

**"Operational Experience: Upgraded MPC&A Systems
for the Radiochemical Plant of the Siberian Chemical Combine."**

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Abstract

The success of reducing the risk of nuclear proliferation through physical protection and material control/ accounting systems depends upon the development of an effective design that includes consideration of the objectives of the systems and the resources available to implement the design. Included among the objectives of the design are facility characterization, definition of threat, and identification of targets. When considering resources, the designer must consider funds available, rapid low-cost elements, technology elements, human resources, and the availability of resources to sustain operation of the end system.

The Siberian Chemical Combine (SCC) is a multi-function nuclear facility located in the Tomsk region of Siberia, Russia. Beginning in 1996, SCC joined with the United States Department of Energy (US/DOE) Material Protection, Control, and Accounting (MPC&A) Program to develop and implement MPC&A upgrades for the Radiochemical, Chemical Metallurgical, Conversion, Uranium Enrichment, and Reactor Plants of the SCC. At the Radiochemical Plant the MPC&A design and implementation process has been largely completed for the Plutonium Storage Facility and related areas of the Radiochemical Plant.

Design and implementation of upgrades for the Radiochemical Plant include rapid physical protection upgrades such as bricking up of doors and windows, and installation of security-hardened doors. Rapid material control and accounting upgrades include installation of modern balances and bar code equipment.

Comprehensive MPC&A upgrades include the installation of access controls to sensitive areas of the Plant, alarm communication and display (AC&D) systems to detect and annunciate alarm conditions, closed circuit (CCTV) systems to assess alarm conditions, central and secondary alarm station upgrades that enable security forces to assess and respond to alarm conditions, material control and accounting upgrades that include upgraded physical inventory procedures, and destructive and nondestructive assay equipment to perform neutron and gamma measurements on nuclear materials in process or storage.

These MPC&A upgrades have been in operation at the SCC Radiochemical Plant for between 2 and 3 years. The operational experience gained by SCC during this period is currently being evaluated by SCC and "lessons learned" will be considered both for continued operation of the Radiochemical Plant MPC&A systems and similar MPC&A systems that are currently being planned for other Plant Sites of the SCC.

Introduction

The Siberian Chemical Combine (SCC), known during the days of the USSR as "Tomsk-7", is located along the Tom River within the "closed city" of Seversk. The city of Seversk, with a population of 112,000, is fifteen kilometers northwest of Tomsk, the principal city of the Tomsk Region of central Siberia. The Siberian Chemical Combine, along with the closed city of Seversk, occupies nearly two hundred square kilometers.

The SCC is a multi-function special nuclear material production and processing complex that was established on March 26, 1949. The original mission of the SCC was the production of highly enriched uranium and plutonium and the fabrication of nuclear weapons components. Currently, SCC operates 5 main Plant Sites whose capabilities include reprocessing of spent nuclear fuel, production of plutonium, centrifuge enrichment of uranium, blending of highly enriched uranium into low enriched uranium to produce power fuel stock, production of heat and electricity, and refurbishment of plutonium and uranium weapon components.

The Siberian Chemical Combine Radiochemical Plant

The Radiochemical Plant of the SCC reprocesses spent fuel from industrial reactors for the purpose of separating plutonium and uranium. Plutonium is extracted in the form of dioxide. Industrial buildings of the Radiochemical Plant occupy 32% of the Radiochemical Plant territory. The protected perimeter of the Radiochemical Plant is approximately 6 kilometers in length. Surrounding terrain is rugged and heavily forested, the climate is cold in the winter (as low as -54 C) and hot in the summer (as warm as $+40$ C), and the prevailing southwestern winds can blow 20 - 30 knots (10 - 15 meters per second).

Successful implementation of nuclear material physical protection, nuclear material control, and nuclear material accounting systems is a challenge in this environment. Sustaining the systems to achieve the ultimate goal of reducing the risk of nuclear proliferation over time depends on an effective design that not only considers technology solutions, but considers the human resources required to run the system and financial resources that will be required for optimal operations.

