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ABSTRACT

The All Russian Institute of Technical Physics (VNIITF), also called Chelyabinsk-70, is one of two Russian federal nuclear centers established to design, test and support nuclear weapons throughout their life cycle. The site contains research facilities which use nuclear materials, two experimental plants which manufacture prototype samples for nuclear weapons, and a site for various ground tests. Chelyabinsk-70 also has cooperative relationships with the major nuclear materials production facilities in the Urals region of Russia.

Chelyabinsk-70 has been participating in the US/Russian Laboratory–to–Laboratory cooperative program for approximately one year. Six US Department of Energy Laboratories are carrying out a program of cooperation with VNIITF to improve the capabilities and facilities for nuclear materials protection, control, and accounting (MPC&A) at VNIITF. A Safeguards Effectiveness Evaluation Workshop was conducted at VNIITF in July, 1995. Enhanced safeguards systems are being implemented, initially at a reactor test area that contains three pulse reactors. Significant improvements to physical security and access control systems are under way.

C-70 is developing an extensive computerized system that integrates the physical security alarm station with elements of the nuclear material control system. The existing systems will be augmented with Russian and US technologies.

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

INTRODUCTION

The work described in this paper is part of a larger effort called the Laboratory-to-Laboratory Nuclear Materials Protection, Control, and Accounting Program which was created in response to a DOE directive to the national laboratories to develop a cooperative program between the six US Department of Energy laboratories and Russian institutes in the area of nuclear materials non-proliferation. The objective of the program, which began in 1994, is to accelerate progress toward a common goal: to reduce the risks of nuclear weapons proliferation by strengthening systems of nuclear material protection control and accounting (MPC&A) at Russian nuclear facilities. The Russian institutes and US laboratories are developing and implementing a collaborative program for the improvement of nuclear MPC&A systems at Russian facilities. More specifically, the lab-

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to-lab 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 working directly and cooperatively with each other.

This paper describes that portion of the lab-to-lab MPC&A program that focuses on the Russian Federal Nuclear Center: Institute for Technical Physics (VNIITF), Chelyabinsk-70, adjacent to the town of Snezhinsk. 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. Chelyabinsk-70 is located in the Ural mountains, approximately 2000 km east of Moscow.

Work in MPC&A under the Lab-to-Lab Program at VNIITF is supervised and coordinated by a Project Team consisting of staff from the Lawrence Livermore, Los Alamos, Sandia, Oak Ridge, Pacific Northwest, and Brookhaven US Department of Energy National Laboratories and VNIITF.

HISTORICAL BACKGROUND OF VNIITF SECURITY

The physical security program at VNIITF was designed at a time when the former Soviet Union emphasized strict control systems such as enforcement of personnel passport controls. 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. Therefore VNIITF is enhancing 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 organizations within VNIITF were brought together to work on the enhanced MPC&A program. However, progress was limited due to a lack of funds. Discussions of mutual areas of interest for cooperation were held in the US in February, 1995, the VNIITF Project Team was formed a few months later and several joint MPC&A efforts were begun.

SELECTION OF A SITE FOR MPC&A IMPLEMENTATION

VNIITF selected the Pulse Reactor Facility Complex, including one metal and two liquid reactors, at Site 20, for enhanced MPC&A systems implementation. This site offers the opportunity for implementation of essentially all MPC&A technologies. VNIITF historically has had very close relations with five different nuclear facilities in the Urals region, and it is anticipated that the systems and hardware developed at VNIITF will be transferred as needed to all five of these facilities.

Work Undertaken Prior to Fiscal Year 1996 (October 1995)

A systematic program of MPC&A enhancements is being implemented at VNIITF. Evaluation, site characterization, and planning activities, which will direct future work, have been completed. In addition, plans for physical protection rapid enhancements are being implemented to improve facility protection.

The US Project Team has established contracts with VNIITF to provide facility characterization, conceptual design of a Physical Protection System (PPS), conceptual design of a Material Control and Accountability System (MC&A), and testing and evaluation of Nuclear Material portal monitors. The facility also has hosted a Safeguards Effectiveness Evaluation (SEE) Workshop and has produced several deliverables under a contract to provide a vulnerability assessment (VA) of one of the facilities at the site.

Current Activities

The current work at VNIITF may be categorized as follows: Physical Protection, which includes rapid enhancements and studies of available technologies; MC&A, which includes all work involved in the accounting and control of nuclear materials; Nondestructive Testing/Nuclear materials measurement, which includes projects for determining amounts and types of nuclear materials; and miscellaneous projects such as computer security.

Physical Protection

A comprehensive physical protection program is being implemented at VNIITF. One of the project team goals is to assist the facility managers with rapid enhancements designed to provide significant, cost effective improvements to the Pulse Reactor Facility Complex. Actual physical upgrades are in progress and will be built upon in future planning. A contract is in place and work is underway to implement rapid enhancements, including barriers, alarms, and communications at the Site 20 research reactor facilities.

