Code Title 18, Section 2332a
- FBI Response / Crisis Management Plans

CRIMINAL JURISDICTION
-ATOMIC ENERGY ACT-

- Originally Passed in 1946, Amended in 1954
- Title 42, Section 2011-2284 of the United States Code
  - Entitled, "Development and Control of Atomic Energy"
  - Referred to As "Atomic Energy Act"
- Criminal Violations
- Civil (Licensing) Violations
- FBI Investigates All Alleged or Suspected Criminal Violations

CRIMINAL VIOLATIONS
-ATOMIC ENERGY ACT-

- Control of "Restricted Data"
  - (Penalty: up to Life in Prison)
- Possession of Nuclear Weapons
  - (Penalty: up to Life in Prison)
- Interfering, Harming or Threatening Nuclear Inspectors
  - (Penalty: up to 10 Years in Jail)
- Sabotage of Nuclear Facilities
  - (Penalty: up to 10 Years in Jail)
- Trespassing on Nuclear Facilities
  - (Penalty: up to 1 Year in Jail)

CRIMINAL JURISDICTION
-U.S. CODE TITLE 18, SECTION 831-

- Passed in 1982 As the "Convention on the Physical Protection of Nuclear Materials"
  - Strengthened the Atomic Energy Act Provisions on Nuclear Material
  - Law Previously Only Applied to Plutonium or "Processed" Uranium
- Currently the Only Criminal Statute for Non-Weapons Grade Radioactive Material
- In 1996 This Statute Was Amended to Include "By-Product Material"
  - Any Man-Made Radioactive Substance That Is Created Through an Irradiation Process in a Nuclear Reactor/Accelerator

TITLE 18 U.S. CODE, SECTION 831
-VIOLATIONS-

- Illegal to obtain or attempt to obtain radioactive material through theft, unauthorized use, intimidation or fraud
- Illegal to obtain or attempt to obtain radioactive material and:
  - Cause or possibly cause death or injury
  - Cause or possibly cause substantial property/environmental damage

TITLE 18 U.S. CODE, SECTION 831
-VIOLATIONS (CONT'D)-

- Illegal to threaten to steal radioactive material with the intent to coerce any person or government
- Illegal to attempt or threaten to kill, or injure anyone or cause property/environmental damage with radioactive material.
- Illegal to engage in conspiracy to do any of the above

TITLE 18 U.S. CODE, SECTION 831
-EXTRATERRITORIAL JURISDICTION-

- Offense Occurs in "Special Maritime Jurisdiction"
  - U.S. Owned Vessels on the High Seas
  - U.S. Owned Aircraft over the High Seas
  - Any Place Outside the Jurisdiction of Any Nation With Respect to an Offense by or Against a U.S. National
- Destined for a State in the United States

Example: FBI has Jurisdiction for Terrorist Attack of Spent Nuclear Fuel Shipments from Foreign Governments into Concord, Charleston, if the Attack Occurs on the High Seas.

TITLE 18 U.S. CODE, SECTION 831
-PENALTIES-

- Up to $250,000 Fine
- Life Imprisonment If:
  - Action Results in Death
  - Action Shows Extreme Disregard for Life
- Up to 20 Years Otherwise
- Up to 10 Years for a Conspiracy Not Involving Death

CRIMINAL JURISDICTION
-TITLE 18 U.S. CODE, SECTION 2332A-

- "Use of Weapons of Mass Destruction"
  - "WMD" Statute : Passed in 1994
- Strengthens Protection Against Terrorist Use of WMD
- Includes Threat to Use WMD
- WMD Defined As:
  - Destructive Devices (Bombs, Grenades, Rockets)
  - Chemical
  - Biological
  - Release of Life-Threatening Levels of Radioactive Material
- **IF DEATH OCCURS: LIFE IN PRISON OR DEATH PENALTY**

CRISIS MANAGEMENT
-FBI ROLE -

- Lead Federal Agency for Terrorist Incidents at Nuclear Facilities
- Contingency Planning
  - FBI Involved in the Generation of Site-Specific Plans
- Response to Incidents Well Thought Out and Exercised
  - Develop Close Liaison With Facility Security Forces
- FBI Ready to Assume Command and Control

POTENTIAL NUCLEAR INCIDENT
-SCENARIOS-

- Communicated Threat to Use Nuclear Weapons or Radiological Materials
- Threat Directed at a Specific Nuclear Facility
- Hostage/Barricade Type Situation at a Nuclear Facility
- Theft and/or Malevolent Use of Nuclear Weapons or Radiological Materials up to and Including "Hot Pursuit" Situations

NUCLEAR THREAT
-TARGETS-

- Department of Defense Facilities:
  - Nuclear Weapons Storage Sites
  - Deployed ICBM, SLBM Warheads
- Department of Energy Facilities:
  - Nuclear Weapon Production/Dismantlement Facilities
  - Special Nuclear Material Production Facilities
  - Facilities With Significant Special Nuclear Material
- Commercial Sites:
  - Power and Research Reactors
  - Nuclear Fuel Cycle Facilities With Enriched Uranium
  - Nuclear Regulatory Commission-Licensed Sites
  - Critical/High Visibility Infrastructures

THREAT ASSESSMENT PROCESS

- Coordinated Between FBI and Department of Energy
- Communicated Threat Credibility Assessment Program
  - DOE Managed Program
  - Assessment From Behavioral, Operational and Technical Perspectives
  - Behavioral Assessments Coordinated With FBI Quantico
  - Initial Assessment Within One Hour, Final Assessment Within Four Hours
  - Threat Will Be Declared Non-Credible or Credible With Either a Low, Medium or High Level of Confidence
  - Rationale Will Be Provided for Conclusion

