EXPERIENCE IN INTEGRATING MATERIAL PROTECTION, CONTROL, AND ACCOUNTING AND PROTECTIVE FORCE UPGRADES AT A UNIQUE UNDERGROUND NUCLEAR PRODUCTION FACILITY

Konstantin Dorofeev, STC-MCC
Vladislav Cherkasov, MCC
Andrey Momot, MCC

Doyle Hembree, Oak Ridge National Laboratory
Thomas Bonner, Oak Ridge National Laboratory

Steven Vasel, Gregg Protection Services

Adrian Pidlusky, United States Department of Energy

ABSTRACT

The Scientific and Technical Center Mining and Chemical Combine (STC-MCC) is a Federal Agency for Atomic Energy (FAAE) nuclear facility located near the city of Zheleznogorsk, Russia. Located on the banks of the Yenisy River, the production facility is contained within a granite massif which houses both a reactor plant and a radiochemical plant. Prior to 1995, the facility was tasked with the production of plutonium oxides for shipment off-site. However, in 1995, the mission of the site changed to include provision of longer-term storage of nuclear materials produced as a result of site operations, a mission that continues today. This paper details the cooperative Material Protection, Control, and Accounting (MPC&A) Program efforts between the MCC team and the U.S. project team to implement integrated physical protection and protective force measures necessary to ensure continued safeguarding of nuclear materials at the site. These efforts include the upgrading and expansion of the existing plutonium storage area pending installation of a permanent storage area, the design and development of permanent storage, and the expansion of physical protection and protective force upgrades necessary to provide increased detection and response capabilities.

INTRODUCTION

The Mining and Chemical Combine [MCC, or Gorno-Khimichesky Kombinat (GKhK)] is a Federal Agency for Atomic Energy (FAAE) production facility located within the city of Zheleznogorsk, in the Krasnoyarsk region of Russia. Zheleznogorsk, a city with a population of approximately 100,000, is located approximately 10 km from the underground site of MCC. The decision to build MCC was made in 1950. The initial purpose of MCC was to ensure continuity in the production of weapons-grade plutonium for defense purposes.

The nature of the MCC site is unique, considering the spectrum of activities and interests maintained in the facility and the location and construction of the facility within a solid mountain enclosure. The underground MCC facility, which is located on the east side of the Yenisey River, includes two decommissioned nuclear reactors, one operating nuclear reactor, a radiochemical processing facility, a heat and electric power plant, water supply and ventilation facilities, underground waste storage facilities, and storage areas for special nuclear material (SNM).

In 1992, two of the three reactors (AD and ADE-1) at the site were shut down. The ADE-2 dual-purpose reactor continues to operate, providing electricity and process steam for Zheleznogorsk. This reactor is expected to operate until 2009, at which time power for the city of Zheleznogorsk will be provided by a coal-fired plant that is currently under construction.

Part of the above-ground section of MCC includes a deep-well injection site and an unfinished radiochemical processing facility (RT-2). These sites are not currently covered by the MPC&A program.

The MCC radiochemical plant (RCP) became operational in 1964 and produces PuO_2 from natural uranium fuel slugs used in the reactors. The materials produced at the RCP originally were transported to other MinAtom nuclear sites for storage and use. However, in the mid-1990s MCC was directed by MinAtom to stop shipment of PuO_2, and this material has since been stored at the underground facility.

OVERVIEW OF MPC&A COOPERATIVE EFFORTS

MPC&A cooperative efforts at MCC were initiated in 1996, and these efforts continue. Cooperative efforts at the site focused on the provision of reasonable layers of physical protection for site interests when feasible, and the implementation of MPC&A infrastructure needs. Initially, MCC established a team of support specialists to work with the U.S. project team in identifying and evaluating upgrade needs, and the MCC team remains basically the same in composition today as it was during the early years of cooperative efforts. The MCC team includes senior management personnel with decision-making authority as well as technical experts in physical protection and material control and accounting (MC&A).

