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 (Mayak) 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 Mayak. Current cooperative efforts are focused on enhancements to the existing MPC&A systems at two plants that are operated by Mayak and that produce, process, handle and/or store proliferation-sensitive nuclear materials.

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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 (Mayak) 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 Mayak. US participation on the JUSMPT is drawn from the following national laboratories: Brookhaven, Lawrence Livermore, Los Alamos, Oak Ridge, Pacific Northwest, and Sandia.

Mayak operates a number of plants and facilities that produce, process, handle and/or store proliferation-sensitive nuclear materials. MINATOM has given permission for the JUSMPT to engage in cooperative efforts to enhance the existing MPC&A systems at four of the plants operated by Mayak that produce, process, handle and/or store proliferation-sensitive nuclear materials. The JUSMPT has determined that two of these four plants do not present a significant proliferation risk and thus the work of the JUSMPT is currently focused two of the four plants permitted by MINATOM.

BACKGROUND

Mayak began operation in June 1948 for the purpose of producing plutonium and other nuclear materials for weapons. In 1976 Mayak commissioned the RT-1 plant for the purpose of reprocessing spent nuclear fuel from civilian reactors. Mayak continues to operate a number of plants and facilities that produce, process, handle and/or store proliferation-sensitive nuclear materials. Two of these plants are the subject of current MINATOM / DOE cooperative efforts to enhance existing MPC&A systems. These are:

1. The RT-1 Plant. One of the primary goals in the reprocessing of civilian spent nuclear fuel is the extraction and affinage (refinement) of plutonium as plutonium dioxide. The original plan was to use the plutonium dioxide as a feed stock in a closed nuclear fuel cycle that would have involved producing mixed-oxide fuels containing both uranium and plutonium for use in civilian power reactors. To date, this plan has not been put into operation. As a result Mayak is now faced with the long-term problem of storing and safeguarding the plutonium dioxide, which is a proliferation-sensitive nuclear material.

For long-term storage, the plutonium dioxide is packed in a specially designed, hermetically sealed containers comprised of inner and outer containers 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 boundary and consists of two buildings along with engineering facilities that ensure that the functions of receiving, handling, controlling and accounting are properly executed.
2. Plant 1. This plant contains the facility in which some of the Highly-Enriched-Uranium (HEU) obtained from the dismantling of nuclear weapons is oxidized for subsequent blending with Low Enriched Uranium (LEU) as part of the HEU Purchase Program – another joint Russian/US nonproliferation program.

Initial contacts with Mayak related to the DOE MPC&A program began with a visit in July 1994 by a Russian delegation, including representatives of Mayak, 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. In a June 1995 agreement between MINATOM and DOE, Mayak was selected to be one of the sites for expanded cooperation. This selection paved the way for the first meeting of the JUSMPT which was held at Ozersk in February 1996.

The February 1996 meeting of the JUSMPT 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 the plant. During this meeting, Mayak 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 July 1997, MINATOM gave permission for the JUSMPT to implement enhancements to the existing physical protection systems at Plant 1.

WORK IN PROGRESS

Work at the RT-1 Plant is currently divided into four major work packages:
1. MPC&A enhancements to the RT-1 Plant security perimeter.
2. MPC&A enhancements within the reprocessing buildings.
3. MPC&A enhancements to the temporary storage vault located at the end of the reprocessing line. The canisters of plutonium dioxide are temporarily stored in this vault for a short time until eight canisters have accumulated. After eight canisters have accumulated they are transported to the long-term storage buildings discussed below.
4. MPC&A enhancements to the buildings that are used for the long-term storage of the plutonium dioxide.

Work at Plant 1 is still in the discussion stage. Nuclear-material-detection monitors for use at the pedestrian and vehicular portals to the plant have been received at Mayak and will be installed in FY99.
The MPC&A objectives for the RT-1 Plant security perimeter are:

1. To repair the existing security perimeter around the RT-1 Plant. A section of the existing security perimeter around the RT-1 plant that had been damaged by a rising water table has been repaired.