NUCLEAR THREAT ASSESSMENTS

-THREE VIEWPOINTS-

Behavioral Resolve

Technical Feasibility

Operational Practicality

FBI RESPONSE

- Statutorially the FBI is the Lead Federal Agency for response to terrorist and/or criminal nuclear incidents. HOWEVER:
- A number of other agencies provide support:
  - Department of Defense
  - Department of Energy
  - Nuclear Regulatory Commission
  - Federal Emergency Management Agency
  - Environmental Protection Agency
  - U.S. Public Health Service

DOMESTIC EMERGENCY SUPPORT TEAM
-(DEST)-

- FBI Led - Rapidly Deployable Interagency Team
- WMD Oriented
- Supports FBI On-Scene Commander (OSC)
- Advisory in Nature (Some Limited Operational Capability)
- FBI Director Deploys Based on Incident and Request of OSC
- Task Organized Specific to Incident

DEST
-PRIMARY AGENCIES-

- Federal Bureau of Investigation
- Department of Defense
- Public Health Service
- Federal Emergency Management Agency
- Environmental Protection Agency
- Department of Energy

NUCLEAR THREATS
-SPECIAL FBI RESOURCES-

- Critical Incident Response Group (CIRG)
  - Hostage Rescue Team (HRT)
  - Crisis Management Unit (CRU)
  - Critical Incident Negotiation Team (CINT)
  - Investigative Support Unit (ISU)
  - Profiling and Behavioral Assessment Unit (PBAU)
- Laboratory Division
  - Hazardous Materials Response Unit (HMRU)
  - Explosives Unit
- Information Resources Division (IRD)
  - Crisis Response Team
  - Rapid Start Team

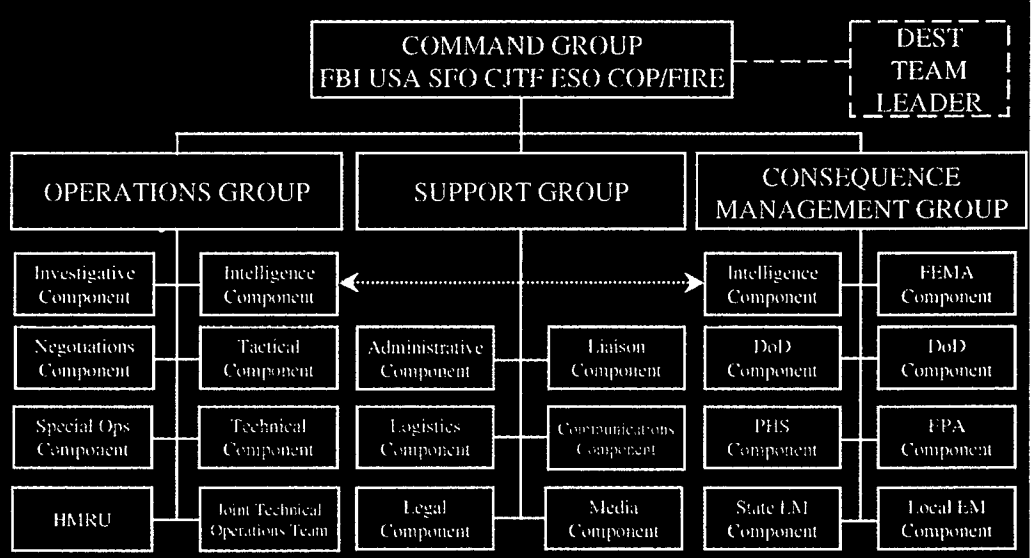
NUCLEAR THREATS

-SPECIALIZED FEDERAL SUPPORT AVAILABLE-

- Department of Defense: Joint Technical Operations Team
  - Provides Tactical Render Safe Capability
  - Given Time, Provides a Deliberate Render Safe Capability
  - Clear Working Point/Device of Improvised Explosive Devices or Booby Traps
- Department of Energy: Nuclear/Radiological Assistance Team and Nuclear Emergency Search Team (NEST)
  - Provides Quick Response Technical Support
  - Provides Specialized Search Equipment and Expertise
  - Provides Nuclear Weapon Disablement Expertise

FBI JOINT OPERATIONS CENTER

-JOC-



CONCLUSIONS

- The FBI is in Command During a Terrorist Crisis
  - Operational Command Responsibility Extends into Consequence Management Phase
- The FBI Is Responding to Both the Nuclear Proliferation and Nuclear Terrorism Threat Through:
  - Development of Nonproliferation Strategies
  - Contingency Planning
  - Working to Uncover U.S. Targeting
  - Working With Domestic and Foreign Law Enforcement

QUESTIONS AND ANSWERS:

V. Jodoin: Your high priority didn't include tall buildings in Manhatten and rapid transit.

T. Jourdan: This is part of the contingency plan.

D. Crane: There are other sections which deal with domestic and international terrorists.

J. Immele: The FBI integrated CW and BW. Is it effective and synergistic to treat chem, bio and nuclear as a family?

T. Jourdan: The Hazardous Materials Response Unit handles all of these areas, including environmental cases.

D. Crane: Crisis management is crisis management. From a law enforcement perspective, not doing consequence management. Someone is going to jail.

