

**U.S. Russian Cooperative Efforts to Enhance Nuclear
Material Protection, Control, and Accounting at the All
Russian Scientific Research Institute of Technical Physics
(VNIITF), Chelyabinsk-70**

**G. Tsygankov, Y. Churikov, D. Bukin, E. Magda, V. Zuev,
J. Blasy, B. Abramson, K. Apt, F. Shultz, L. Neymotin, A. Eras,
T. Slankas**

**This paper was prepared for submittal to the
Institute of Nuclear Materials Management
39th Annual Meeting
Naples, FL
July 26-30, 1998**

July 14, 1998



This is a preprint of a paper intended for publication in a journal or proceedings. Since changes may be made before publication, this preprint is made available with the understanding that it will not be cited or reproduced without the permission of the author.

DISCLAIMER

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

U.S./Russian Cooperative Efforts to Enhance Nuclear Material Protection, Control, and Accounting at the All Russian Scientific Research Institute of Technical Physics (VNIITF), Chelyabinsk-70

Authors:

Gennady Tsygankov, Yuri Churikov, Dmitry Bukin, Edward Magda , Vitaliy Zuev, (VNIITF, Chelyabinsk-70, Russia), Jack Blasy, Bill Abramson (LLNL), Kenneth Apt (LANL), Fred Shultz (ORNL), Lev Neymotin (BNL), Albert Eras (SNL), and Tom Slankas (PNNL)

ABSTRACT

The All Russian Scientific Research Institute of Technical Physics (VNIITF) is one of the major sites in the nuclear weapons complex in Russia. The site contains a number of research facilities which use nuclear material as well as assembly, disassembly, and testing of prototypes (pilot samples) of nuclear weapons. VNIITF also has ties to the major nuclear materials production facilities in the Urals region of Russia.

Under the U.S./Russian Materials Protection Control and Accounting (MPC&A) cooperative program between the US Department of Energy and Russia's Ministry of Atomic Energy, enhanced safeguards systems have been implemented at a reactor test area called the Pulse Research Reactor Facility (PRR). The area contains three pulse reactors with associated storage areas. The integrated MPC&A system at the PRR was demonstrated to US and Russian audiences in May, 1998. Expansion of work into several new facilities is underway.

C-70 has developed an extensive computerized system that integrates the physical security alarm station with elements of the nuclear material control system. Under the MPC&A program, the existing systems have been augmented with Russian and US technologies.

This paper will describe the work completed at the PRR, and the on-going activities and cooperative effort between the Lawrence Livermore, Los Alamos, Sandia, Oak Ridge, Pacific Northwest, and Brookhaven US Department of Energy National Laboratories in support of VNIITF.

INTRODUCTION

The work described in this paper is part of an effort called the Nuclear Materials Protection, Control, and Accounting (MPC&A) Program which was created in response to a DOE directive to the national laboratories to develop a cooperative program between the US. and Russian institutes in the area of nuclear materials non-proliferation. The objective of the program is to reduce the risk of nuclear proliferation by strengthening MPC&A systems at Russian nuclear facilities. More specifically the MPC&A program is attempting to make rapid improvements in the protection, control, and accounting of nuclear material, especially weapons-grade materials such as separated plutonium and highly enriched uranium, by having the US laboratories and Russian institutes and other nuclear facilities work directly and cooperatively with each other.

This paper describes that portion of the MPC&A program that is directed specifically to the needs of All Russian Scientific Research Institute of Technical Physics (VNIITF),

also called Chelyabinsk-70, which is located inside the closed city of Sinezhinsk. VNIITF was established in 1955 as a second nuclear weapons design institute for competition and peer review of the initial Russian nuclear design institute at Arzamas-16. The site contains a number of research facilities which use nuclear material, i.e. plutonium and highly enriched uranium (HEU), as well as assembly, disassembly, and testing of prototypes (pilot samples) of nuclear weapons. Chelyabinsk-70 is located in the Ural mountains, approximately 2000 km east of Moscow and 100 km south of Ekaterinburg.

HISTORICAL BACKGROUND OF VNIITF SECURITY

The physical security program at VNIITF was designed at a time when the former Soviet Union emphasized more strict control over individuals. Russia is now in a very different situation, where their diversification activities are resulting in an influx of business and industrial people whose reliability cannot be guaranteed through personnel screening. These changes in addition to the economic difficulties there have caused VNIITF to modify its security systems to apply to this different situation.

VNIITF began modernizing its security system in 1993, at the direction of MinAtom. At that time, a specific program was created with emphasis on MPC&A. People from separate laboratories within VNIITF were brought together to work on the enhanced MPC&A program. The program was approved by MinAtom, however, VNIITF has not received additional money to implement this program. Lack of money therefore limited the rate of progress.

