SYSTEMS SUSTAINABILITY: IMPLEMENTATION of ENHANCED MAINTENANCE PROGRAMS at the KURCHATOV INSTITUTE, the ALL-RUSSIAN RESEARCH INSTITUTE of EXPERIMENTAL PHYSICS (VNIIEF) and the ALL-RUSSIAN SCIENTIFIC INSTITUTE for TECHNICAL PHYSICS(VNIITF)

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ABSTRACT

Implementation of quality maintenance programs is essential to enhancing sustainable continuous operations of United States funded Materials Protection, Control and Accountability (MPC&A) equipment/systems upgrades at various Russian nuclear facilities. An effective maintenance program is expected to provide assurances to both parties for achieving maximum continuous systems operations with minimum down time. To be effective, the program developed must focus on minimum down time for any part of a system. Minimum down time is realized through the implementation of a quality maintenance program that includes preventative maintenance, necessary diagnostic tools, properly trained technical staff, and an in-house inventory of required spare parts for repairing the impacted component of the system. A centralized maintenance management program is logistically essential for the success of this effort because of the large volume of MPC&A equipment/systems installed at those sites. This paper will discuss current programs and conditions at the Russian Research Center-Kurchatov Institute, the All-Russian Scientific Institute for Technical Physics and the All-Russian Research Institute of Experimental Physics and will address those steps necessary to implement an upgraded program at those sites.

I. INTRODUCTION

The United States Department of Energy (DOE), under the Nunn-Luger Act, was empowered by Congress in the early 1990's to address nuclear proliferation prevention measures through Materials Protection, Control and Accountability (MPC&A) upgrades for various nuclear facilities in the Former Soviet Union (FSU), in an effort to provide improved security of existing and stockpiled special nuclear materials (SNM). The formative period of this program included site assessments of several nuclear facilities within the FSU. DOE established teams of technical experts from the various national laboratories throughout the United States (US) for the purpose of addressing the MPC&A upgrade opportunities at those sites. Each team was assigned to a particular site, which included the Russian Research Center-Kurchatov Institute (KI), the All-Russian Research Institute of Experimental Physics (VNIIEF), and the All-Russian Scientific Institute for Technical Physics (VNIITF). The Ministry of Atomic Energy (MinAtom), Russia's equivalent to DOE, and each individual Russian site developed teams of experts to work with their American counterparts to achieve improvements in safeguards and security. The Russian teams are made up of representatives from each individual site only.

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The previous safeguards and security systems at those sites relied heavily on the human element for deterrent and detection. With the collapse of the Soviet Union and the dramatic impact on their economy, the fear of insider threat escalated. Both the US and Russia recognized the potential for weapons-grade nuclear material theft and jointly took necessary steps to reduce that threat.

The old Materials control and Accountability (MC&A) system in Russia is based on personal responsibility and manual bookkeeping records. This labor intensive system has been in effect at these sites for many years. Technological advancements in database management and new methods of objective verification for materials integrity and intactness raised the opportunity for further development and upgrading of MC&A systems.

The old Physical Protection (PP) system relied heavily on the protective forces for intrusion detection and also for insider theft detection. More modern electronic surveillance and intrusion detection systems have also contributed to PP system upgrades at the various facilities.

II. SITE ASSESSMENTS OF CURRENT MAINTENANCE PROGRAMS

A. Kurchatov Institute

The Kurchatov Institute (KI), named after the famous scientist Ivan Kurchatov, is located in Moscow and is a research facility dedicated to performing unique research on behalf of the Russian government. KI's research programs include solid state physics, fusion and plasma physics, and nuclear physics, as well as nuclear power and reactor safety.

One of the first activities to be conducted at this site was a US team assessment of the current safeguards and security programs. This assessment was completed by the US team in cooperation with the Russian colleagues. The joint team effort identified those specific sites where MPC&A upgrades should be applied. As a result of this continuous joint team effort, several upgrades for PP and MC&A have been implemented.

The US team assigned to the KI project is comprised of members from various US Laboratories with each member being assigned specific MPC&A responsibilities. Those responsibilities include procurement of necessary PP and MC&A equipment through Task Project contracts agreed upon by the joint US/Russian team leads. In some cases, spare parts and standard operating manuals were also provided with those procurements.