G. Anzelon: Will investigation get in the way of preventing the loss of life?

T. Jourdan: Of course not.

M. Eisenstein: Can put all WMD into the same basket due to PDD 39. This includes non-NBC.

C. Cornett: Timothy McVeigh was convicted of WMD.

T. Jourdan: His intent was to destroy the building and kill its occupants.

D. Crane: It doesn't depend on number of fatalities to be considered a terrorist act.

Appendices

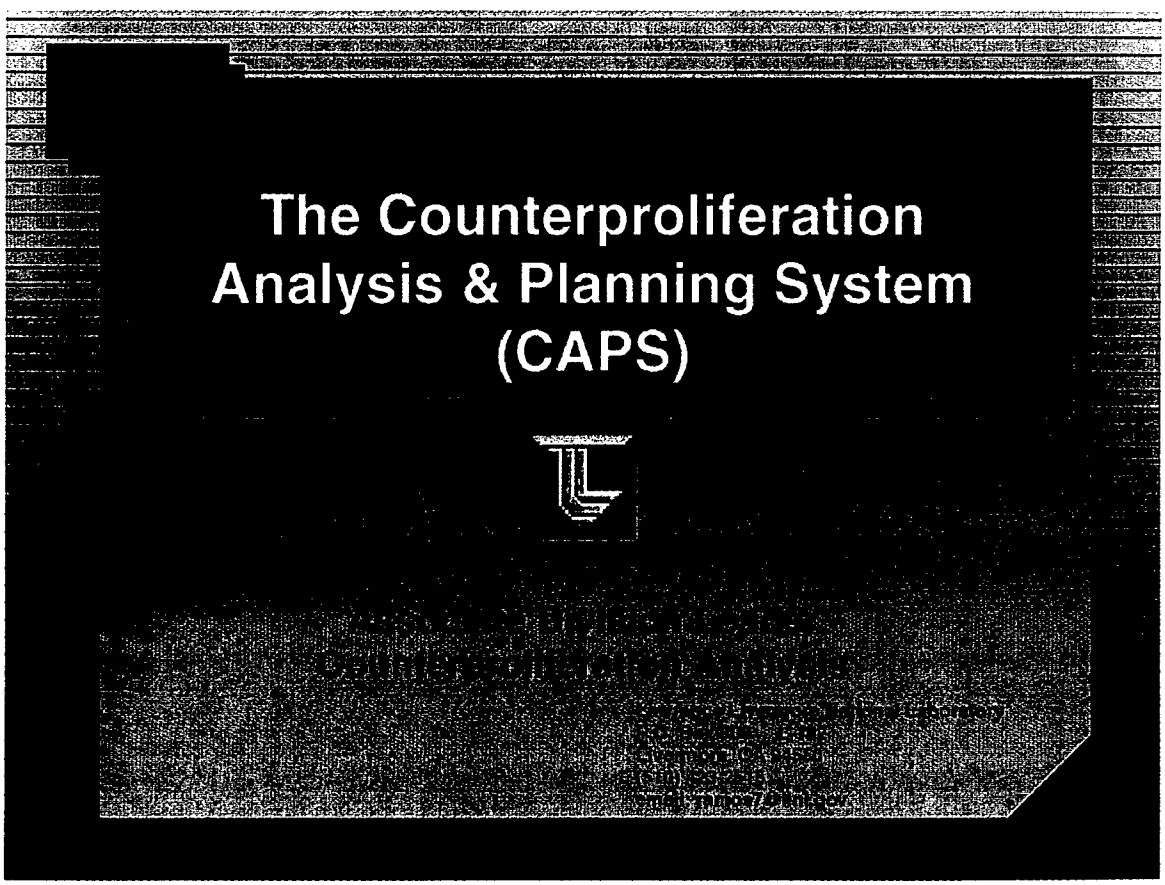
(A)