In the first two years of the VNIITF project, emphasis was on the Pulse Research Reactor Facility (PRR), with some work being done which is applicable at the entire VNIITF site. Several collaboration tasks required to implement a comprehensive enhanced MPC&A system at VNIITF were also undertaken. The tasks were prioritized to form a planned approach beginning with a site characterization study and analysis of the existing system followed by system design and installation.

US and Russian personnel shared safeguards and security Vulnerability Assessment (VA) techniques and approaches and obtained some early results by actually applying them to an existing building at VNIITF. This effort included a two week Vulnerability Assessment workshop conducted jointly by LLNL and SNL at VNIITF.

VNIITF recently identified the remaining buildings for which MPC&A upgrades will be needed as part of an "Institute-Wide Study of Nuclear Material Protection Control & Accounting Requirements."

COMMISSIONING / DEMONSTRATION

In May of this year DOE Under Secretary Moniz participated in a major milestone at VNIITF, the Commissioning of the PRR, which was selected for initial MPC&A improvements. The PRR contains one metal and two liquid pulse reactors and associated nuclear material storage rooms in buildings 711 and 712, and a control center in building 713, at the Experimental Physics area, also called Site 20. The commissioning included all physical protection systems, including an alarmed perimeter fence, and alarm center as well as nuclear material measurement and computerized accounting systems. After the Commissioning VNIITF held a formal demonstration of the improvements for several other Russian nuclear facility representatives.

Typical upgrades at the three buildings in the PRR included the installation of hardened doors at all entrances and metal grillwork on all first and second floor windows. The reactor and reactor control room doors were replaced with hardened doors. Door contact sensors were placed at a number of key locations and at all entrances to the buildings. A vibration sensor was wrapped around the building's exterior and connected to the metal grillwork over the windows. Microwave, capacitance sensors, and video cameras were installed at various locations in and outside of this building. Access control consists of a combination of a booth with card and hand geometry readers. A telephone unit and metal detector are installed at the main entrance to one building, with additional telephone units located at key points throughout the building.

A Physical Protection Control Station was also installed in the PRR. The VNIITF MARS-90 system processes all alarms, access control, and video assessment from the three PRR buildings.

Nuclear measurement, and computerized accounting systems were demonstrated. These included integrated barcode and scales systems. Tamper Indicator Device (TID) procedures were also demonstrated.

PHYSICAL PROTECTION

With the completion of the MPC&A work in the PRR, new physical protection work is focusing on other areas, both inside Site 20, and at other locations. The newer facilities are more sensitive and require modified methods for assuring that the agreed to work is completed. These include the use of video, photographs and certifications. Physical protection upgrades have started at one building within Site 20, which contains another pulse reactor and critical mass stand and nuclear material storage rooms and at two production buildings at other technical areas. Physical protection upgrade design is underway at another building called the Research Technological Center (RTC), located in Site 20.

Physical Protection activities include barriers, intrusion detection, video assessment, and access control system upgrades; and control station implementation.

VNIITF-wide physical protection initiatives include access control and computerized badging systems, and a central MPC&A control system.

A major new initiative being considered is the construction of a new Nuclear Material Storage Building, which if completed, would replace three existing storage buildings. The construction would take place over a period of 2-3 years, with a design and site preparation occurring during the coming year. This building would consolidate nuclear materials in a new structure and enhance the protection of the nuclear material.

MATERIAL CONTROL AND ACCOUNTING

A VNIITF-wide computerized accounting system is being developed for the large and diverse inventory of nuclear material subject to MPC&A. Initial activities of the task include development of a detailed design for some of the material balance areas (MBAs) and characterization of nuclear material handling at VNIITF, including a) nuclear material centralized accounting, b) storage and transportation, and c) preparation of VNIITF reports on nuclear material for subsequent transfer to MinAtom's nuclear material information system and several central and peripheral depots.

The nuclear material computerized accounting system will be based on a prototype developed under an earlier MPC&A contract. This prototype has been expanded to meet more general requirements (e.g., the introduction of bar-code technology) and will be introduced within selected MBAs. The accounting system is based on the commercial Oracle data base, but VNIITF has introduced custom aspects into the system design. Additionally, VNIITF computer scientists have incorporated some of the LANL-developed CoreMAS concepts (designs, capabilities, algorithms, etc.) into their Oracle-based system.

As part of this task, a computer security plan and an emergency response plan will be developed. A system test plan also will be developed and system users registered. Test data will be prepared on MBAs and nuclear material, and these will be entered into databases.

A VNIITF-wide MPC&A telecommunications network system is being developed to organize a single communication medium that integrates computer and information resources of the VNIITF system for computerized accountability of nuclear materials. This project will implement reliable and protected communications channels between buildings and sites where computers and equipment of centralized accounting of nuclear materials will be located. Provision is also made for a protected information connection between this network and the nuclear material accountability network of MinAtom.