2. To install nuclear-material-detection monitors at plant portals for the purpose of detecting attempts to remove proliferation-sensitive nuclear material from the plant. Nuclear-material and metal-detection monitors have been installed at all frequently used pedestrian portals. The monitors required for all frequently used vehicle portals have been delivered to Mayak and will be installed in FY99. Special procedures involving hand-held monitors will be used at infrequently used vehicle and pedestrian portals.

3. To upgrade the existing security communication system. The first phase of the security communication system upgrades have been delivered and installed. The second phase will be delivered and installed in FY99.

4. To enhance the existing personnel badge and access control system. A study to determine what enhancements are required is scheduled for completion in early FY99. Implementation of the enhancements is scheduled to be completed in FY99.

The MPC&A objectives for the RT-1 reprocessing buildings are:

1. To enhance nuclear-material-balance calculations in the reprocessing buildings. On the order of two metric tonnes of plutonium dioxide are produced each year in the RT-1 reprocessing building. At any one time, tens of kilograms of plutonium are spread throughout the tanks and pipes in the processing line. Material balance calculations are used to detect theft of material from the reprocessing building. The nuclear-material-balance accounting enhancements are being implemented by improving nuclear-material measurements at the reprocessing building. Improvements are being made in both measurement instruments and measurement methodologies. Measurements are used to determine the quantities of nuclear materials entering and leaving the building between material balance determinations, as well as to determine the quantities of nuclear materials spread throughout the reprocessing line during material balance determinations. Measurement upgrades are being made for bulk quantities such as volume and mass as well as destructive and non-destructive measurements of nuclear quantities. The majority of this work is under way and continues into FY99.

2. To purchase and install a computerized system that will acquire and log the material-balance measurements. This computer system will become part of the computer network that will maintain an accounting of the quantities and locations of nuclear materials as they pass through the reprocessing building and, thereby, support detection of a theft of nuclear materials. Typically, to detect a theft or loss of nuclear material, the reprocessing line is shutdown and flushed-out on a periodic schedule to conduct a static material balance. The time between static inventories might be on the order of one year. In addition to providing the data needed for the static material balance calculations, the instruments and computer network that are being implemented by the MPC&A program will enable detection of theft.
more frequently, without requiring a line shutdown, by enabling dynamic physical
inventories and material balance calculations while the plant continues to operate.

The MPC&A objectives for the temporary storage vault at the end of reprocessing building
are:
(1) To hardening the vault walls and doors.
(2) To build an access delay cage in which to temporarily store up to eight canisters.
(3) To install interior and exterior intrusion-detection sensors, lights, and video-assessment
cameras.

The MPC&A objectives for the plutonium dioxide storage buildings are:
(1) To design and construct an access delay system consisting of more than 1600 steel-clad,
steel-reinforced, one-ton, concrete blocks that are being placed over the concrete trenches
in which the canisters are stored. These blocks interlock with each other so as to create a
thick steel and concrete access-delay covering over the canisters.
(2) To design and construct a local perimeter intrusion detection and assessment system
(PIDAS) around the storage buildings including (a) fences and intrusion sensors, (b) alarm
assessment video cameras and lights, (c) central and secondary alarm stations, (d) an
access control portal with nuclear material detection sensors.
(3) To design and construct a Physical Inventory Taking (PIT) laboratory that includes non-
destructive analysis (NDA) instruments to be used during inventories of the canisters in
the storage buildings. These NDA measurements will be used to confirm the previous
inventory records relating to the contents of the canisters, and to detect unauthorized
diversion of plutonium dioxide.
(4) To design and implement a computerized system for controlling and accounting for the
canisters in storage.
(5) To evaluate, select and install tamper-indicating devices and bar code labels on the
canisters in storage and on new canisters as they are brought to storage.

CONCLUSION

Because of the quantity and nature of the nuclear materials 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 Mayak plants and facilities that produce,
process, handle and/or store proliferation-sensitive nuclear materials.