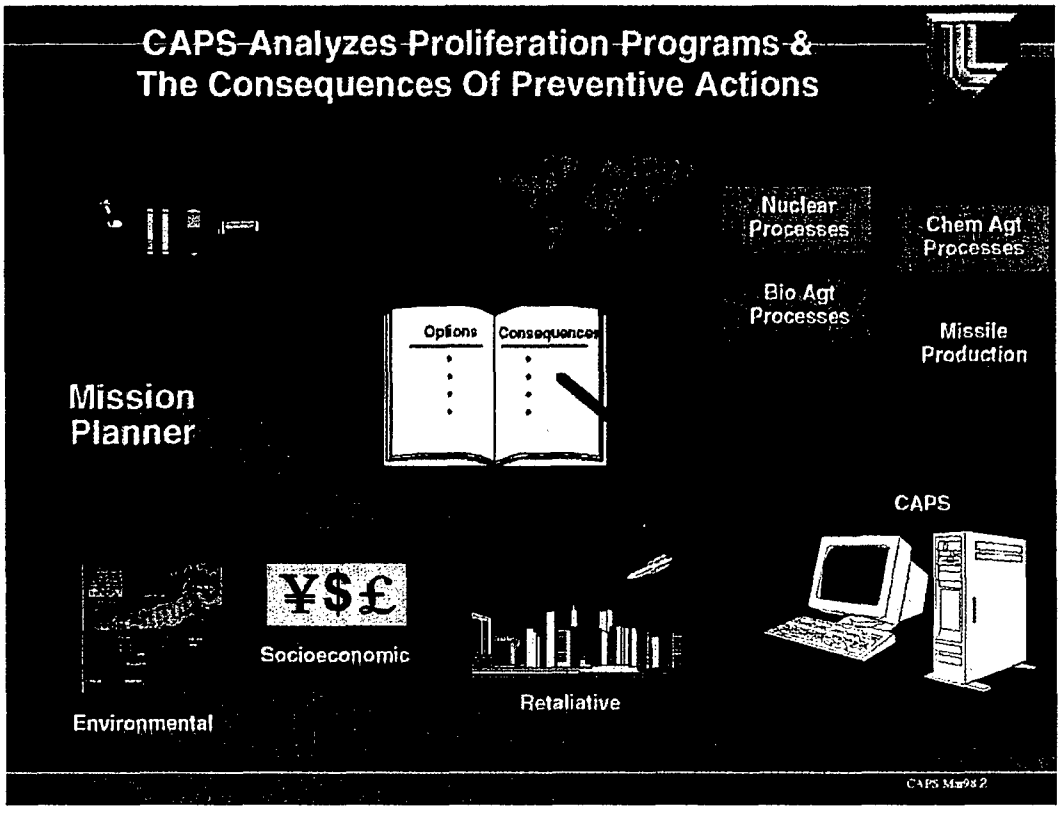
LIST OF ATTENDEES

NAME	ORGANIZATION	TELEPHONE/FAX No.
Adams, James	UPI, MD	202-898-8174/202-371-1239
Alonzo, Gorgiana	LLNL, CA	925-422-6100/925-423-9091
Andresen, Brian	LLNL, CA	925-422-0903/925-423-9014
Anzelon, George	LLNL, CA	925-422-5038/925-422-4563
Ball, Debbie	LLNL, CA	925-422-5029/925-423-4051
Beals, Donna Marie	SRTC, SC	803-725-0847/803-725-4478
Brovkin, Vladimir	American U., DC	202-895-4916/202-895-4964
Cantlin, Shawn	LLNL, CA	925-423-6734
Cornett, Cathryn	FBI, DC	202-324-0719/202-324-9248
Crane, David M.	FBI, DC	202-324-0759/202-324-1524
Dellenbach, Nicolas	EdHEeSS, France	F#33-3-4427-9983/6886
Dougan, Arden	LLNL, CA	925-422-5549/925-423-2759
Edwards, Matthew	DOE, D.C.	202-586-8628
Eisenstein, Maury	RAND Corp., CA	310-393-0411, X6633/310-451-7066
Emerton, William	New Scotland Yard, UK	44-171-230-2717/44-171-230-3480
Erickson, Stanley A.	LLNL, CA	925-422-6548/925-422-8471
Ewell, Emily	MIIS, CA	408-647-3523/408-647-6522
Ficek, Christopher	U. of NM	505-262-1824
Ford, James L.	Natl. Def. U., DC	202-685-4207
Fotheringill, Jerry J.	DoS (ACIS/CIA), DC	703-874-0762/703-734-1565
Guertner, Gary L.	US Army War College, PA	717-245-3238/717-245-3530
Hayward, Mary Alice	DOE, DC	F#202-586-3617
Heller, Arnie	LLNL, CA	925-423-3105
Hutcheon, Ian	LLNL, CA	925-422-4481/925-422-3160
Immele, John D.	DOE, DC	202-586-0588/202-586-2755
Jodoin, Vince	USAF Academy, CO	719-333-7228
Jourdan, Tom	FBI, DC	202-324-4341/202-324-3407
Kammeraad, Judy	LLNL, CA	925-423-6757/925-422-3160
Kinnison, James Allen	Univ. of NM	505-344-0978/505-247-1344
Koch, Lothar	EITE, Germany	49-7247-951-538/49-7247-951-595
Kyryshchuk, Volodymry	INR, Ukraine	38-044-265-85-06/38-044-265-44-63
Larsen, Jeff	SAIC, CO	303-773-6900/303-770-3297
Lee, Rensselaer W. III	GAS, VA	703-838-9219/703-548-4585
Lehman, Ronald F. II	LLNL, CA	925-423-3711/925-422-5252
Lyle, Gregory K.	DSWA, VA	703-325-1008/703-325-1069
Maceda, Edward	DoS (ACIS/CIA), DC	703-874-0909/703-784-1565
Madigan, Thomas	US Customs Service, DC	202-927-1192/202-927-1181
Mathews, Julia	DOE, D.C.	202-586-5165/202-586-0751
Mauger, Joe	LLNL, CA	925-423-7682/925-422-3160
Maurer, Juergen	German Embassy, DC	202-471-5511/202-625-7601
Mullen, Sarah (Sallie)	AC&DA, DC	202-647-0854/202-647-1407
Nadler, Eric	Front Line, Public Broadcasting	718-335-6409/718-335-6409
Niewodniczanski, Jerzy	PNAG, Poland	48-22-628-2722/48-22-629-0164
Niemeyer, Sidney	LLNL, CA	925-422-6672/925-422-3160

Counterproliferation Analysis and Planning Systems (CAPS)

