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PORTAL MONITORING TECHNOLOGY CONTROL PROCESS

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Abstract

Portal monitors are an important part of the material protection, control, and accounting (MPC&A) programs in Russia and the US. Although portal monitors are only a part of an integrated MPC&A system, they are an effective means of controlling the unauthorized movement of special nuclear material (SNM). Russian technical experts have gained experience in the use of SNM portal monitors from US experts and this has allowed them to use the monitors more effectively. Several Russian institutes and companies are designing and manufacturing SNM portal monitors in Russia. Interactions between Russian and US experts have resulted in improvements to the instruments. SNM portal monitor technology has been effectively transferred from the US to Russia and should be and permanent part of the Russian MPC&A program. Progress in the implementation of the monitors and improvements to how they are used will be discussed.

INTRODUCTION

Controlling the movement of nuclear materials is still the most effective nonproliferation measure. Automatic pedestrian and vehicle portal monitors have been an established tool for preventing the unauthorized movement of special nuclear material (SNM) across US nuclear facility boundaries for 15 years. These monitors are also an elemental part of the US-Russian material protection, control, and accounting (MPC&A) program to improve the safeguarding of the SNM at Russian nuclear facilities. When properly installed and calibrated at "chokepoints" in the physical security system of a facility, these instruments can detect the unauthorized movement of SNM. While these instruments are an effective barrier to the theft of SNM, they are only one element of a complete system of safeguards and must be integrated into a total MPC&A system for maximum effectiveness. At numerous Russian facilities, portal monitors have been used as an initial step to reduce the risk of the unauthorized movement of SNM while the more comprehensive MPC&A systems are being installed. The MPC&A program has equipped Russian facilities with SNM portal monitors and supplied spare parts and training to ensure that the role of portal monitor technology is a permanent component of the Russian MPC&A system. We have also transferred sufficient technology to ensure the establishment of an indigenous Russian manufacturing capability.

BACKGROUND The technology of automatic pedestrian and vehicle monitors was developed at Los Alamos National Laboratory (LANL) in the 1970s and early 1980s.[1,2,3] This work resulted in the these instruments being commercially available in the US. These monitors determine the presence of SNM by comparing the gamma-ray and neutron intensity while occupied to the continuously updated background radiation level which is measured while the monitor is unoccupied. SNM portals generally consist of two vertical cabinets containing both large plastic scintillators and decision-making

electronics. These scintillators continuously measure the gamma-ray background intensity and adjust the alarm threshold to maintain an unchanging nuisance alarm rate. Plastic scintillators are used in this application because they are more cost-effective than NaI detectors.[4]

Commercially available pedestrian monitors in the US are generally of the walk-through variety. These monitors allow for large pedestrian traffic flows with monitoring times of only one to two seconds. However, for optimum performance, a period of unoccupancy must be allowed every 15 to 20 passages to allow the unit to update the background level. The US sensitivity performance standard for these units is stated in the American Society for Testing and Materials (ASTM) standards.[5] These standards require a pedestrian monitor to detect a 10-g sample of metallic ^{235}U in its most self-attenuating form when a pedestrian carries the sample anywhere through the monitor at normal walking pace in a nominal 20-μR/h background intensity. The instruments must also demonstrate a nuisance alarm rate of less than one per one thousand occupancies.

The two types of automatic vehicle monitors presently in use are the vehicle monitoring station and the drive-through vehicle monitor. The vehicle monitoring station has a worst-case detection sensitivity of 40 g of highly enriched uranium (HEU) in its most self-attenuating form and can only be used in low traffic flow locations. The drive-through vehicle portal has a worst-case detection sensitivity of 1 kg of HEU in its most self-attenuating form. Neutron vehicle monitors are also used at US facilities which store large quantities of plutonium. In the US, hand-held monitors are used to backup all automatic SNM portal monitors and to perform searches in very low traffic flow areas.

TECHNOLOGY TRANSFER

The first US commercial SNM portal monitors were sent to Arzamas-16 and IPPE in early 1995 for testing and evaluation. A broader introduction of portal technology was accomplished at two portal technology workshops held at Oak Ridge National Laboratory (ORNL) in the summer of 1995. At these workshops, details of the operational capabilities and proper use of the SNM pedestrian and vehicle portals were discussed. The application of portal monitors to a dozen Russian nuclear facilities was discussed. These discussions were followed by SNM portal technical experts visiting the individual facilities. The SNM pedestrian and vehicle portals have since been introduced to facilities through collaborations between US and Russian technical experts. A summary of the SNM portal monitor activities is given Tables 1. Highlights of the interactions with the individual facilities are also presented.

IPPE An SNM pedestrian portal was first set up and evaluated in at the Institute of Physics and Power Engineering's (IPPE) BFS critical facility in April 1995. BFS technical experts in collaboration with LANL, designed and built two "man trap" monitors at the entrance to the BFS storage facility. These devices consist of metal detectors, badge readers, and SNM monitors. These SNM monitors were constructed entirely from Russian components. The use of portal monitors to protect the SNM material stored at BFS was demonstrated along with other upgrades to their MPC&A

Table 1.
A summary of the US-Russian MPC&A portal monitor activities.

