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**OSTI****THE U.S. DOE MPC&A ASSISTANCE PROGRAM TO UKRAINE**

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**ABSTRACT**

The nuclear industry of Ukraine is a vital part of the national economy. In 1995 nuclear power accounted for approximately 37% of the total electricity production. Ukraine has five nuclear power stations with fourteen reactors in commercial operation. Ukraine also has research facilities whose work involves nuclear materials. Improving the security of the nuclear material under its control is an important goal for the Ukrainian nuclear community. Ukraine has requested and is receiving the assistance of several IAEA member states in material protection, control and accounting (MPC&A). The U.S. DOE is providing assistance in nuclear material safeguards in both material control and accountability (MC&A) and physical protection (PP) to the national regulatory authority and to four facilities in Ukraine. The program is well under way. At the Kiev Institute of Nuclear Research (KINR) a significant upgrade of the PP system has been completed. Similar upgrades are in progress at the Kharkov Institute of Physics & Technology (KIPT), South Ukraine Nuclear Power Plant (SUNPP) and Sevastopol Institute of Nuclear Energy & Industry (SINEI). MC&A equipment and software, including computers and NDA instrumentation, have been delivered to the facilities. This paper summarizes accomplishments of the program to date, and future plans.

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**I. INTRODUCTION**

In April 1992, discussions began between the governments of the United States and Ukraine on U.S. assistance in the area of Nuclear Material Protection, Control and Accounting (MPC&A). Formal agreements on this topic were signed on October 25, 1993, and December 18, 1993. Cooperation between the U.S. and Ukraine continues under the Cooperative Threat Reduction (CTR) Program.

In the spring of 1994, the U.S. and Ukraine selected "model facilities" at which the initial efforts to evaluate and upgrade nuclear material safeguards systems were to be concentrated. The facilities identified were the Kiev Institute for Nuclear Research (KINR) and South Ukraine Nuclear Power Plant (SUNPP). Since then the U.S. has also agreed to assist Ukraine in improving safeguards at the Kharkiv Institute of Physics and Technology (KIPT) and at the Sevastopol Institute for Nuclear Energy and Industry (SINEI).

In the Autumn of 1994, site surveys were conducted at KINR and SUNPP. Technical specialists in both material control and accountability (MC&A) and physical protection (PP) observed the safeguards systems and reviewed the procedures at the facilities. The U.S. team used the information obtained in the surveys to analyze the systems at KINR and SUNPP and develop preliminary designs containing detailed lists of recommendations to upgrade MPC&A at these facilities. Similar surveys

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have also been conducted at KIPT and SINEI.

After the site surveys, the upgrade recommendations for MC&A and PP systems are reevaluated, near-term equipment specifications are developed and additional information is collected to prepare the documentation for the design reviews. The process of data collection and design is a collaborative effort involving specialists from both the U.S. and Ukrainian sides. At the design review the U.S. team presents documentation packages that include a design description document and engineering drawings to direct the implementation of the proposed upgrades. After agreement is reached between the U.S. and Ukraine sides, work then begins with the installation subcontractor on procurement and installation. Additional information on these activities may be obtained in References 1- 3.

#### *International Coordination*

The United States is coordinating its assistance efforts in MPC&A with other Donor States to avoid duplication of effort. U.S. representatives have attended IAEA Coordinated Technical Support Plan meetings as well as meetings with representatives from Hungary, Finland, Sweden and Japan.

In the area of MC&A, assistance is being provided by Finland, Japan, Sweden and the U.S. Finland has been host to meetings to coordinate the procurement of NDA measurement equipment. The objective was to avoid duplication of the instrumentation supplied to Ukraine. U.S. representatives have met with representatives from the Swedish Nuclear Power Inspectorate (SKI) to discuss MC&A software assistance programs to Ukraine. Sweden has provided software for a Ukrainian Government system that will report to the IAEA. The U.S. is developing facility level systems that will supply the data needed for the IAEA reports.

In the area of physical protection, representatives from the U.S. and Finland have met in Washington, D.C. and Helsinki to review the status of their assistance programs to Ukraine. Discussions centered on physical protection systems at VVER power plants. At KIPT, specialists from Sweden and Japan are working with specialists from the U.S. to upgrade the physical protection systems. The U.S. effort is centered on the buildings containing the nuclear materials while Sweden and Japan are upgrading the perimeter of the site.