In this paper we present nuclear protection, control, and accounting (MPC&A) upgrades that have been implemented at the SCC Radiochemical Plant through collaboration between the SCC and the United States Department of Energy Material Protection, Control, and Accounting Program. Of specific interest is the knowledge gained by the SCC during the design, implementation, and operations process, lessons learned, and how they have been applied to other MPC&A upgrade projects at the SCC.

MPC&A Upgrades

MPC&A upgrades for the Radiochemical Plant began in 1996 and were implemented using a collaborative approach between the US/DOE MPC&A Program and the

Administration of the SCC. MPC&A upgrades focused on areas where plutonium dioxide is produced and stored. SCC sponsored upgrades focused primarily on perimeter intrusion detection systems.

Material Control and Accounting

Rapid and comprehensive material control and accounting upgrades have been completed for the Radiochemical Plant controlled personnel entry point and the plutonium dioxide Storage Facility. At the controlled personnel entry point metal and radiation detection portal monitors have been in operation since 1996. Plutonium dioxide Storage Facility upgrades include

- Modern weighing systems,
- Bar code application,
- Destructive and non-destructive analytical capabilities, and
- Upgraded procedures to facilitate physical inventory taking for the plutonium dioxide Storage Facility.



Vehicle Portal
Monitors located at
a Vehicle Entry
Point to the
Radiochemical
Plant



Bar Codes Applied to Plutonium Dioxide Container
Facilitating Physical Inventory Procedures

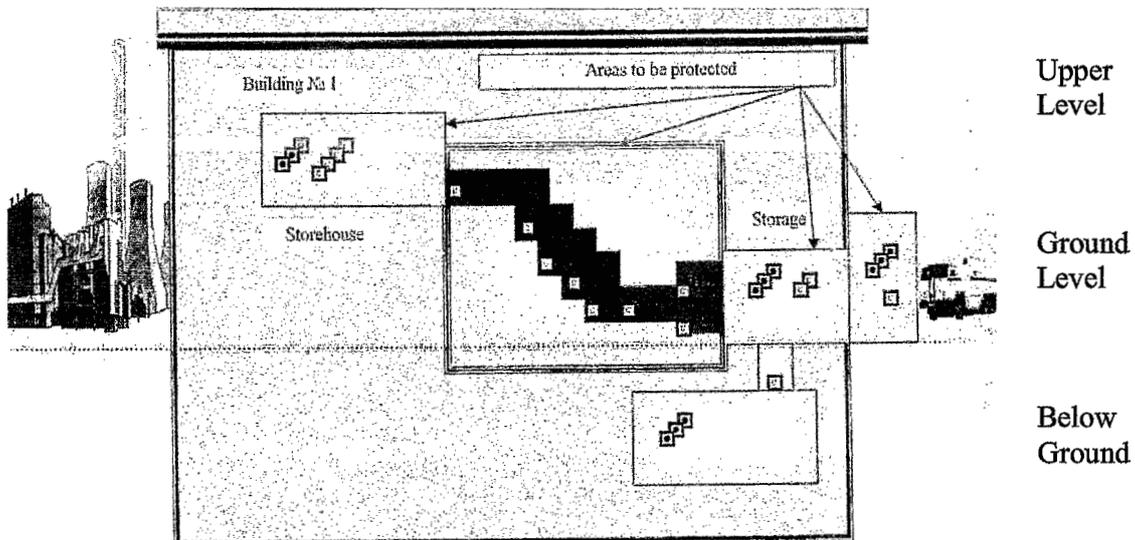
Designs are currently being evaluated for proposed upgrades for the plutonium Product Finishing Area where plutonium dioxide is packaged.

Physical Protection

Also implemented in rapid and comprehensive phases, physical protection upgrades have been implemented for the

- Process Output Area where plutonium solutions are converted to plutonium dioxide,
- Product Finishing Area,
- Interim Storage Area, and the
- Transportation Corridor where the dioxide is manually transported up a series of stairways to the Storage Facility.

