1. Introduction
As part of the joint U.S. and Republic of Kazakstan nuclear Material Protection, Control, and Accounting (MPC&A) program, the U.S. Department of Energy (DOE) is providing assistance at four nuclear facilities in Kazakstan. These facilities are the Ulba Metallurgical Plant, the National Nuclear Center (NNC) Institute of Atomic Energy at Kurchatov (IAE-K), the Mangyshlak Atomic Energy Complex (BN-350) Reactor, and the NNC Institute of Atomic Energy at Almaty (IAE-A). This paper describes the DOE MPC&A physical protection program at each of the facilities.

2. DOE MPC&A Program
The U.S. goal of this MPC&A program is:

Reduce the threat of nuclear proliferation and nuclear terrorism by rapidly improving the security of all weapon-useable nuclear material in Russia, the Newly Independent States, and the Baltics.

To achieve this goal, the U.S. is taking the following steps:

1. Implementing systematic MPC&A enhancements at the nuclear facilities
2. Providing for the development of national-level systems to sustain MPC&A
3. Providing for the long-term sustainability of MPC&A enhancements

In the Republic of Kazakstan, the DOE MPC&A program activities have been primarily concerned with the rapid implementation of the MPC&A enhancements (step 1). The U.S. Nuclear Regulatory Commission (NRC) has focused on providing assistance to the national-level MPC&A systems (step 2). As steps 1 and 2 progress toward completion, the issue of additional long-term sustainability support is becoming very important. It is important to note that the long-term sustainability of MPC&A enhancements has been an integral consideration in the design of MPC&A systems and in MPC&A training courses. Further, it is important to note that other IAEA donor countries have been cooperating with the U.S. and Kazakstan in these efforts.

One technique which addresses long-term sustainability issues is to foster the indigenous sources of equipment. Because of the limited availability of MPC&A equipment in Kazakstan, most of the MPC&A equipment supplied has been from outside of Kazakstan. However, as the program progresses, more and more of the ancillary equipment such as cable, air conditioners, tools, etc., is being procured from local sources of supply. Another method of addressing long-term sustainability concerns is to work jointly with the facilities themselves to ensure that the design and installation of MPC&A systems are significantly the work of facility engineers and other workers. In practice, this involves the DOE national laboratories contracting with the facilities directly to implement the upgrades. The DOE technical specialists then serve primarily as contract administrators and consultants for the MPC&A work.

The MPC&A programs are in different stages of completion for each of the nuclear material facilities. The programs at the Ulba and the IAE-K facilities are scheduled to be completed before the end of December 1997. The programs at the MAEC and the IAE-A are scheduled to be completed one year later before the end of December 1998.
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3. Physical Protection Program in the Republic of Kazakhstan

In the Republic of Kazakhstan, the following steps are used to provide for MPC&A enhancements at the nuclear material facilities:

- Conduct MPC&A site surveys
- Jointly develop a prioritized list of MPC&A upgrades and training
- Provide MPC&A equipment and training

The development of the prioritized MPC&A upgrades and training lists for the facilities was especially important because it was recognized early on that funding to provide all desired upgrades was not available. Concurrently, with the supplying of upgrades, contracts were placed with the facilities to define a physical protection upgrade plan. Training in the U.S. method of conducting physical protection vulnerability assessments (VA) was also given. The physical protection plan and the VA training provided the opportunity to determine as early as possible whether any potential upgrades were missed during the initial development of the prioritized lists.

3.1 Physical Protection Upgrades

In general, the following physical protection upgrades are being provided to the nuclear sites in Kazakhstan. Upgrades specific to individual sites are also being provided. These site-specific upgrades are listed in the sections describing the individual sites:

- **Metal and Nuclear Material Detectors**
- **Hardening of Access Points to Nuclear Materials**
- **Hand-held Guard Force Radio Communications Systems**
- **Alarm and Access Control Systems**

Hand-held metal and nuclear material detectors are being provided for personnel and vehicle searches. In conjunction with the metal and nuclear material detectors, Russian language procedures for their use are being provided.

Examples of the hardening of access points to nuclear materials include: (1) the replacement of wooden doors with metal doors, (2) the addition of metal grill work to exterior windows, and (3) the development of barriers that inhibit access to cranes that can move nuclear material. These enhancements increase the time required for an adversary to reach the nuclear material.

In addition to increasing the time required for an adversary to reach the nuclear material, the physical protection of the nuclear material can be enhanced by decreasing the response time of the guard force thus increasing their effectiveness. Hand-held radios are being provided for this purpose. Although there are currently some portable radios at the facilities, telephone lines are still the primary means of communication.

The most extensive upgrades to facilities are the alarm and access control systems. The existing systems are approaching the end of their intended design life. They are being replaced by computer controlled systems that provide integrated alarm and access control. These computer systems also provide automated logging of personnel and report generation. Battery back-up power provides continued operation in the event of power outages. At the request of the government of Kazakhstan, U.S. produced physical protection equipment has been used.

