COOPERATION BETWEEN THE RUSSIAN FEDERATION AND THE UNITED STATES TO ENHANCE THE EXISTING NUCLEAR-MATERIAL PROTECTION, CONTROL, AND ACCOUNTING SYSTEMS AT MAYAK PRODUCTION ASSOCIATION

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ABSTRACT

The Ministry of the Russian Federation for Atomic Energy (MINATOM) and the US Department of Energy (DOE) are engaged in joint, cooperative efforts to reduce the likelihood of nuclear proliferation by enhancing Material Protection, Control and Accounting (MPC&A) systems in both countries. Mayak Production Association (MPA) is a major Russian nuclear enterprise within the nuclear complex that is operated by MINATOM.

This paper describes the nature, scope, and status of the joint, cooperative efforts to enhance existing MPC&A systems at MPA. Current cooperative efforts are focused on enhancements to the existing MPC&A systems at four plants that are operated by MPA and that produce, process, handle and/or store proliferation-sensitive nuclear materials.

INTRODUCTION

In accordance with agreements between the Russian Federation and the United States concerning control, accounting, and physical protection of nuclear material, the Mayak Production Association (MPA) is participating as a partner with MINATOM, DOE and six DOE national laboratories in the Joint US/Mayak Project Team (JUSMPT). The goal of the JUSMPT is to reduce the likelihood of nuclear proliferation by enhancing the existing MPC&A systems at MPA. The US members of the JUSMPT are drawn from the following national laboratories: Brookhaven, Lawrence Livermore, Los Alamos, Oak Ridge, Pacific Northwest, and Sandia.

The work of the JUSMPT is currently focused on enhancements to the existing MPC&A systems at four plants that are operated by MPA and that produce, process, handle and/or store proliferation-sensitive nuclear materials.

BACKGROUND

MPA began operation in June 1948 for the purpose of producing plutonium and other nuclear materials for weapons. In 1976 MPA began reprocessing spent nuclear fuel from civilian reactors. MPA continues to operate a number of plants and facilities that produce, process, handle and/or store proliferation-sensitive nuclear materials. Four of these plants and facilities are the subject of current cooperative efforts to enhance existing MPC&A systems. These four are: Plant 235, the Isotope Production Reactor Plant, the Isotope Production

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DISCLAIMER

Plant and the Highly-Enriched-Urainium-Purchase-Program Oxidization Facility.

Plant 235 contains the RT-1 Plant which was brought on line in 1976 to reprocess civilian spent nuclear fuel. One of the aims in the reprocessing of spent nuclear fuel at the RT-1 plant is the extraction and affinage (refinement) of plutonium as plutonium dioxide, which is a proliferation-sensitive nuclear material. Originally the plan was to develop a closed nuclear fuel cycle that would have involved producing mixed-oxide fuels containing both uranium and plutonium. This plan has not been put into operation, and MPA is now faced with the long-term problem of storing and safeguarding the plutonium dioxide.

For long-term storage, the plutonium dioxide is packed in a specially designed, hermetically sealed container comprised of inner and outer canisters made of stainless steel. The container lid is a metal-ceramic filter. The storage facility for these containers is located within the Plant 235 and consists of two buildings, 104 and 142, along with engineering facilities that ensure that the functions of receiving, handling, controlling and accounting are properly executed.

The Isotope Production Reactor (IPR) Plant houses a reactor that is used to generate radioactive isotopes.

The materials produced at the IPR Plant are subsequently reprocessed at the Isotope Production Plant to obtain radioactive isotopes. These isotopes are used in Russia for a variety of purposes and are also sold around the world for industrial, medical and research applications.

The US Government has entered into agreements with the Russian Federation to purchase Highly-Enriched-Uranium (HEU) that is obtained from the dismantling of nuclear weapons. These agreements are being implemented under the HEU-Purchase-Program. MPA operates one of the many facilities located throughout Russia that are involved in the HEU-Purchase-Program. In this paper the facility operated by MPA is referred to as the HEU-Purchase-Program Oxidization Facility.

