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Title: DEVELOPMENT OF COMPUTERIZED MATERIALS, PROTECTION, CONTROL, AND ACCOUNTABILITY SYSTEMS IN THE FORMER SOVIET REPBULICS: A JOINT EFFORT

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Development of Computerized Materials Protection, Control, and Accountability Systems in the Former Soviet Republics: A Joint Effort*

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Abstract

The laboratory-to-laboratory programs of cooperation between the US Department of Energy (DOE) and the Institutes of the Russian Federation and the government-to-government programs between the US and Russia have the goal of reducing the danger of nuclear weapons proliferation by strengthening systems of nuclear materials protection, control, and accountability (MPC&A). As part of these programs, DOE is making available to sites in the former Soviet Republics a new-generation nuclear materials accountability system similar to one developed for DOE sites. This new system, the Core Materials Accountability System (COREMAS), is designed for international use. It is a core system to which facility-specific extensions are expected to be made. This paper describes the joint efforts of US personnel and software development teams at sites in Russia, Kazakhstan, and the Ukraine to develop sophisticated computerized MPC&A systems that are customized for the site-specific needs of each facility.

Why Nonproliferation?

The end of the Cold War, the breakup of the Soviet Union, the dismantlement of significant numbers of nuclear weapons, and the growth of plutonium inventories in spent power reactor fuel make a worldwide approach to managing and controlling fissile material a matter of international urgency.

The proliferation of weapons of mass destruction remains a major security issue despite the end of the Cold War. The purpose of nuclear nonproliferation efforts is to apply preeminent science and technology capabilities to deter, detect, and respond to proliferation of weapons of mass destruction, to ensure national security, and to promote international nuclear cooperation. The proliferation of nuclear weapons, along with the technical knowledge, facilities, and materials needed to make these weapons, is an enduring problem. The fate of the nuclear weapons, materials, and expertise in the massive weapons infrastructure of the former Soviet Union (FSU) presents an immediate proliferation danger. Cooperation between US national laboratories and FSU institutes is essential for success of this mission. The main objective of this program is the deterrence, detection, and assessment of international security threats.

The management and control of nuclear materials has been identified as a key element in preventing the spread of nuclear weapons and thus reducing nuclear danger. Proliferation of nuclear weapons is a threat to US and international security. Nuclear materials, an essential ingredient of nuclear weapons, are still relatively scarce and difficult to produce. Therefore, the control and management of nuclear materials is one of the few remaining barriers to nuclear weapons development and proliferation. Nuclear materials management is central to the nonproliferation regime that is designed to detect clandestine proliferation and to protect nuclear materials from diversion. Capabilities and expertise in domestic and international safeguards are the foundation of an effective nonproliferation effort.

How MPC&A Supports Nonproliferation

Strengthening systems of nuclear materials protection, control, and accountability (MPC&A) reduces the risk of nuclear weapons proliferation. MPC&A deters unauthorized acquisition of nuclear materials by threatening to detect the diversion of material. Such an accountability system helps to ensure that all materials in a facility are present in the correct quantities, that any loss of material will be detected promptly, and that the

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quantity and location of any loss will be accurately estimated. These objectives are attained by measuring the materials, analyzing the measurements, and reporting the status of materials within a facility. MPC&A systems deter the diversion of nuclear materials by maintaining positive control of the materials. A computerized accountability system is a critical part of any integrated MPC&A system. To effectively track and monitor the current status of nuclear materials, the nuclear materials custodian must have access to a large amount of data that are best handled in specially designed databases. The custodian must be able to draw material balances around specifically defined operations, monitoring the input and outputs to determine if a diversion may have occurred. Records of transfer of nuclear materials must be maintained so that the history of an item is traceable (auditable). Accountability data must be readily accessible and integrated into a comprehensive safeguards system.

Modern MPC&A technology can insure that nuclear weapons materials around the world are under safe and secure storage. At the heart of any effective program to prevent the proliferation of weapons of mass destruction is a robust analytic program of safeguarding of nuclear materials. The goal of a nuclear management regime is the assurance that all weapons-usable nuclear materials are protected and accounted for and that their use outside the weapons inventories is not for nuclear explosives.

The elements of a nuclear materials management regime include

- protection of and accounting for all nuclear materials by those responsible for the materials; and
- inspection of protection and accountability systems at the national, regional, and international level.

The Benefits of Computerized MPC&A

Accurate recording of the processing, transportation, and storage of nuclear materials is essential to protect and safeguard nuclear materials and thereby reduce nuclear danger. Large amounts of data describing transactions that involve nuclear materials are collected and stored by nuclear materials storage facilities, nuclear chemical processing plants, and nuclear fuel fabrication facilities. Information in these records include

- type of material,
- isotopics,
- quantity,
- owner, and
- past history.

