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COOPERATION BETWEEN THE UNITED STATES DEPARTMENT OF ENERGY NATIONAL LABORATORIES AND MAYAK PRODUCTION ASSOCIATION FOR ENHANCEMENTS TO MATERIAL PROTECTION CONTROL AND ACCOUNTING SYSTEMS

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ABSTRACT

The Agreement Between the Department of Defense of the United States and The Ministry of the Russian Federation for Atomic Energy (MINATOM) Concerning Control, Accounting, and Physical Protection of Nuclear Material, as well as a subsequent amendment to that agreement and a joint statement signed by the Department of Energy (DOE) and MINATOM, resulted in the selection of the Mayak Production Association (MPA) as one of the Russian enterprises that would participate with DOE Laboratories in expanded cooperation aimed at enhancing Material Protection, Control and Accounting (MPC&A) systems in both countries.

This paper describes the nature and scope of the expanded cooperation involving MPA and six DOE laboratories at an operating civilian, spent-nuclear-fuel reprocessing plant designated RT-1. RT-1 produces, among other materials, reactor-grade plutonium dioxide, a direct-use material that is stored within the boundaries of this plant. Initial efforts at expanded cooperation will focus on enhancements to the existing MPC&A systems at MPA's RT-1 plant.

INTRODUCTION

The governments of both the United States and Russia have repeatedly expressed the importance of cooperation between the two countries in their efforts to enhance the nuclear Material Protection, Control and Accounting (MPC&A) systems in both countries. The goal of these MPC&A enhancements is to reduce the likelihood

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of nuclear weapons proliferation. Both governments have also emphasized the importance of rapid, demonstrable progress in our cooperative efforts to enhance MPC&A systems in both countries.

In accordance with The Agreement Between the Department of Defense of the United States and The Ministry of the Russian Federation for Atomic Energy (MINATOM) Concerning Control, Accounting, and Physical Protection of Nuclear Material, as well as a subsequent amendment to that agreement and a joint statement signed in June 1995 by the Department of Energy (DOE) and MINATOM, the Mayak Production Association (MPA) is participating as a partner with six of the DOE national laboratories in the Joint US/Mayak Project Team (JUSMPT). The goal of the JUSMPT is to enhance 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.

BACKGROUND

MPA began operation in June 1948 for the purpose of producing plutonium for nuclear weapons. In 1976 MPA began reprocessing spent nuclear fuel from civilian reactors. MPA's RT-1 plant continues 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, a direct-use 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 RT-1 plant 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.

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.

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 MC&A systems at the plutonium dioxide storage facility located within the RT-1 plant. Fifteen orders have been signed that call for collaborative efforts between MPA and the six participating national laboratories 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 Fence: The perimeter fence surrounding MPA's

RT-1 reprocessing plant has been damaged by a rising water table. Repairing the damaged section of 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 the RT-1 plant. Despite their importance, these buildings are currently protected at the same level as other industrial buildings located within the RT-1 plant. 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 system within the RT-1 plant depends on adequate communication between the security forces that are located throughout Ozersk City. This order enables MPA to upgrade the existing security communication system at MPA so as to further enhance nuclear MPC&A at the RT-1 plant and 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.

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 direct-use 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.