Basically, all of the items purchased carried a warranty and in some cases a maintenance contract was also part of the procurement. For most items, the failed equipment was returned to the vendor for repair or replacement since there was no in-house capabilities for repair. Most of the time the equipment was simply replaced. This resulted in long down times and delays especially if the equipment was purchased outside Russia.

For those items having a maintenance service contract, Kurchatov Institute occasionally experienced problems with this arrangement. One example was a PP system upgrade procured in Moscow from a Russian vendor. Once the equipment was in place and a system failure occurred it was reported that the vendor took approximately three weeks to respond.

As equipment was installed at this institute and failures occurred it became obvious that a joint US/Russian team effort to upgrade the KI maintenance program was essential for sustainable operations. In late 1998, dialogue was begun with Kurchatov Institute for the development of this program.

In late February 1999, the first phase of upgrading KI PP and MC&A equipment maintenance capability was accomplished with the completion of an on-site assessment of the KI maintenance program. The lead laboratory for this task, Oak Ridge National Laboratory (ORNL), was assisted by PANTEX in the performance of the assessment because of their experience with VNIIEF and VNIITF to establish an enhanced maintenance program for US funded equipment at those sites. From this assessment, it was learned that KI has two separate maintenance programs. The first is for the PP system under the management of the Ministry of Defense (MVD). The second is for the MC&A system under the management of KI. The MVD provides the protective forces for guarding the compound and maintains separate controlling authority on the PP maintenance system.

A maintenance criteria checklist, developed by PANTEX, was used in the assessment. The checklist was used to collect important information on the KI maintenance program. Together with the information shared by the Russian counterparts and the information noted on the checklist a set of findings could be identified. These findings would reveal the strengths and weaknesses of the current maintenance system.

1. Physical Protection. The MVD has its own laboratory for testing new equipment and failed equipment. This laboratory is small and the testing equipment does not appear to be sufficient for the more modern equipment supplied through the US DOE program. Many of the US supplied equipment did not include any technical service manuals or spare parts, which are essential to a maintenance program's success.

2. Materials Control and Accountability. The KI Test/Maintenance Center is comprised of a highly skilled workforce but appears to be too small for a facility of this size. Their diagnostic equipment is apparently sufficient for their systems, but not adequate for some of the US supplied equipment. Technical service manuals and spare parts for the US supplied equipment are limited or lacking altogether.

3. Centralized Maintenance System. KI has a Centralized Maintenance System but it is not clear if the system comprises both PP (under MVD auspices) and MC&A (under KI auspices). KI did indicate that they do perform maintenance on select PP equipment for which MVD does not have on-site technical capabilities. The program apparently does have a Preventive Maintenance (PM) aspect with limited computerization. This assessment revealed that KI has experienced failures on some US provided equipment. In some cases, those failures resulted in long down times.

B. All-Russian Institute of Experimental Physics (VNIIEF)

The VNIIEF site is comprised of research (reactor) facilities (Scientific Zone) and nuclear material production facilities (Industrial Zone). Representatives from seven US DOE laboratories/facilities comprise the US team that works jointly with VNIIEF for the enhancement of the VNIIEF MPC&A systems. The US team members from the DOE PANTEX site were assigned responsibility for assisting VNIIEF in the enhancement of their existing maintenance program for US funded MPC&A equipment/systems.

The PANTEX team approach was to begin by establishing a Maintenance Implementation Plan (MIP). The following are essential areas that VNIIEF is using to establish an enhanced maintenance program for U.S. funded MPC&A equipment:

a) Training and knowledge level of maintenance personnel (which includes preventive, corrective, emergent maintenance).

b) Maintenance procedures (creation of maintenance tasks and what is required to document preventive, corrective, emergent work).

c) Work control (which includes maintenance work requests and how they are handled, routed and worked in the field; planning and scheduling responsibilities; and control of work orders).

d) Procurement of parts and materials (procurement policies and procedures, procurement control, material receipt inspection, handling, storage retrieval and issuance).

e M)aintenance management (management responsibilities, lines of communication, field observations, data monitoring, self-assessments, program reviews and problem analysis).

During 1997 through September 1998, VNIIEF created preventive maintenance tasks that would be used on the U. S. funded MPC&A equipment. Currently, maintenance manuals for various types of equipment are undergoing translation for use by VNIIEF technicians and engineers. However, this has been very difficult to complete due to the number of manufacturers who only supply operations type manuals that omit such technical information as wiring diagrams, trouble shooting diagrams, and repair procedures. In some cases, these specialized manuals have to be purchased and sent to VNIIEF. Budget restraints will impact this particular effort, slowing the process to a few years.