Initial contacts with MPA related to MPC&A began with a visit in July 1994 by a Russian delegation, including representatives of MPA, to a plutonium storage facility at the Hanford Site, located in Richland, Washington. On a reciprocal visit, a US delegation traveled to Ozersk in October 1994 and toured the RT-1 plant. These initial visits led to an agreement calling for:

1. the US to provide samples of US MPC&A equipment to MPA,
2. the US to demonstrate operation of this equipment in Ozersk,
3. MPA to conduct an evaluation of the suitability of this equipment for use in Russian environmental conditions.

Completion of the steps of this agreement and the selection of MPA to be one of the sites for expanded government-to-government cooperation (based on a June 1995 agreement between DOE and MINATOM) paved the way for MPA participation in a MPC&A workshop that was held in Obninsk in October, 1995 and for a meeting at Ozersk in February 1996.

The February 1996 meeting resulted in the formation of the JUSMPT and provided the opportunity for the US members of the JUSMPT to tour the RT-1 plant and gain first hand insights into the existing MPC&A systems at RT-1. During this meeting, MPA personnel pointed out that the RT-1 plant had been in use for more than 20 years and that the existing MPC&A systems could benefit from design, equipment and methodology enhancements. This meeting resulted in the identification of short-term, medium-term and long-term enhancements to the existing MPC&A systems at the RT-1 plant.

In the fall of 1996 the Isotope Production Reactor Plant was added to the list of plants and facilities that could be the subject of cooperative efforts to enhance existing MPC&A systems. In the summer of 1997 the Isotope Production Plant and the HEU-Purchase-Program Oxidization Facility were added to the list.

WORK IN PROGRESS

During the February 1996 meeting in Ozersk and a subsequent meeting in the US in April 1996, the JUSMPT agreed on the scope of its initial efforts. These efforts include enhancements to the existing physical protection systems at the RT-1 plant as well as enhancements and further development of the existing MPC&A systems at the plutonium dioxide storage facility located within the Plant 235. Fifteen orders have been signed that call for collaborative efforts to enhance existing MPC&A systems at the RT-1 plant. These are:

- Characterization of RT-1 Industrial Site: This order enables MPA to prepare a report characterizing the RT-1 industrial site. This report will describe the existing MPC&A systems at the RT-1 industrial site and will also be used as input data for subsequent evaluations of the effectiveness of existing MPC&A systems. These evaluations will, in turn, guide the design and development of enhancements to the existing systems.

- Safeguards Effectiveness Evaluation Workshop: This order enables MPA to host a Vulnerability Assessment (VA) workshop. VA is an analytical methodology that can be used to evaluate existing MPC&A systems. The VA methodology produces mathematical estimates of nuclear proliferation risks. The VA methodology also provides the data required to compare the costs of various alternative options for enhancing the existing MPC&A systems. Since the plutonium dioxide storage facility will be used as an example in the exercises completed during this workshop, the experience gained by the MPA specialists participating in this workshop will be particularly relevant to our work-in-progress and to our future collaboration.

- Enhance Perimeter Security: The perimeter security system surrounding Plant 235 has been damaged by a rising water table. Repairing the damaged section of security perimeter is considered a high priority task that merits immediate action. Repairing the perimeter fence involves soil engineering and repairs and fence repairs as well as re-engineering and repairing the perimeter intrusion detection and assessment system.

- Physical Protection Enhancements to Storage Buildings 104 and 142: From the point of view of physical protection of direct-use materials, buildings 104 and 142, which are used as storage buildings for significant quantities of plutonium dioxide, are the most important buildings at Plant 235. Despite their importance, these buildings are currently protected at the same level as other industrial buildings located within Plant 235. This order enables MPA to design and install physical protection system enhancements for the interior and exterior of these storage buildings. These enhancements will include provisions for a local perimeter intrusion detection and assessment system, a personnel/vehicle access control portal, an alarm display and assessment station, entry controls, access delays, and emergency communications.

- Communication Enhancements: The physical protection systems at MPA depend on adequate communication between the security forces that are located throughout the large geographic area over which the operations of MPA are spread. This order enables MPA to upgrade the existing security communication system at MPA so as to further enhance nuclear MPC&A throughout MPA.

- TID Program: A complete MPC&A system includes Tamper Indicating Devices (TIDs) that are used to detect unauthorized access to sensitive facilities or to nuclear material itself. This order enables MPA to develop and implement a TID program to increase the efficiency of the existing nuclear material monitoring and inventory systems used in the plutonium dioxide storage facilities.