Thomas F. Ramos
Lawrence Livermore National Laboratory
Livermore, CA





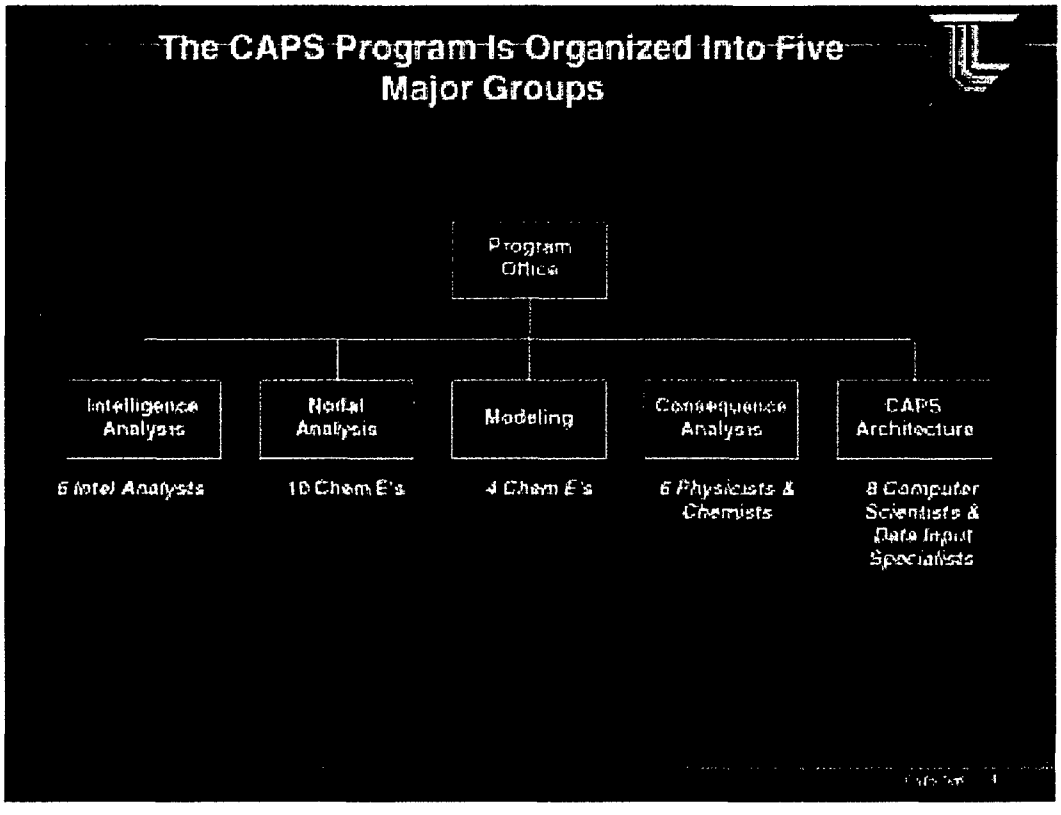
A Five Tier Approach To Assessing Proliferation

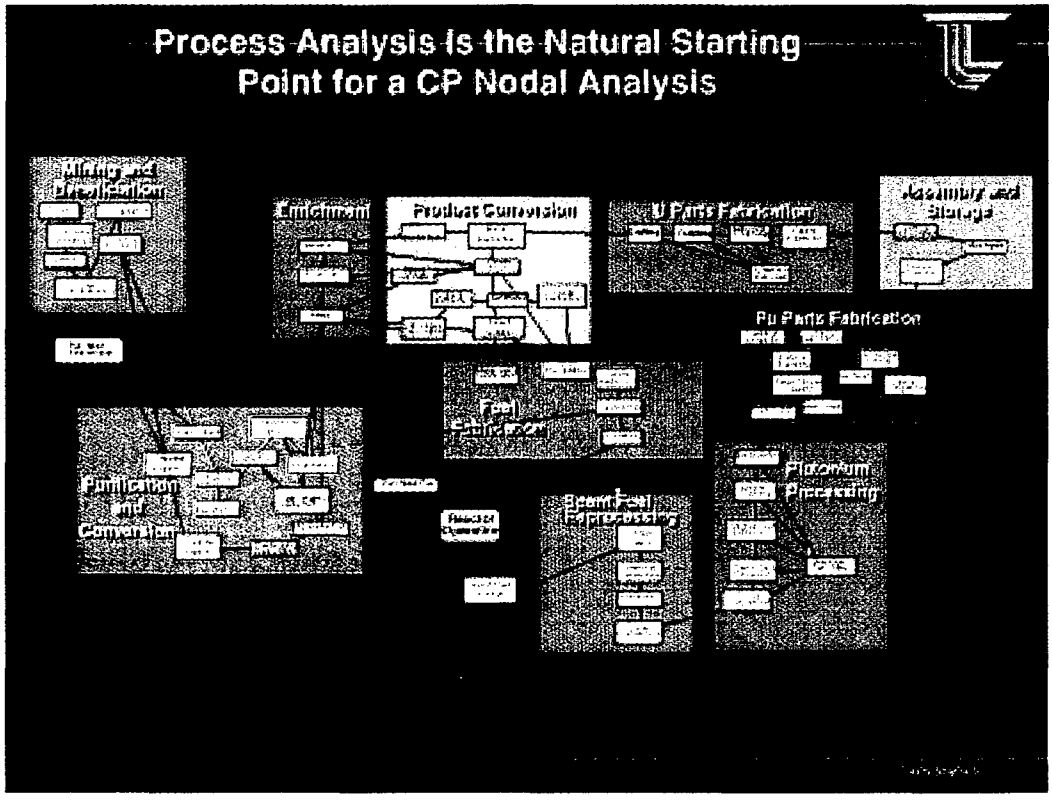
First Priority Is To Provide Balanced Coverage Of Proliferating Countries