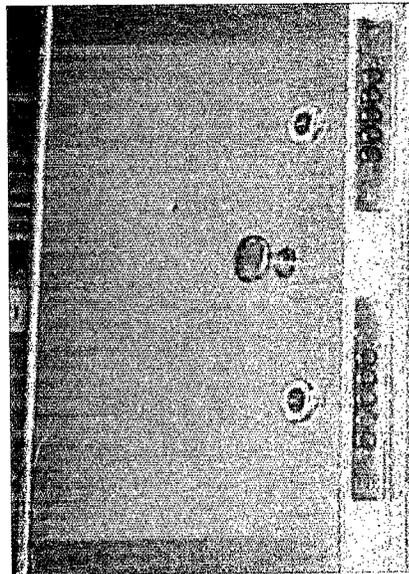
At the Storage Facility, the plutonium dioxide is currently stored and monitored under the Plutonium Production Reactor Agreement.



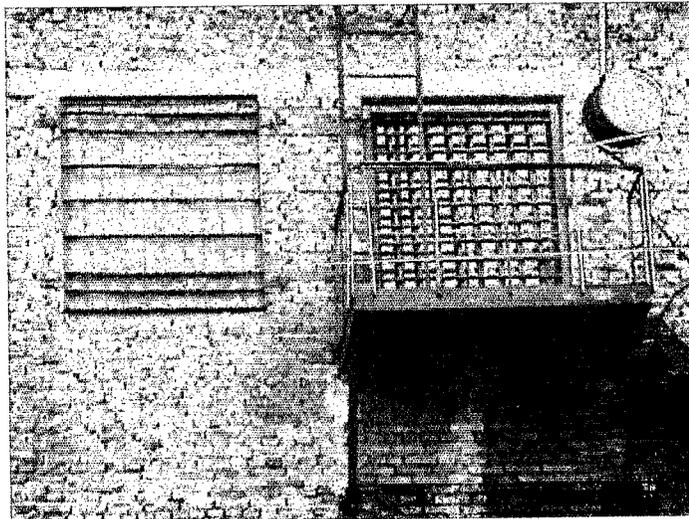
Locations for physical protection upgrades:
Process Output below ground level,
Product Finishing and **Interim Storage** area at ground level,
Transportation Corridor, and
The Storage Facility on the upper level.

Rapid Physical Protection Upgrades

Rapid physical protection upgrades were implemented for Building 1 where solutions of uranium and plutonium are processed to produce plutonium dioxide. These upgrades included installation of hardened steel doors and bricking up of windows along the "Transportation Corridor" between process and storage areas, and grating installed to reinforce windows and emergency exits near process areas.