The composition of the U.S. team has evolved since 1996, but all changes have considered the need for continuity of efforts and ensuring that the supporting team members provide the expertise needed to meet the strategic goals and objectives of the cooperative upgrade program. U.S. team representatives include experts in the fields of engineering, physical protection, and MC&A. The team also includes a representative of the U.S. Protective Force Team and a Department of Energy (DOE) project manager as active team members. The U.S. team has included representatives from Oak Ridge National Laboratory, Brookhaven National Laboratory, Sandia National Laboratory, Los Alamos National Laboratory, and Lawrence Livermore National Laboratory, as well as personnel from Gregg Protection Services and the Savannah River Site.

INITIAL COOPERATIVE UPGRADES

Plutonium oxide is currently stored at the site in an established secure storage area within the underground complex. However, the area provided for storage is limited and cannot accommodate near- and long-term storage demands that will result from the continued processing of spent nuclear fuel at the site. The production of PuO_2 will continue beyond the projected shutdown date of the ADE-2 reactor in order to process natural uranium fuel slugs in the spent fuel cooling pond at the underground facility. As a result, MCC, in cooperation with the DOE MPC&A program, has designed and started construction of a new PuO_2 storage area to address current and future storage requirements for PuO_2. Further, discussions between the DOE and MinAtom have identified the potential transfer of additional plutonium materials from other Minatom sites to MCC for longer-term storage. This transfer of additional materials remains under review.

The initial efforts of the joint MCC and U.S. project team focused on expanding and upgrading the existing storage area for PuO_2 at the site. These efforts were recognized by both MCC and the U.S. project team as providing a fast but temporary solution to the issue of available storage space. This work was based upon the completion of a non-sensitive characterization of the existing storage area and materials being maintained in the area. Physical protection and MC&A upgrades were implemented at the storage area to further enhance and supplement existing physical protection provided by MCC. Hardened pathways were built, additional detection and assessment equipment was installed in the storage area, and the use of tamper-indicating devices and material measurement capabilities were implemented for the PuO_2 in storage.

The physical protection infrastructure necessary to support an integrated protection system for the existing storage area was also considered and addressed during initial cooperative efforts. Entry control portals were established for personnel to provide routine access to the radiochemical plant and the nuclear material storage area. Equipped with SNM detectors, metal detectors, and access control systems, the entry control points were staffed by MCC protective force personnel. The use of these portals enhanced access control for both the radiochemical plant and the storage area.

The integration of these measures with the MCC protective force within the underground facility and with Ministry of Internal Affairs-Internal Troops (MVD-IT) protective forces tasked with facility protection and security response duties was also a primary objective of initial efforts. A temporary alarm station was established within the radiochemical plant to provide a centralized location for the receipt of intrusion alarms and for video assessment of alarm conditions.

The upgrade of an existing radio communications system further supported the integration of the MCC and MVD-IT protective forces into the overall site protection plan. Base stations, hand-held radios for protective force personnel, and support equipment necessary to support radio communications within the underground facility were provided and installed.

REVIEW AND PLANNING FOR THE SECOND PHASE OF COOPERATIVE UPGRADES

Between 1998 and 2000, cooperative upgrade efforts moved from an initial implementation phase to one in which a comprehensive path forward was reviewed, discussed, and planned. During this time, benefits from upgrades up to that point and needs for future upgrade were identified and evaluated by MCC and the U.S. project team. As a result, a path forward for further cooperative upgrade efforts was identified. Although the initial campaign of upgrades addressed the most pressing needs of the site, both MCC and the U.S. project team recognized the need to ensure that an integrated protection system—including complementary physical protection and MC&A and protective force elements—was necessary to ensure the continued and future successes at the site. Consistent with current DOE MPC&A programmatic guidance, a target-out approach was considered whenever possible.