The most efficient, effective way to manage these large amounts of data is through computerized accountability systems. Computerized MPC&A can automate the tracking of movements of material through a site and generate the required material accountability reports. Such systems can assist with international safeguards by generating reports for the International Atomic Energy Agency.

Computer software is becoming increasingly important in the design, development, implementation, and operation of materials control and accountability systems for safeguarding nuclear materials. MPC&A software is used to

- organize and manage safeguards-relevant data,
- acquire data from measurement and surveillance instruments,
- allocate scarce resources in achieving optimal system designs,
- simulate the random and dynamic aspects of facility and safeguards operations,
- analyze data to detect and resolve anomalies, and
- identify vulnerabilities.

US Aid to FSU Facilities in Developing MPC&A Systems

The US has an effort underway to enhance, through technical cooperation between US and FSU states, the effectiveness of MPC&A technology at nuclear facilities that process or store high- or low-enriched uranium and plutonium. The intent of this initiative is to provide a means for rapid implementation of technology to improve the MPC&A of nuclear weapons materials. This is part of a major US effort to work jointly with the FSU states to control nuclear weapons, materials, and expertise. Scientific collaborations under the laboratory-to-laboratory agreement provide a mechanism for cooperative work and complement the more formal government-to-government arrangements. US laboratories and FSU institutes share technical information and experience from their application of MPC&A methods and technologies.

Sites in the US Department of Energy complex that process or store nuclear materials are adopting a computerized nuclear materials accountability system that was developed at Los Alamos National Laboratory. The Core Materials Accountability System (COREMAS), an international version of this software, is available to FSU sites. This is a network-based nuclear materials accountability system that operates in a client/server mode, utilizing a local area network. The database resides on the server, whereas the user interface runs on the client. The client accesses the server through a network connection. COREMAS is available with English or Russian language user interfaces. Figure 1 shows the English language version of the form used to report the combining of multiple nuclear materials items into a new item. A complete history of all items is maintained.

COREMAS is fully functional as distributed and may be used immediately. The database includes all tables necessary for full performance of the accountability system. It was designed to fully characterize a facility's nuclear materials. The COREMAS distribution package includes all source code, so a facility may use it as a foundation for building their own MPC&A system. This provides the capability of adding functionality and building on COREMAS by writing software that interfaces with the core application. Sites can add tables to the database, add functionality that addresses site-specific or national requirements, and create their own user interface. Enhancements will be implemented by equipment and techniques of both the FSU institutes and the US.

COREMAS includes the following functionality:

- material movement—intra-material balance area (MBA) moves, inter-MBA moves, and external shipments and receipts;
- material transforms—splits, combines, decay of materials;
- containerization of materials;
- physical inventory support functions;
- support for standard and ad hoc queries and reports;
- complete item transaction history; and
- system maintenance and administration functions.

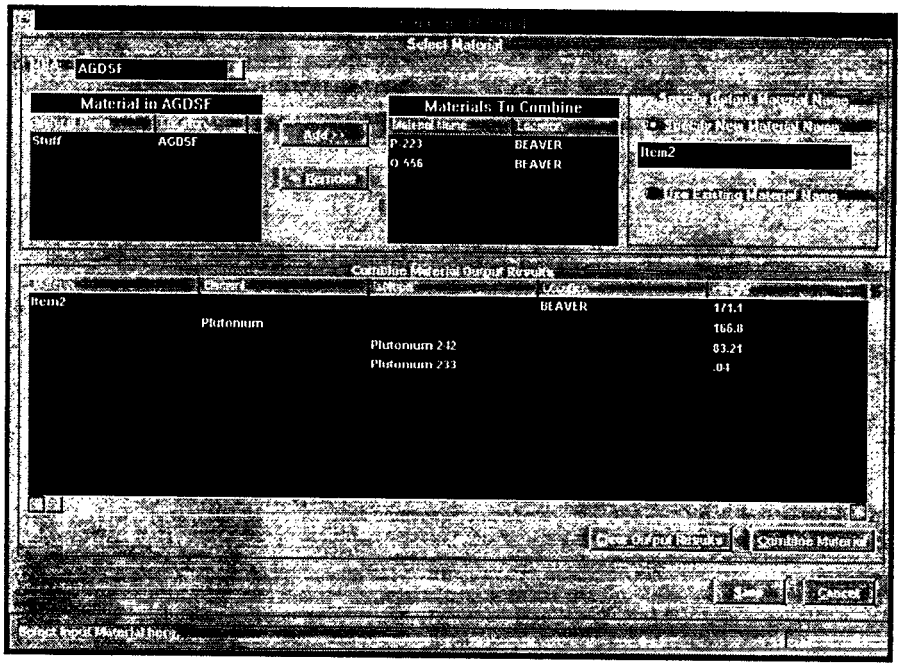

Figure 1.
The English language ***Combine Material*** form.