- Bar Code Program: The purpose of this order is to provide bar code equipment to support enhancement of the existing

procedures used to control and account for the containers of plutonium dioxide at the RT-1 plant. As a first step in the completion of this order, the US will supply bar code equipment to MPA to support a demonstration of bar code technology in the storage buildings 104 and 142.

- Computerized Inventory Records: This order enables the rapid design, implementation and demonstration of a computerized inventory system for the containers of plutonium dioxide at the RT-1 storage facility. These computerized records will incorporate the same passport data that is currently in the hand written journals of MPA. The work that will be completed under this order is a basic, labor-intensive first step in the development of a comprehensive computerized control and accounting system for the containers of plutonium dioxide at the RT-1 storage facility.

- Tank Volume Measurement Techniques: This order enables the test and evaluation of computerized tank volume measurement (TVM) instrumentation at the RT-1 plant. TVM equipment will be provided to MPA to support a demonstration of TVM technology in a test-stand environment. This demonstration may subsequently lead to the application TVM technology in the operational environment of the RT-1 plant.

- Inventory Taking in Buildings 104 and 142: This order enables the rapid design, implementation and demonstration of a Physical Inventory Taking (PIT) of the plutonium dioxide storage containers in buildings 142 and 104 at the RT-1 plant.

- Pedestrian and Vehicle Portal Monitors: Portal monitoring to deter and detect possible special nuclear material (SNM) diversion from the RT-1 plant is currently implemented on a limited scale. The intent of this order is to enhance both technological and procedural methods for detecting and deterring SNM diversion by increasing the use of pedestrian and vehicle portal monitors.

- Hand-Held Radiation Monitors: This order enables evaluating appropriate applications for hand-held radiation detectors at the RT-1 plant and procuring the appropriate numbers and types of detectors for the selected applications.

- MC&A Measurement Support: The purposes of this order are threefold: (1) to enhance general MC&A measurement support, (2) to enhance non-destructive isotopic measurement methods for use in process measurements at MPA, and (3) to evaluate gamma and neutron Non-Destructive Analysis (NDA) measurement methods for quantitative inventory measurement and verification.

- Enhancement of Plutonium-Mass Measurement: This order enables MPA to develop and implement an enhanced, computerized plutonium-mass measurement system to be used in the final stage of the plutonium dioxide production facility. This system will lead to more accurate knowledge of the quantity of plutonium dioxide being produced and stored at MPA.

- Computerized MC&A Systems: This order enables MPA to develop, test and implement an enhanced computerized MC&A system at the final stage of plutonium dioxide production from the RT-1 plant and the plutonium dioxide storage buildings.

- Improved Access Control at the IPR Plant: This order enables MPA to design an improved access control system for the IPR Plant.

PROGRESS TO DATE

Progress on all the orders is well underway. The initial characterization of RT-1 industrial site has been completed and is being updated as required. The Safeguards Effectiveness Evaluation Workshop has been completed as

have a number of other MPC&A related workshops. Enhancements to the existing perimeter security system at Plant 235 have been designed and are being implemented. MPA wide security communication system enhancements have been designed and are being implemented. TID and bar code programs have been designed and are being implemented. The existing inventory records for the plutonium dioxide storage canisters are being computerized. A TVM system has been installed in an operating tank at the RT-1 reprocessing plant and installations of additional TVM systems are planned. Plans for taking a complete physical inventory of the plutonium dioxide storage canisters have been formulated and the inventory will begin soon. Pedestrian and vehicle portal monitors have been delivered and are being installed at Plant 235. Hand-held radiation monitors have been delivered and are being used at Plant 235. A gamma spectrometer and neutron spectrometer have been delivered and are is use at the RT-1 plant analytical laboratory. Development of a computerized MC&A systems for use at the RT-1 plant and other MPA plants and facilities are underway. A design for improved access control at the IPR Plant has been developed and is under review.

CONCLUSION

Because of the quantity and nature of the nuclear material involved, the work outlined in this paper represents a significant milestone in the ongoing program of cooperation between the Russian Federation and the United States on issues related to nuclear non-proliferation. Successful completion of this work will place a considerable quantity of proliferation-sensitive nuclear material under significantly improved protection, control and accountability. Furthermore, successful completion of this initial work will create the conditions for expansion of our collaboration to include other MPA facilities and operations.