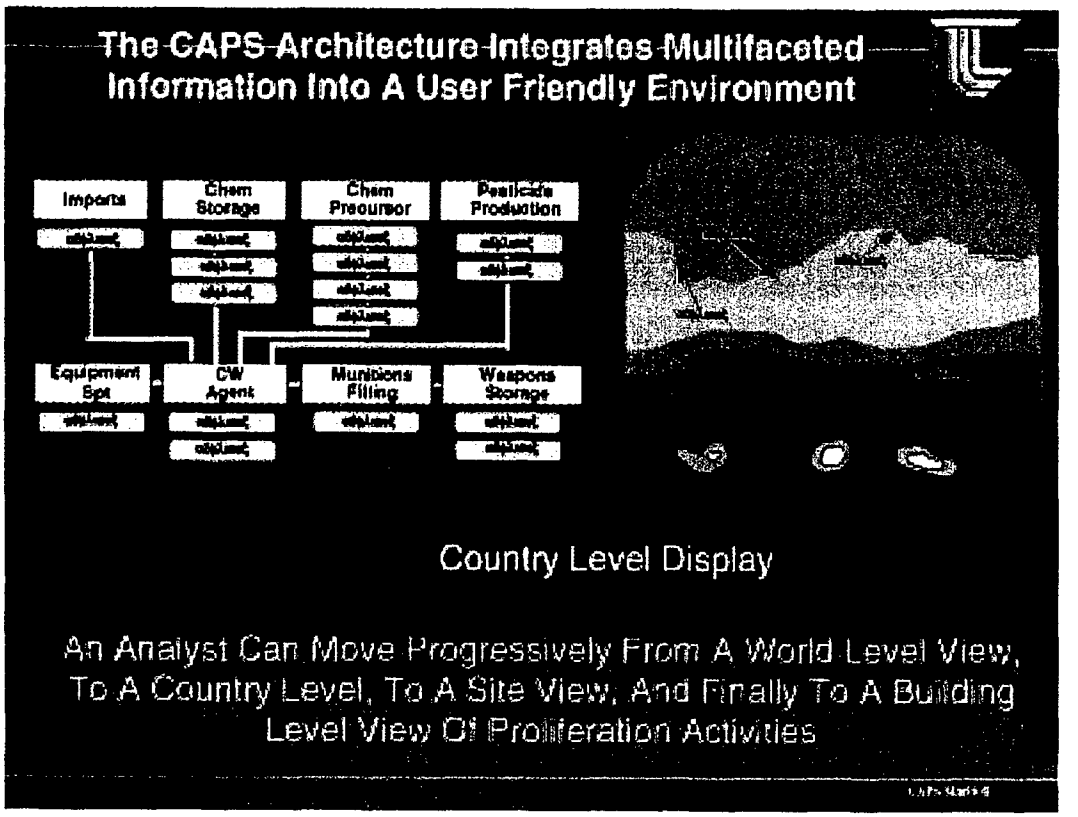
The Depth Of Further Analysis Is Determined By User Requirements

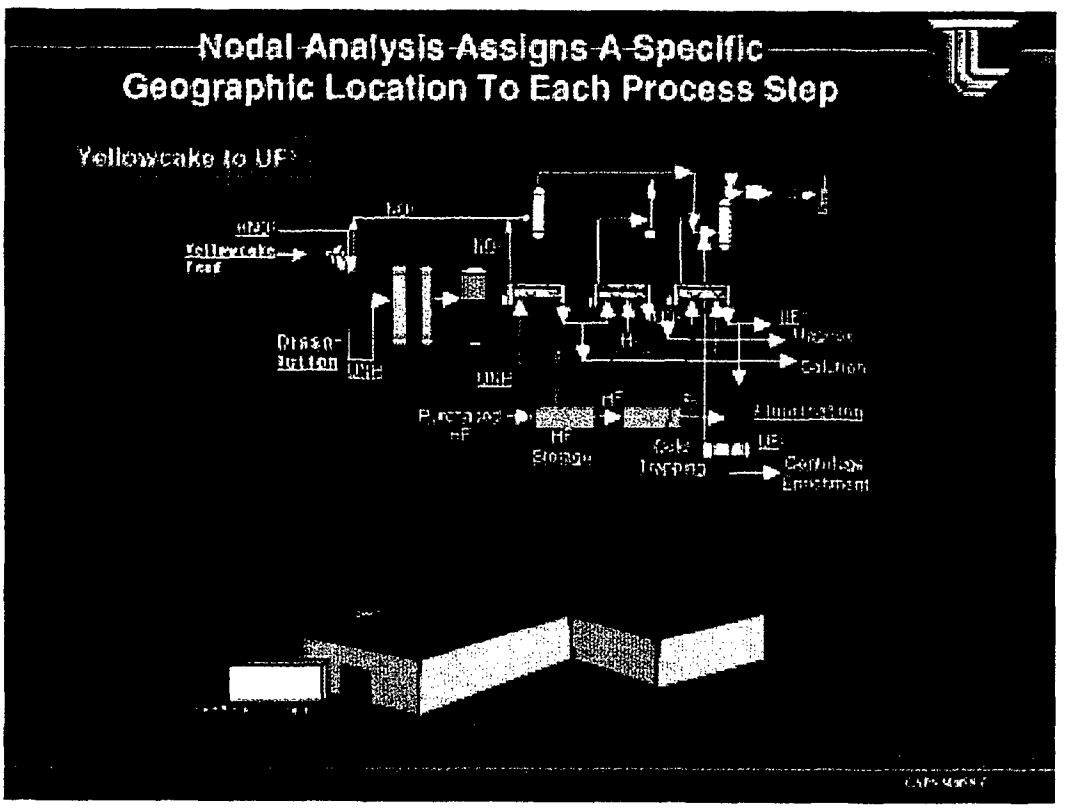
Methodology Permits Us To Dissect Countries At Five Levels Of Detail