The system level design of the alarm and access control systems have been provided by the DOE teams. The final facility-specific design and installation drawings for these systems are generated by the facilities under contract. The installation and configuration of the alarm and access control systems is also performed by the facilities and/or Kazakhstani firms under contract.
3.2 Training

MPC&A training is being provided to complement the MPC&A upgrades. The following formal training has been or will be provided for all of the sites:

- Physical Protection System Design
- Vulnerability Assessment of Physical Protection Systems
- Alarm and Access Control System equipment-specific training

Early in the programs for the sites, the “Physical Protection System Design,” course was given in the U.S. This course is a similar but condensed version of the IAEA-sponsored International Training Course that has been given to hundreds of nuclear specialists from all over the world. At the completion of this course, the facility representatives were taken to nuclear facilities to observe U.S. physical protection systems.

Training in the conducting of physical protection vulnerability assessments using U.S. software has also been given. This training was given on-site at both the Institute of Atomic Energy at Kurchatov and the Mangyshlak Atomic Energy Complex. On-site training provides for the modeling of an actual facility during the course of the VA training. Representatives from the Ulba Metallurgical Plant, the Institute of Atomic Energy at Almaty, and Kazakstan Atomic Energy Agency were invited to attend the class at the IAE-K. As part of the vulnerability assessment training, contracts have been placed that provide for the facilities to conduct VAs at their own facilities.

The final formal training involves the design, installation, configuration, and operation of the computer-based alarm and access control systems being supplied to all of the sites. This training can be broken into the following parts:

- General system design
- Site-specific configuration and operation
- On-site installation and configuration consultation

Because of the complexity of computer-based alarm and access control systems, training is a very important part of the program. Relatively early in the design process general training in system design is given to the facility. This provides a basis for the facilities to be able to participate in the high-level system design. Since this training is general, it is either provided in the U.S. or on-site as the design and installation of the system progresses. Site-specific training is required. This training is provided on-site. Both system configuration and operator training is required. Finally, during the actual installation and configuration of the system by the facility, on-site consultation is provided.

4. Physical Protection Upgrades at the Nuclear Material Sites

A detailed list of physical protection upgrades and training for each of the sites is given in the following sections.

4.1 Ulba Metallurgical Plant

The initial MPC&A site survey of the Ulba facility was held 26-28 September 1994. A detailed physical protection site survey followed on 11-20 April 1995. The main portion of the physical protection program at the Ulba facility is scheduled to end 30 September 1997, with some very limited follow-on cooperation in fiscal year 1998 (October 1997 - September 1998). Given below is a list of physical protection upgrades and training to date.

Physical protection upgrades

- Hand-held metal detectors delivered April 1995
- Radio communications system and hand-held nuclear material detectors delivered November 1995
- Door locks delivered January 1996
- Alarm system equipment for one of the nuclear material buildings delivered August 1996
• Alarm system installation for one of the nuclear material buildings, June-September 1997
• MPC&A program completion ceremony, 6 September 1997

Training

• Physical protection systems training and U.S. facility tour, 23 October - 3 November 1995
• Ulba representative attendance at Semipalatinsk vulnerability assessment course, 22-30 April 1996
• Alarm system training in the U.S., 14-18 April 1997
• On-site alarm system training, 6-15 August 1997

4.2 National Nuclear Center Institute of Atomic Energy at Kurchatov
The initial MPC&A site survey of the National Nuclear Center (NNC) Institute of Atomic Energy (IAE-K) was held 3-5 October 1994. A detailed physical protection site survey followed on 23-30 August 1995. The MPC&A program is concerned with the nuclear material located at the IGR and Baikal 1 reactor sites at the IAE-K. As with the Ulba facility, the main portion of the physical protection program at the IAE-K is scheduled to end 30 September 1997, with some very limited follow-on cooperation in fiscal year 1998. Given below is a list of physical protection accomplishments and training to date.

Physical protection upgrades

• Hand-held metal detectors delivered March 1996
• Hand-held nuclear material detectors delivered May 1996
• Door locks delivered June 1996
• Alarm and access control system equipment for the two reactor sites delivered November 1996
• Radio communications system delivered January 1997
• Radio tower installation and radio system configuration April-September 1997
• Alarm and access control system installation for the two reactor sites April-September 1997
• Perimeter microwave sensor system installation for the Baikal 1 site August-September 1997
• MPC&A Program Completion Ceremony, 12 September, 1997

Training

• Physical protection systems training, 23-27 October 1995
• Vulnerability assessment course at the IAE-K, 22-30 April 1996
• Alarm system training in the U.S., 14-18 April 1997
• Exterior microwave system installation training in the U.S., 9-13 June 1997
• On-site alarm system training, 8-17 July 1997

4.3 Mangyshlak Atomic Energy Complex
The initial MPC&A site survey of the Mangyshlak Atomic Energy Complex, BN-350 reactor was held 4-7 September 1995. A detailed physical protection site survey followed on 18-21 March 1996. The main portion of the physical protection program at the Complex is scheduled to end 30 December 1997, with some limited follow-on cooperation in calendar year 1998. Given below is a list of physical protection upgrades and training to date.