## **II. ASSISTANCE ON PHYSICAL PROTECTION SYSTEMS**

The program to upgrade the physical protection systems at the selected Ukrainian nuclear facilities is well underway. The standards for protection at these facilities used in the designs were based on INFCIRC/225, Rev.3 and the threat concepts used in the U.S. (10 CFR 73.1). The objective of the designs is to protect against radiological sabotage and theft or diversion of significant amounts of direct use nuclear material.

#### *KINR*

At KINR the facility of interest is the 10-MW WWR-M research reactor. The reactor is fueled with HEU. Working with the technical staff of KINR, personnel from Sandia National Laboratory (SNL) and Advantor Corp. have significantly improved the facility's physical protection system. Aging portals in the old perimeter have been replaced. A new double fenced perimeter has been installed

inside the old wall. This inner perimeter is equipped with lighting, state-of-the-art intrusion detection sensors, closed circuit television (CCTV) cameras, and a vehicle barrier system. A new, hardened portal guard station has been integrated into the inner perimeter and a hardened central alarm station has been created to protect the facility guard force as they use the high-technology sensor monitoring and assessment equipment provided by DOE. Sensors, access controls and cameras have been placed throughout the interior of the facility and the material storage vaults have been strengthened against a variety of threats. Guard force procedures and training programs are being established by KINR with DOE's assistance.

#### *SUNPP*

At SUNPP the facilities of interest are the three VVER-1000 nuclear reactors. The staff at SUNPP has submitted proposed designs for many facilities at the power plant. As the SUNPP staff completes complete designs and provide equipment specifications the U.S. side reviews the information. After both sides reach an agreement on a proposed upgrade, the U.S. side will provide equipment for installation and work with the Ukrainian side to effect its installation. Advantor Corp. is installing physical protection upgrades in the following facilities: 1) the Central Alarm Station, 2) the Spent Fuel Storage Facility, 3) the Emergency Diesel Generator Building, 4) the Central Portal of the Administration Building, 5) the exterior of the Administration Building. The major portion of the installation will occur later this year.

#### *KIPT*

The primary concern at KIPT is the large quantity of bulk nuclear material in various physical and chemical states and isotopic enrichments. Working with the technical staff of KIPT, engineers from ANL are implementing a number of upgrades to improve the existing physical protection system. (See Reference 4 for additional information.) ANL contracted with a local Ukrainian company, Vacuum Mash Ltd., to harden the material storage area. Walls were strengthened, doors and door frames replaced, metal grating installed on windows, and a roof repaired and strengthened. Additional protection is provided by a modular vault fabricated and installed by SNL.

The guard force voice communication system is being significantly enhanced with a radio system provided by Condor Communications and Motorola Corp. Two dozen hand-held portable radios, several vehicle radios, and three base stations were shipped to KIPT earlier this year. The equipment was recently released by Ukrainian customs and is being installed.

The Swedish and Japanese governments, through the Swedish nuclear power Inspectorate and the Japan Committee on Cooperation for the Elimination of Nuclear Weapons in the Russian Federation, have also agreed to assist with the physical protection upgrades at KIPT. They are working with the KIPT staff to upgrade the perimeter physical protection system. The final design is near completion. The upgrades will include new fences, intrusion detection sensors, and CCTV cameras.

#### *SINEI*

At SINEI, the facility of interest is the IR-200 research reactor, which is fueled with HEU. The reactor, which was part of the Sevastopol Naval Institute, was used for training submariners. Last fall, the Naval Institute was restructured; part of it, including the reactor, became the Institute of Nuclear Energy and Industry. The new Institute is administered by Derzhcomatom, which is responsible for all of the nuclear power plants in Ukraine.

Engineers from ANL and SNL have been working with members of the Derzhcomatom physical protection department to generate and implement physical protection upgrades at the reactor facility. Designs for interior upgrades have been completed. A contract has been awarded to Advantor Corp. to provide and install interior intrusion detection equipment, CCTV assessment equipment, and an alarm monitoring and entry control system. The physical protection upgrades for the perimeter are in the final design stage.

### III. ASSISTANCE IN MC&A

Assistance in material control and accountability includes upgrades in the areas of training on MC&A procedures, providing nondestructive assay (NDA) instrumentation and assisting in the development of computer-based accounting systems.

Training courses have been developed to improve the skills of Ukrainian specialists in material control and accountability. Courses in the following areas have been identified and are being provided:

- Fundamentals of MC&A;
- Fundamentals of NDA;
- Statistics, Variance Propagation, and Measurement Control;
- Structure and Management of a Safeguards Seals (TIDs) Program;
- Software Utilization (viz, MS Windows, MS Office and MS Access).