A scale and weight measurement control program is being implemented at VNIITF for safeguarding nuclear materials at selected facilities. The program has three major components: 1) selection and procurement of appropriate weight measurement equipment; 2) interface of the weight measurement equipment with the barcode equipment used to identify/label material being weighed; and 3) development and implementation of operational procedures and protocols including necessary quality control. The measurement equipment includes 53 scales, weight standards for calibrating the scales, and all necessary electronic equipment to interface output of the scales to the MC&A computer system.

Because of the extensive quantities of special nuclear material at VNIITF, an Active Well Coincidence Counter (AWCC) is required to assay the nuclear material in a variety of physical and chemical forms as used and stored at VNIITF. Such measurements are necessary in preparation for placing the nuclear material under inventory. Desirable attributes of the installed AWCC measurement system will be rapid detection and identification of the fissile inventory in variable background environments, without opening storage containers. The AWCC neutron assay system is designed to complement the gamma ray spectroscopic techniques for determining the isotopic composition of the special nuclear material already being implemented under the MPC&A program at VNIITF.

Bar code technologies and rapid Inventory confirmation systems have been introduced at VNIITF in an effort to establish effective nuclear material inventory controls. Bar code readers and computers has been purchased and transferred to VNIITF to establish effective inventory control stations for 18 MBAs. Future plans call for the establishment of additional control stations at 15 MBAs. The bar code readers and rapid inventory confirmation systems ensure that HEU and Pu storage containers have been properly identified and inventoried and can be accurately tracked from one area to another.

Vehicle and pedestrian portal monitors technologies were introduced to VNIITF early in the program in an effort to establish an effective method for the detection of unauthorized movement of special nuclear material (SNM). Portals are an important tool used to detect concealed SNM as persons or vehicles pass through facility checkpoints or gates. Operational difficulties associated with Russian facility procedures caused initial

failures of the portal batteries; however these difficulties have been corrected and new batteries are being installed.

Metal detectors are being incorporated at selected VNIITF locations. These provide an additional component to a comprehensive MPC&A System. Under this effort VNIITF has assessed the requirements for detection, determined locations and placements of the detectors, and developed the appropriate operational/maintenance/training procedures. Procurement orders have been placed for 7 interior walk-through portal metal detectors, 3 exterior (weatherized) walk-through portal metal detectors, and 15 hand-held metal detectors.

VNIITF is implementing a TID program across the entire institute. They have defined their general requirements for TIDs, which include: (1) a unique serial number, (2) a facility identifier, and (3) a bar code, if possible. Over 30,000 seals are now on order (in a combination of E-Cup, Multi-Lok, Cable Lock, vinyl, and mylar types).

VNIITF is developing a network of four U.S. and eight Russian hand geometry units for a prototype hand geometry access recognition/control at the PRR. Performance of the U. S. units and the Russian prototype unit last year found that the Russian unit met all performance requirements. Components are now being ordered for VNIITF to construct the eight units.

Part of the MPC&A program at VNIITF is the development of a radio communications system to cover the areas of operation where materials are stored and transported. Important functions include operations, safety, and emergency response.

INFRASTRUCTURE

Certain tasks at VNIITF are designed to develop the infrastructure and improve the sustainability of the MPC&A program. VNIITF personnel have participated in over twenty training classes and workshops, including a computerized MC&A seminar held by VNIITF for the benefit for five other Russian nuclear facilities. The major purpose of the seminar was to develop draft MC&A system and network requirements, initial system designs, and a strategy for further work that would result in implemented systems at each facility while taking into consideration quantities, forms and processing of the nuclear materials at those facilities. It is planned that VNIITF will develop a comprehensive training program under a MPC&A task for next year.

An internal review and assessment program is being developed under an MPC&A contract at VNIITF to allow VNIITF management to have an independent capability to assess their nuclear material protection, control and accounting program. The VNIITF project team also has recently enlisted Pantex to assist VNIITF to develop an integrated system approach to maintenance.

CONCLUSION

A major MPC&A milestone was met at VNIITF when the MPC&A improvements were commissioned at the Pulse Research Reactor Facility in May of this year. VNIITF has identified all the facilities for which MPC&A improvements will need to be made and MPC&A work has now started in several of the new more sensitive facilities. The US National Laboratories plan to continue contracting directly with VNIITF to carry out MPC&A improvements and provide support, technical assistance, and equipment as needed to further the objectives of the program. VNIITF has taken the primary

responsibility to provide the effort needed to improve their MPC&A system based upon their requirements. Several initiatives involving the VNIITF infrastructure have been undertaken to institutionalize the improvements and transfer them to other facilities both at VNIITF and at other Russian nuclear facilities.

ACKNOWLEDGMENT

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

Technical Information Department • Lawrence Livermore National Laboratory
University of California • Livermore, California 94551