Physical protection upgrades

• Hand held radiation, SNM, and metal detectors delivered May 1996
• Guard force procedure training videos and vehicle inspection mirrors delivered July 1996
• Upgraded security and access to spent fuel cranes July 1996
• Short term physical protection upgrades for the spent fuel storage area began September 1995, completed November 1996
• Central alarm stations upgrades began May 1997, completion expected November 1997
• BN-350 lobby access control upgrades began May 1997, completion expected November 1997
• Upgrades to exterior doors and windows began May 1997, completion expected October 1997
• Upgrades to the access control system began May 1997, completion expected September 1997
• Upgrades to the fresh fuel building began September 1997, completion expected November 1997
• Installation of exterior lighting and cameras began September 1997, completion expected Fall 1997
• Interior upgrades began June 1997, completion expected December 1997
• Computerized material accounting system upgrades began December 1995, completion expected March 1998
• MC&A procedure upgrades began October 1996, completion expected October 1997

Training

• Physical protection training February 1996
• Physical protection orientation February 1997
• Radiation detection equipment training July 1996
• MC&A Training December 1995
• Radiation monitoring system training July 1996
• Computer-based vulnerability assessment training November 1996

4.4 National Nuclear Center Institute of Atomic Energy at Almaty

The initial MPC&A site survey of the National Nuclear Center (NNC) Institute of Atomic Energy-Alatau (IAE-A) was held 11-12 September 1995. A detailed physical protection site survey followed on 13-15 March 1996. The main portion of the physical protection program at the Institute is scheduled to end in 1998. Given below is a list of physical protection upgrades and training to date.

Physical protection upgrades

• Upgrades to the material storage area began Spring 1996, completed Summer 1996
• Replacement of control room and nuclear material storage vault doors within the facility began Summer 1996, completed Fall 1996
• Upgrades to the VVR-K building exterior and 10 meter perimeter began May 1997, completed September 1997
• Upgrades to the nuclear material accounting system began May 1996, completed March 1997
• Upgrades to the facility's material measurement capabilities began October 1996, completed September 1997
• Upgrades to MC&A procedures began March 1997, completion expected December 1997
• Hand-held nuclear material detectors and metal detectors delivered March 1996
• Nuclear storage vault motion sensors and alarms delivered and installed July 1996
• Upgrades to the bulk material storage area completed July 1996
• Upgrades to the nuclear material storage vaults completed September 1996
• Computers and hardware for material accounting system delivered May 1996
• Precision balance for material measurement delivered October 1996
• Nuclear material accounting system software delivered and installed November 1996
• Gamma spectroscopy for material measurements delivered March 1997

Training

• Material Control and Accounting training began February 1996, completed April 1997
• Physical Protection training began February 1996, completion: TED (see comment above)
• Fundamentals of Material Control and Accounting workshop February 1996
• Basic Physical Protection Theory and Implementation course February 1996
• **Advanced Statistics and Measurement Control workshop March 1996**
• **Introductory Vulnerability Assessment course April 1996**
• **Non-Destructive Analysis seminar April 1997**
• **Vulnerability Assessment course at the IAE-K, 22-30 April 1996**

5. Conclusion

The current joint physical protection portion of the DOE MPC&A program is progressing steadily and on-track for the scheduled completion dates of December 1997 for the Ulba and IAE-K facilities and prior to December 1998 for the MAEC and IAE-A facilities. As noted above, the main focus of the DOE MPC&A program so far has been the rapid enhancement of the security of the nuclear material in Kazakhstan. However, as the MPC&A enhancement programs at each of the sites progress to completion, it is recognized that there is a need to address the long-term sustainability of the MPC&A enhancements. Training is currently being provided to address this need. Also, a future option is to expand the Kazakhstan participation in the training courses provided by the Regional Methodological Training Center (RMTC) in Obninsk. However, the most important strategy that addresses the long-term sustainability of MPC&A will be provisions for long-term interaction of U.S. and Kazakhstan specialists. The enhancements provided have a finite design life. Over time the value of these enhancements will become insignificant compared to the mutual enhancements provided by the exchange of ideas of U.S. and Kazakhstan MPC&A specialists.
Report Number (14) SAND-97-20870
CONF-970996--

Publ. Date (11) DE/AN 199709

Sponsor Code (18) UC-90 DOE/NN XF

UC Category (19) UC-900 DOE/ER

DOE