NDA instrumentation needs have been identified in the areas of shipper / receiver measurements and inventory verification measurements. Among the instruments recommended are:

- Gamma-ray spectrometry instrumentation for fuel enrichment measurements;
- Cherenkov radiation viewing systems for in-pool spent fuel verification;
- Active Well Coincidence Counter (AWCC) for NDA measurements on uranium samples.

A software prototype has been developed for an MC&A inventory system for Ukrainian facilities. This software (AIMAS) has been installed on computers delivered to the nuclear facilities. The prototype was designed to provide a starting point for joint U.S. / Ukraine system development. AIMAS was created using Microsoft Access, a relational data base management system (RDBMS) in a graphical environment. The current prototype offers basic, generic functionality for tracking the physical inventory, maintaining a historical record of additions or changes to the inventory, and provides basic reporting capabilities. Additional information on AIMAS may be obtained in Reference 5.

#### *KINR*

DOE has provided both high and low resolution gamma-ray spectrometry systems for nondestructive assay and a radioactive source set. This equipment will allow KINR to confirm the isotopic composition of nuclear materials in its inventory. Los Alamos National Laboratory has delivered the instrumentation and will be providing hands-on training in its use. AIMAS software has been provided to KINR along with computers and training for KINR technical staff responsible for material control and accounting. ANL is working with KINR to develop

appropriate MC&A procedures and to make sure that KINR staff receives the necessary training to carry out these procedures fully.

#### *SUNPP*

DOE has provided a low resolution gamma-ray spectrometry system for nondestructive assay and a radioactive source set. AIMAS software has been provided to SUNPP along with computers and training for SUNPP technical staff responsible for material control and accounting. The AIMAS software will include a burn-up program (LEOPARD-VENTURE) to estimate fissile material loss/gain due to reactor operation. LANL is providing an underwater video camera (Calycine tube for high temperature resistance) with remote zoom, focus and iris.

#### *KIPT*

Personnel from Lockheed Martin Energy Systems (LMES) and KIPT are working with staff at the Ukrainian Ministry of Environmental Protection and Nuclear Safety to develop a plan for repackaging the weapons-useable nuclear material at KIPT. These nuclear materials must be repackaged so that accurate inventory measurements can be made to fulfill IAEA safeguards requirements. The necessary materials for the repackaging operation (including scales and check-weights, inert-atmosphere glove boxes, plastics glove bags, blowers and HEPA filters, and bar code readers and printers) have been purchased. A contract for the repackaging operation is being written by LMES personnel, and will be submitted to KIPT for concurrence. According to current projections, repackaging is to be completed later this year.

High and low resolution gamma-ray spectrometry instruments and corresponding source sets have been procured by LANL and delivered to KIPT. Oak Ridge National Laboratory is reconfiguring a surplus AWCC for use by KIPT. The use of surplus equipment allows DOE to provide a significant nondestructive assay capability to KIPT while realizing a significant savings over buying the equipment new.

#### *SINEI*

DOE has provided a general purpose gamma-ray spectrometry system for nondestructive assay and a radioactive source set. This equipment will allow SINEI to confirm the isotopic composition of nuclear materials in its inventory. AIMAS software has been provided to SINEI along with computers and training for technical staff responsible for material control and accounting. ANL is developing appropriate MC&A procedures and working with the SINEI staff to insure that they receive the necessary training to implement these procedures.

### **IV. FUTURE ACTIVITIES**

Improvement in the safeguards systems at the nuclear facilities is an ongoing effort involving both the U.S. and Ukraine. The physical protection upgrades at KINR are mostly complete and a commissioning ceremony for this system is planned for August 1997. The design of physical protection upgrades for SUNPP was completed in 1996, installation of the upgrades is underway and will be completed in 1998. The designs of the upgrades at KIPT are complete and installation of the upgrades is underway and will be completed in 1998. Much of the design for the SINEI upgrades has been completed. Installation will soon start and will be complete near the end of 1998.

The remaining MC&A training courses are scheduled for later this year. The majority of the NDA equipment has been purchased and delivered to the Ukrainian nuclear facilities. Site specific training on the use of the equipment will occur later this year. The PCs for the nuclear material accounting systems have been purchased and delivered to Kiev. The hardware is awaiting clearance by Ukrainian Customs so that it may be transferred to the facilities. The uranium repackaging project at KIPT is awaiting approval from the Ukrainian regulatory authorities, but is expected to be completed later this year.

## V. References

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- 1) U.S. DOE \ NN-40,
  - 2) Argonne National Laboratory,
  - 3) Los Alamos National Laboratory,
  - 4) Sandia National Laboratory,
  - 5) Lockheed Martin Energy Systems.

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