Other contracts include: 1. assessment of hand-geometry access control, 2. testing and evaluation of vehicle portal monitors, and 3. implementation of pedestrian and hand-held monitors for Special Nuclear Materials. The purpose of the vehicle monitor task is to monitor vehicles for the passage of nuclear materials. Two commercial drive-through vehicle portal monitors will be evaluated to determine their suitability for near-term applications in VNIITF. There is a portal monitor task to design a vehicle monitor that is suitable for detecting shielded plutonium as well as uranium in metal or liquid forms. US portal monitor components may be used with Russian components and will be integrated with a Russian designed installation.

Materials Control and Accountability

The emphasis of the MC&A program has been to provide the facility with the tools to develop a rigorous accountability program. The facility has been tasked to develop and implement a trial application of procedures and methodology for physical inventories. A task has also been approved to provide item control through bar-coding. VNIITF has been tasked to investigate a system to measure the gamma field within the storage facility itself, using sensors mounted within the facility which could be periodically queried for data. They will evaluate existing instrumentation, such as that which the US labs have transferred to industry. Contracts also have been approved for: Tamper Indicating Device (TID) program enhancement; Physical Inventory Taking (PIT); daily administrative checks; and an MC&A effectiveness workshop.

The Tamper Indicating Device (TID) Program is intended to enhance the use and application of TIDs at the Institute. A TID Workshop is scheduled at VNIITF during 1996. The Workshop provides an introduction and overview of TID program development, and describes the various elements of a TID program. The Workshop is intended to provide a forum for representatives from VNIITF to discuss site-specific TID problems and issues so that the US and Russian participants can determine the requirements for the development and implementation of a TID program.

Non Destructive Testing/Nuclear Materials Measurement

A SOW has been issued to evaluate the technical elements necessary to determine initial inventory of Bulk Special Nuclear Materials (SNM), and to leave VNIITF with equipment for re-verification of inventory. The liquid core assay and accounting procedures apply to bulk form materials like nitrate solution tanks, etc., hence the project name.

The facility has an approved task for the implementation of non-destructive assay methods for the measurement of nuclear material in solid form (i.e. uranium, plutonium, etc.). The approach to

inventory of the solid core reactor is similar to the liquid core except that the metal uranium is measured without the complexity of the density correction and mass is obtained with a weighing scale. Reverification that the core mass is present will be based on measurements of the neutron flux die-away period and a surface-only uranium enrichment or an isotopic assay measurement.

In addition the facility has two separate tasks to test and evaluate gamma ray measurement equipment. The one task is to evaluate high-resolution gamma-ray spectrometry for radiation "passportization" as discussed below. The other task is to test and evaluate gamma-ray measurements for determining the isotopic composition of nuclear materials at C-70. The gamma-ray analysis program, MGA, will be tested for measuring the isotopic composition of plutonium materials, and the program, MGAU, will be tested for measuring the enrichment of uranium materials. Nuclear materials of different forms, i.e. metal, oxide, and solution with varying isotopic abundances will be measured under this task.

The planned approach to accounting for material is to rely on an integrated sensory, database, and control system to manage movement and access. The proposed system, called Peripheral Automated Complex, is computer controlled and extends from off-site administrative areas to nuclear material storage vaults. The idea is that simultaneous administrative and technical oversight is levied on the material. An experimenter needs administrative permission to get the material, must prove identity, and must move the nuclear material past material identification sensors.

One of the first contracts with C-70 was the "passportization" project where nuclear material signatures (a passport) will be collected, automatically read by the PAC and compared with archived information. To obtain permission to move the material, the passport signatures must match archived information.

Miscellaneous

VNIITF has made significant progress on a classified computer security program for their nuclear material accountability system.

FUTURE PROJECT INVESTIGATIONS

There is significant work that still needs to be done at the Pulse Reactor facility at VNIITF. Some of this work has already been identified and additional work will likely be identified as vulnerability assessments continue. Some of the potential projects already identified include: the purchase or construction and installation of vehicle monitors (awaiting evaluation of available technology); additional gamma ray measurement work, including providing VNIITF with a set of reference materials for gamma ray isotopic measurements; an integrated automated control system (also called Peripheral Automated Complex), which will integrate physical protection and MC&A information; a Pulse Research Reactor perimeter system; active well coincidence counters; analysis of optical seals technology; and investigation of devices to measure density of radioactive solutions.

CONCLUSION

Through increased cooperation it is being shown that the lab-to-lab MPC&A program effort at VNIITF is making significant improvements in the protection, control, and accounting of nuclear material. Some specific results are:

- Nineteen active contracts are in place
- Vulnerability assessment workshop completed and vulnerability assessment of one facility underway
- Physical protection and MC&A conceptual designs drafted

- Physical protection rapid enhancements are being implemented
- Rigorous MC&A program being developed
- Several nondestructive analysis project are being implemented

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. Our mutual long range goal is for the VNIITF to institutionalize the improvements and transfer them to other facilities and organizations.