Hardened Steel Doors with Dual Key Locks



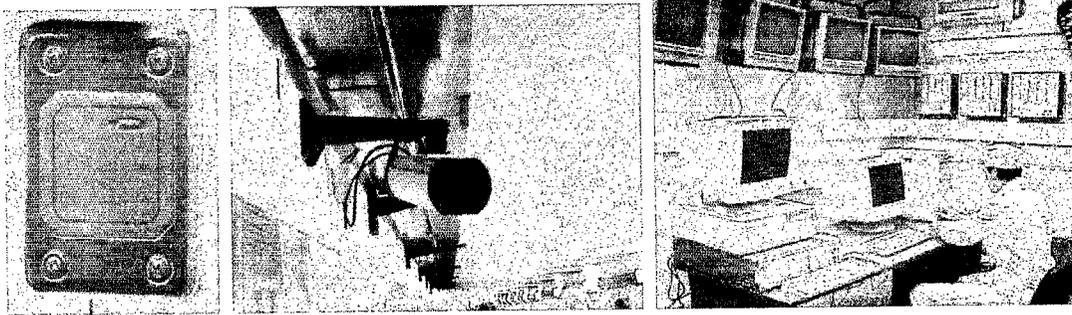
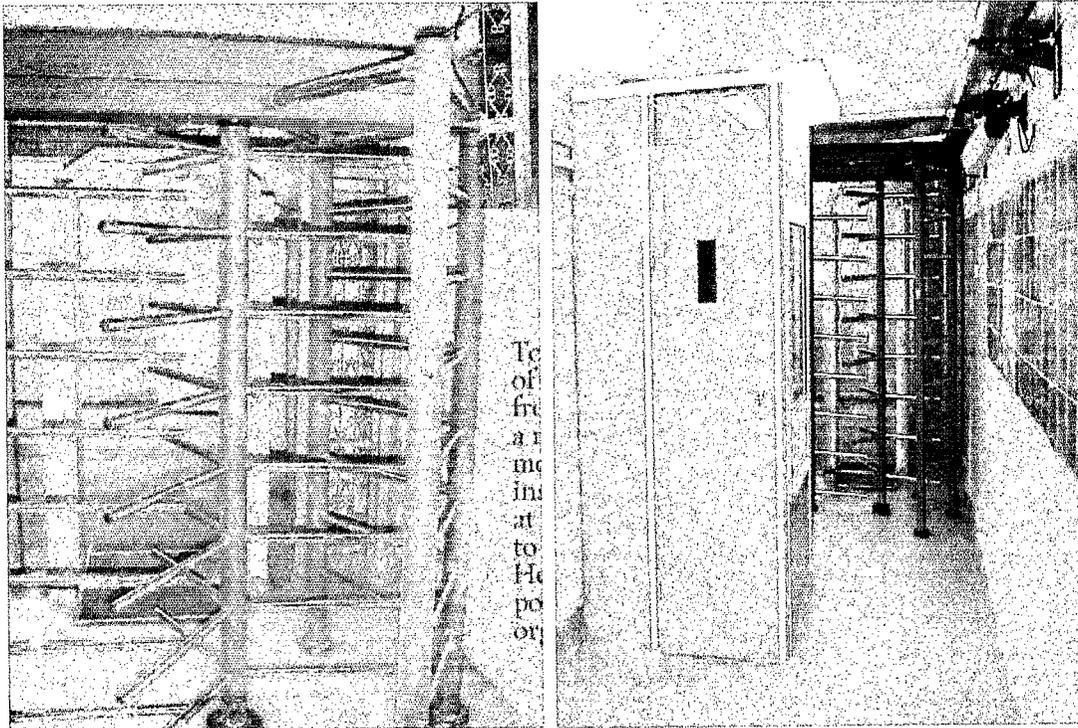
Metal Grate Reinforcing Emergency Exit

Bricked Window in Processing Area

Hardened Doors, Bricked Windows, and Grating

Comprehensive Physical Protection Upgrades

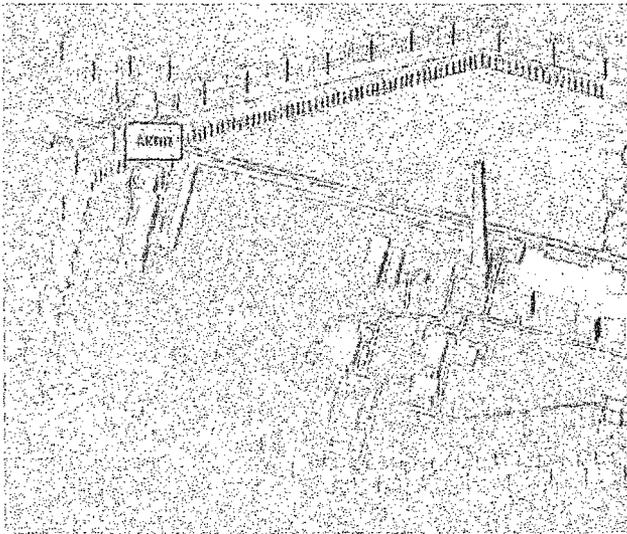
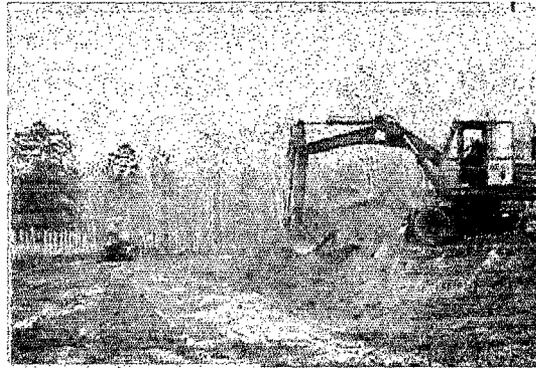
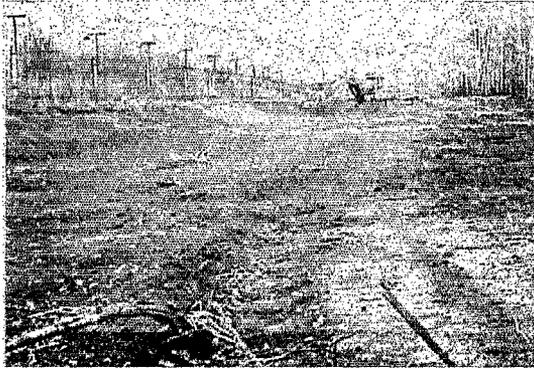
Comprehensive physical protection upgrades for Building 1 include modern access control systems, alarm communication and display (AC&D) systems, and closed circuit television (CCTV) that feed information to protective forces stationed at new central alarm and secondary alarm stations.