- Tier 1 - Preliminary All-Source Country Survey
- Tier 2 - Analyses Of Major Proliferation Sites
- Tier 3 - Country Wide Proliferation Network ID & Analysis
- Tier 4 - Building Level Analyses At Major Weapons Complexes
- Tier 5 - Building Level Analyses At Subsidiary Sites

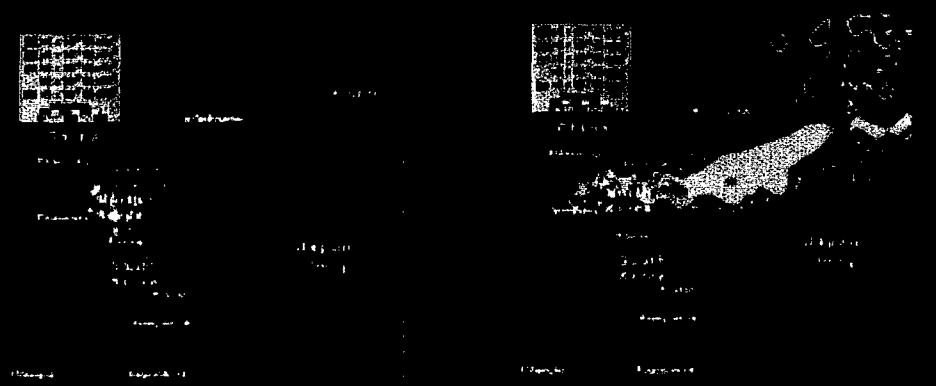

The CAPS Program Is Organized Into Five Major Groups
Program Office
Intelligence Analysis
Nodal Analysis
Modeling
Consequence Analysis
CAPS Architecture
6 Intel Analysts
10 Chem E's
4 Chem E's
6 Physicists & Chemists
8 Computer Scientists & Data Input Specialists


Process Analysis Is the Natural Starting Point for a CP Nodal Analysis
Product Conversion
U Parts Fabrication
Pu Parts Fabrication
Fuel Fabrication
Purification and Conversion
Plutonium Processing


The CAPS Architecture Integrates Multifaceted Information Into A User Friendly Environment
Imports
Chem Storage
Chem Precursor
Pesticide Production
Equipment Spot
CW Agent
Munitions Filling
Weapons Storage
Country Level Display
An Analyst Can Move Progressively From A World Level View, To A Country Level, To A Site View, And Finally To A Building Level View Of Proliferation Activities


Nodal Analysis Assigns A Specific Geographic Location To Each Process Step
Yellowcake to UF6

CAPS Evaluates The Consequences Of Taking Preventive Actions



Plume Calculation of a Hypothetical Release Scenario - Day 2 & Day 6

CAPS Program Accomplishments

Acceptance Within The US Armed Forces
- JWICA - Endorsed By All Combatant CINCs As CP Planning Tool
- JROC - Endorsement For FY00-05 Funding At $12M/Year

CAPS Reaches Military Commands Via High Speed Computer Network
- Approved Network Connects LLNL Scientists To Mil Operational Planners
- Brings Complex Planning Applications To Planners' Desktops

CAPS Actively Supports DIA's CP Program - *Dragon Fury*
- Major Contributor To The *Dragon Fury*'s Computer Interface - *Athena*
- CAPS Provides The Exec Secretary For DIA's CP Program
- CAPS Prgrm Ldr Is Responsible For Incorporating Applications Into *Athena*

CONCLUDING COMMENTS

S. Mullen: The comments by James Adams were very thought provoking. CBW is getting more attention, and we discussed reasons for the lull in apparent nuclear smuggling. Considering the risk, although the probability of an incident is decreasing due to programs like MPC&A, the consequences are severe and increasing, so it is important to continue to pay attention. It is gratifying to hear of the progress in the NIS.

W. Pollack: Problem is, you can't prove that you had an effect.

J. Immele: The program is broader than responding to scams. It involves trafficking, terrorism. The comments by James Adams were very stimulating. FEMA may get responsibility for incident management, as DoD will probably not want that responsibility.

S. Parrish: The comments of V. Brovkin emphasize the need for further analysis of economic and political drivers.

A. Weber: The ISTC and STCU are good programs for weapons scientists. A recent NY Times article praises these programs, but notes that they are underfunded.

S. Mullen: It is hard to keep NBC visible.

E. Vergino: ISTC and STCU are good programs but need to be better connected to the end user (for example, Customs organizations).

G. Anzelon: The IAEA has programs to coordinate technical support, import / export control. There is to be a meeting soon in Vienna to review some of these programs.

V. Jodoin: What was emphasized is the layered defense concept and the need for coordination. We should think about new threats, new technologies: ask ourselves what wasn't covered during this Workshop.