Progress in the Implementation of SNM Portals					
Russian Facilities	Pedestrian Portals	Drive-Through Vehicle Portals	Neutron or Wait-in Vehicle Portals	Russian Built Portals	Hand-held Monitors
IPPE	3			2	13
SKhC	33	18	4		13
VNIIEF	3	9		6	1
RRC KI	7	4		7	1
VNIITF	18	9		6	5
VNIIA	2				2
SSC RIAR	1	3		3	23
K-26	15				11
K-45	7				6
TOMSK-POLY	1				2
KRYLOV				2	
ELECTROSTAL	6				3
LUCH	4				16
MEPHI	2				
ITEP	3				
MAYAK	14	6			17

system in August 1995. The demonstrated portals consisted of a pedestrian monitor at the entrance to BFS, the two "man traps" at the lower level storage facility, and a drive-through vehicle monitor at the main exit to IPPE. This demonstration was very effective for introducing portal monitoring technology to numerous other Russian facilities.

Work in progress at IPPE includes installing three "man traps" at the "nuclear island," two pedestrian monitors at the Technological Laboratory, and two additional drive-through vehicle monitors at the exit gates. IPPE has received sufficient training and spare parts to insure that SNM portal monitors are a permanent part of their safeguards system.

SKhC The Siberian Group of Chemical Enterprises at Tomsk-7 is our most successful collaboration because it has the most portals protecting the most SNM. After initial introduction to this technology by LANL personnel, the SKhC technical experts have become very proficient in the installation and operation of these instruments. They have installed US commercial pedestrian monitors and a drive-through vehicle monitor at numerous facility sites. Further, they have constructed 20 pedestrian monitors from 80 surplus crash-door SNM monitors supplied by ORNL. This approach was chosen as the most expedient method to supply portals to this facility. The experts at SKhC took a basic LANL design and improved it to obtain a well-engineered operational instrument. The SKhC technical experts have also received detailed training from the manufacturer, TSA Inc., in the repair and maintenance of this equipment. They have also been supplied

with sufficient spare parts for many years of operational maintenance. Continuing efforts include the installation of 6 pedestrian and 18 vehicle portals. Because of the uniquely attractive nature of the material at this facility, three neutron vehicle portals and one vehicle monitoring station are scheduled for commissioning this summer.

VNIIEF Three US pedestrian portals were sent to the Russian Institute of Experimental Physics at Arzamas-16 in early 1995. Two were installed within the facility and one was used for study and evaluation. Because of the high level of experience in electronics and physics that exists at this facility, Russian personnel were contracted to design and build, from Russian components, six pedestrian portal monitors for use at sensitive facility locations. Recently one of these monitors has been evaluated and found to meet the US American Standards for Testing and Measurement (ASTM) standards of performance. This monitor will be an asset for establishing the role SNM portal monitoring as part of the Russian MPC&A system. Three neutron vehicle monitors are currently being constructed at VNIIEF for installation at their facility.

VNIITF The high level of technical expertise at the Institute of Russian Institute Technical Physics at Chelyabensk-70 has furnished useful information on the operation of US portals in Russian environmental and operational conditions. Chelyabensk personnel have installed US pedestrian and vehicle portals and constructed pedestrian portals from crash-door SNM monitor components. They have carefully studied the operation of US and Russian drive-through vehicle monitors installed at their facility under Russian winter weather conditions. This information is very useful for future installations. They designed and evaluated a prototype vehicle monitoring station and are currently negotiating a contract to install a vehicle monitoring station based on this design.

RRC The Kurchatov Institute has considerable experience in the design of Russian contamination monitoring instrumentation. A team of LANL and Kurchatov experts performed a side-by-side comparison of the performance of instruments based on Russian Geiger-Mueller sensors and US plastic scintillators. The results of this comparison prompted Kurchatov experts to design and build an SNM monitor based on plastic scintillators from Russian components. A recent evaluation of this instrument showed that its performance meets those of the US ASTM standards. Kurchatov-designed SNM pedestrians portals have been installed in the institute and their long-term operational reliability is being evaluated. A contract for the design of SNM vehicle monitors is currently being negotiated.

RIAR Dimitrovgrad personnel performed an extensive evaluation of hand-held SNM monitors. This evaluation showed how well the instruments maintain calibration and how effective they are as search instruments. They also performed an evaluation of vehicle monitors. For this study, they developed a set of SNM standard evaluation sources. We are currently negotiating a contract to provide the sources for all the Russian facilities that use SNM portals.

Mayak The Mayak facility has make a significant commitment to use of SNM portals. Their personnel are also undertaking the next step in the effective use of portal monitors. Automatic portals are used to detect SNM. Hand-held instruments are used to localize the material. The final step is to identify the isotope responsible for the detected radiation. Mayak is committed to performing a field evaluation of portable isotope identification instruments. This evaluation will furnish useful information for implementing these instrument at other facilities.

CONCLUSION

The installation of SNM portal monitors has played an important role in improving security of Russian nuclear facilities. The development of SNM portal monitoring technical expertise at each facility has ensured the role of this technology in the more comprehensive MPC&A systems. The level of technology transfer in this area is evidenced in the success of the Working Seminar for Implementations of Radiation Monitoring at Russian Nuclear Facilities hosted by VNIIA in Obninsk. At this workshop, more than 60 Russian specialists met to discuss their ideas and accomplishments in portal monitoring technology. VNIIEF, RRC, and ASPECT have demonstrated their ability to build effective SNM portal monitors. A course on the maintenance of US-manufactured instruments was held in Obninsk, in October 1997. This course provided interactive instruction on all aspects of the maintenance and calibration of these instruments. Six Russian facilities attended this first course which will be taught twice in the fall of 1998, and seven Russian facilities are scheduled to attend these classes. The US-Russian MPC&A program has implemented SNM portals to improve the safeguard systems at Russian facilities and supplied sufficient spare parts and training to insure the long-term reliability these instruments. The role of SNM portal monitors in the comprehensive Russian MPC&A system is well-established and the Russian capability of supplying their future needs for such instruments is rapidly progressing.

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