Access Control, CCTV, and Alarm Monitoring Stations

Perimeter Systems

Perimeter upgrades implemented by SCC include clearing of large areas of heavily forested terrain to install a dual-fence intrusion detection area complete with new lighting, telecommunications for protective forces patrols, and upgraded sentry posts. The Russian "Delphin-M" vibration sensor system provides primary alarm annunciation for the perimeter.



Fencing, Lighting, and
Sensor Upgrades for the
Radiochemical Plant are
Complete and in Routine
Operation

Operational Experience

The various components that comprise the upgraded MC&A system include hardware from companies such as TSA (portal monitors), Canberra (non-destructive assay equipment), Metler-Toledo (balances), Hewlett Packard (computers), Janus (bar coding), and Perkin Elmer (destructive analysis). Software to support the MC&A systems range from common commercial products such as Microsoft Windows/NT to Russian developed applications used for specific accounting functions. Physical protection system components include, among others, products from Eleron, ISTA ("Keeper" AC&D controller), Prizma (hardened doors and windows), Nabda (telecommunications), as well as support equipment for power and ventilation.

SCC's operational experience has been generally good for all of the nuclear material protection, control, and accounting upgrades. Lessons learned from a previous upgrade project performed at the SCC Reactor Plant were helpful to designers, engineers, and technicians. In addition, SCC reports excellent support from most of the vendors during the design and installation of upgrades. A period of one year was allocated for system testing and refinement.

SCC has learned that training of personnel and maintenance of equipment can not always be relegated to the vendor as is common for facilities located closer to cities like Moscow. A local Tomsk vendor easily performs maintenance for common computer equipment. However, maintenance of Metler-Toledo scales, for example, became a problem, as there are no local vendors for such equipment in the remote Tomsk Region. In this case, as in several others, SCC obtained MPC&A support to gain certification for maintenance and repair of the weighing systems from Metler-Toledo's training center.

Critical to long-term operations of the Radiochemical Plant upgrades is certification. SCC reports that the design and installation phase of the upgrade project for the Radiochemical Plant consumes only 30% of the project time line. Once all of the equipment is installed, an acceptance committee is formed with members from SCC, MinAtom, Gosatomnadzor, Fire Safety, and the Ministry of Internal Troops (MVD). The acceptance committee will review the entire design and all equipment used in the project. They then document any corrections that need to be made prior to final acceptance of the project. This has turned out to be a time consuming part of the overall project. In the case of the Radiochemical Plant, 70% of the project time line.

With the material protection, control, and accounting systems largely in place for the Radiochemical Plant, SCC is now expanding MPC&A upgrades to additional facilities. At the SCC Conversion and Uranium Enrichment Plants, where some materials are processed under the auspices of the HEU/LEU Purchase Agreement, similar upgrades are now in progress. As lessons learned from the Reactor Plant project were applied at the Radiochemical Plant, lessons learned from the Radiochemical Plant project are now being applied at the Conversion and Uranium Enrichment Plants. Future plans for upgrades at the SCC Chemical Metallurgical Plant will continue to use design, installation, and operational experience gained through the implementation process for MPC&A upgrades, their operations, and their future sustainability.