NAME	ORGANIZATION	TELEPHONE/FAX No.
Olinger, Chad	LANL, NM	505-665-8564/505-667-7626
Parker, Winifred	LLNL, CA	925-422-1215/925-422-7894
Parrish, Scott	MIIS, CA	408-647-6654/408-647-3519
Pollack, William M.	DOE, DC	202-586-1127/202-586-0746
Purkitt, Helen	US Naval Academy, MD	410-293-6873/410-293-6876
Ramankulov, Dostay	Kazakstan Embassy, DC	202-333-4504/202-333-4509
Ramos, Thomas F.	LLNL, CA	925-423-2515/925-422-3821
Reuter, Nina	German Embassy, DC	202-298-4356/202-298-4307
Richardson, Jeff	LLNL, CA	925-423-5187/925-422-6434
Schuller, Richard	PNNL, WA	206-528-3260/206-528-3552
Shannon, Neil	US Customs Service, DC	202-927-0522/202-927-1096
Shotts, Wayne J.	LLNL, CA	925-423-8770
Sparks, Michael H.	DOE, MD	301-903-7670/301-903-2247
Staehle, George	LLNL, CA	925-422-2192/925-422-6434
Stern, Jessica		202-965-5678 (h)/202-965-6422
Stevenson, Karen A.	AFTAC, FL	407-494-7116/407-494-8496
Tobin, Mike	LLNL, CA	925-423-1168/925-422-8471
Vasiliev, Igor I.	State Customs, Russia	F#7-095-913-9338
Vergino, Eileen S.	LLNL, CA	925-422-3907/925-422-6434
Wacker, John	PNNL, WA	509-376-1076/509-376-5021
Weber, Andrew	Pentagon, DC	703-695-4503/703-693-4576
Woessner, Paul	U. of Pittsburgh, PA	412-648-2563
Yuldashev, Bekhzad S.	INP, Uzbekistan	F#7-3712-642-590

(B)

AGENDA

FISSILE MATERIALS WORKSHOP #5

February 3-4 1998

USAF Institute for National Security Studies

Hosted by Lawrence Livermore National Laboratory

Best Western Monarch Hotel

Dublin, CA

Tuesday, Feb 3:

8:00	Registration & Continental Breakfast	
8:30	Welcome to LLNL	Wayne Shotts (Nonproliferation, Arms Control & International Security)
8:40	Welcome to Workshop	Ron Lehman (Center for Global Security Research)
8:50	Welcome and Review of Previous INSS Weapons Materials Workshops	Jeff Larsen (SAIC)
9:00	Status of Threat	Moderator, Sally Mullen (Arms Control & Disarmament Agency)
	Potential Users of Nuclear Materials	Jessica Stern (Washington, DC)
	Observations on the Nuclear Smuggling Business	Rensselaer Lee (Global Avisory Services)
10:15	Break	
10:30	US Program	Moderator , John Immele (DOE)
	DOE MPC&A Program	Mary Alice Hayward (DOE)
	Evaluating Physical Protection Systems in Rail Transit with Combat Simulation	Stan Erickson (LLNL)
	DoD / CTR Fissile Material Protection Projects	Andrew Weber (DoD)

Tuesday, Feb 3:

12:00	Lunch	
12:45	Proliferation: A Changing Threat?	James Adams (UPI)
1:30	European Status	Moderator , Scott Parrish (Monterey Institute of International Studies)
	Illicit Trafficking of Radioactive and Nuclear Materials in Poland	Jerzy Niewodniczanski (National Atomic Energy Agency, Warsaw)
	Russian Armed Forces Shrinking and Implications for Potential Mass Destruction Weapons Proliferation	Cptn. Dellenbach (École des Hautes Études en Sciences Sociales, Paris)
	Fragmentation of Authority and Privatization of State in Russia: Implications for Proliferation	Vladimir Brovkin (American University)
	Measures Taken by the State Customs Committee of the Russian Federation for the Trafficking Control of Fissile and Radioactive Materials	Igor Vasiliev (State Customs Committee of the Russian Federation, Moscow)
3:30	Break	
3:45	Case Studies:	Moderator , Scott Parrish (Monterey Institute of International Studies)
	NIS Nuclear Smuggling Since 1995: The Apparent Lull in Significant Cases	Emily Ewell (Monterey Institute of International Studies)
	Development of the Unauthorized Transfer Prevention Program of Nuclear Materials in Ukraine	Volodymyr Kyryshchuk (Insitutue for Nuclear Research, Kiev)
	The Potentials of the Institute of Nuclear Physics in Fissile Materials Control in Uzbekistan	Bekhzad Yuldashev (Institute of Nuclear Physics, Tashkent)
	The Control System of Nuclear Materials in Kazakstan	Dostay Ramankulov (Kazakstan Embassy)
6:00	Adjourn	
6:30	Reception	
7:00	Dinner	

Wednesday, Feb 4

7:30	Continental Breakfast	
8:00	Transportation to LLNL	
8:30	Tour of Nova/Visitors Center	
9:15	Return to Hotel	
10:00	International Cooperation	Moderator, Eileen Vergino (LLNL)
	International Training in the Prevention of Nuclear Smuggling	Shawn Cantlin (LLNL)
	International Technical Working Group	Sid Niemeyer (LLNL)
	International Cooperation in Nuclear Forensics	Lothar Koch (Institute of Transuranium Elements, Karlsruhe)
	LLNL Forensices Science Center	Brian Andresen (LLNL)
11:30	Lunch	
12:15	Preventive Steps	Moderator, Vince Jodoin (INSS)
	Countering Illicit Trafficking in Export Controlled Commodities	George Anzelon (LLNL)
	U.S. Customs Interdiction of Fissile Materials	Neil Shannon (US Customs)
	Are We Prepared to Respond to a WMD Terrorist Act in the United States?	Maurice Eisenstein (RAND)
1:45	Orchestration of the U.S. Law Enforcement Response to a Nuclear Event	Tom Jourdan (FBI)
	Forensic Scene Management - A UK Perspective	William Emerton (Metropolitan Police London)
2:45	Round Table	Moderators, Jeff Richardson (LLNL) /Vince Jodoin (INSS)
3:15	Adjourn	
3:15	Transportation to LLNL	
3:45	Counterproliferation Analysis and Planning System (classified)	Tom Ramos (LLNL)*
4:30	Transportation to Hotel	

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