In recognition that the upgrades implemented at the existing PuO_2 storage area supported only a limited storage capacity, planning was initiated to install a new, integrated plutonium storage facility that would provide a self-contained, secure storage location for materials currently in storage and for the PuO_2 that would be produced as a result of continued site operations for the foreseeable future. This facility will have dedicated access control systems, to include internal SNM and metal detection capabilities. Instrumentation and electronics necessary to support detection and video assessment of security conditions within this facility have been included in the design, to include a protective force–staffed access control station for the area. By design, the plutonium storage facility will be capable of supporting MC&A initiatives within the facility, reducing the possible exposure that could result from the unnecessary movement of nuclear materials within the complex to support measurement and accountability processes.

The design of the plutonium storage facility can support the further expansion of storage capabilities should additional materials be transferred to MCC for longer-term storage from other Russian Federation source locations. The basic internal infrastructure installed for current and immediately projected storage needs will also be capable of providing support for future storage needs.

MCC and the U.S. project team are also evaluating the implementation of physical protection upgrades for some process areas within the radiochemical plant, along with the possibility of providing some limited increase in protection for highly enriched uranium used in the reactor plant of the facility. Both of these initiatives are in the preliminary stages of discussion.

Concurrent with the design and planning of the plutonium storage facility, design options for a fully integrated central alarm station (CAS) for all sites of interest were pursued. A decommissioned reactor control room was identified by MCC as an appropriate location for the CAS, which will eventually replace the current temporary alarm station. The new CAS will provide complete monitoring capabilities for access control, intrusion detection, and video assessment systems installed under past, current, and future MPC&A cooperative efforts.

A dedicated physical protection local area network will be used to integrate the operation of the CAS with terminal equipment that includes motion sensors, door switches, video assessment and surveillance cameras, and access control readers. Projected to be staffed with MCC protective force personnel, the CAS will ensure that the timely receipt, processing, and evaluation of alarm conditions are maintained, thus ultimately supporting an effective protective force response to alarm conditions. A training simulator for the CAS system is planned for installation in a training center dedicated for MPC&A interests.

Expansion of the radio communications capabilities within the underground complex is also being pursued. Additional support equipment and radio capabilities will be installed to ensure that comprehensive radio communications are provided for protective force responders in the underground facility.

Two phases of protective force upgrades have been completed under the MPC&A program. Initially, through support of the U.S. protective force team, response vehicles and other approved protective force equipment were provided to MCC for site protection. With the initial provision of equipment providing a baseline, a second phase of support has been pursued by the U.S. project team through which additional equipment needed by the MVD-IT troops for site security are being provided.

THE PATH FORWARD

MCC and the U.S. project team continue to evaluate the evolving status of the MPC&A requirements at the site. As a result, consideration is being given to the installation of expanded monitoring capabilities to detect unauthorized movements of nuclear materials and to further enhance access control measures for the underground facility. In addition, the U.S. protective force team representative and the physical protection team are working closely with MCC and MVD-IT to determine if post and portal enhancements should be considered for the site.

Once physical protection upgrades are fully implemented and integrated, MCC and the U.S. project team recognize the need to ensure that the complex protection system remains operable through an integrated sustainability program. The site will implement requirements for ongoing personnel training, procedures for use and maintenance of the systems and equipment, actual performance and operability testing, and periodic maintenance of the equipment and systems. In addition, it is recognized that sustaining the complex MPC&A system will require strong coordination between MCC site operations, the security department, the protective forces, and the MCC MPC&A support staff. This coordination is necessary to ensure that physical or operational changes at the site do not adversely impact the operability of the MPC&A systems and to ensure that site resources are available to provide continued support to the upgraded systems.

SUMMARY AND CONCLUSIONS

Throughout the course of cooperative efforts at the site, both MCC and the U.S. project team have recognized the complexity of the MPC&A initiatives that have been discussed, negotiated, and ultimately implemented. The challenges of performing upgrades in an existing underground facility required extensive discussion and engineered solutions.

These complex issues have, at times, required complex responses. Thus far, the needs of both MCC and the U.S. project team have been satisfactorily negotiated and resolved to the benefit of both teams. Through the cooperative efforts of the teams, and the support of both DOE and MinAtom, many successes have been experienced during the course of work at MCC, and further successes are anticipated as the MPC&A program continues to move forward at the site.