VNIIEF experienced a camera failure at one of the sites and without the proper technical documentation could not effectively repair the unit. The unit was sent to PANTEX for repair resulting in a downtime of approximately 30 days. At PANTEX, the repair took approximately eight man-hours.

In addition, work on a Computerized Maintenance Management System (CMMS) has begun. The CMMS is expected to assist the maintenance program by automating many functions currently performed manually. With the automation that CMMS will provide, it is anticipated that efficiencies will be gained in: reducing down time, reducing the possibility of not performing required maintenance, adequately tracking of spare parts, and development of an overall equipment pedigree. It is anticipated that the VNIIEF selected CMMS system will be applied at other sites at the beginning of implementation enabling a reduction in the MPC&A sustainability program startup effort.

C. All-Russian Scientific Institute of Technical Physics (VNIITF)

The VNIITF, formerly known as Chelyabinsk-70, contains a number of research facilities which use nuclear material as well as assembly, disassembly, and testing of prototypes (pilot samples) of nuclear weapons. The PANTEX team was also given responsibility for development of the maintenance program upgrade at VNIITF. The PANTEX team conducted an on-site assessment of the VNIITF maintenance program with support of their Russian counterparts. From a lessons-learned perspective at VNIIEF, PANTEX decided to perform a benchmarking exercise using a maintenance program checklist developed by PANTEX. The checklist is based on industry best practice. PANTEX discovered that the VNIITF maintenance management system is decentralized and paper based. Future enhancements planned at VNIITF include the development of a MIP for US funded Equipment. There are also plans for the introduction of a CMMS to perform tasks including:

a) Formalized scheduling of preventive, corrective, and emergent maintenance;
b) Priority assignment management and status tracking;
c) Work order origination;
d) Formalized inventory/control of spare parts, tools, and diagnostic equipment.
e) Tracking of employee skills and training;
f) Incorporate standards, procedures, engineering data, and operating specifications into work orders;
g) Automated procurement including the generation of purchase orders,. and purchase order tracking;
h) Failure and root cause analysis management;

In an effort to reduce diagnostic time on failed equipment, PANTEX will assist VNIITF with the acquisition of operations and maintenance manuals for the US funded equipment.

The cooperation between PANTEX and VNIITF during this assessment was unprecedented in the US\Russian MPC&A program.

As a means of improving the development process of the proposed enhanced maintenance project at this site PANTEX plans on sponsoring and conducting a maintenance management workshop with representatives from VNIITF, Obninsk, Tomsk-7 and Mayak maintenance teams in the fall of 1999.

III. ENHANCED MAINTENANCE PROGRAM

The US objective for improved safeguards and security systems at sites like Kurchatov Institute, VNIIEF and VNIITF were developed with the expectation that Russia would provide the necessary funding and technical support to sustain their improved systems. Initially, the US effort was more focused on supplying the necessary equipment with limited spare parts. However, as the Russian economy experienced a significant downturn, it became apparent that Russia would be severely limited economically in providing the maintenance of the US funded equipment. At this point, the US began to take a hard look at the sustainability issues relating to this effort. The result is that the US recognized the importance of upgrading maintenance programs at those sites where safeguards and security improvements have been made in order to ensure sustainable continuous operations.

A phased approach has been identified as the means to accomplish the enhancements. The phased approach for integrating this plan includes:

a) An on-site assessment of current programs;

b) Development of a detailed Work Plan which includes a Maintenance Implementation Plan and a Configuration Management Plan;

c) Procurement of required diagnostic test equipment and tools;

d) Development, or enhancement, of a controlled spare parts inventory system, with critical spare parts being given highest priority;

e) Training of maintenance management and technical specialists; and,

f) Application of a centralized program that includes a CMMS.

Phase one has been completed at all three sites. Findings from those activities will be applied for each individual site's needs and will be addressed and agreed to jointly between the US and Russian participants.

The second phase of the project has been approved, which calls for the writing of detailed Work Plans that will describe the current system at a particular site and how the new and improved system will be incorporated into that site's system. The detailed work plan for KI will include a Configuration Management Plan (CMP) whereby any changes to the upgraded MPC&A system will require appropriate management approval. Application of a CMP will provide assurances to KI, MinAtom, and DOE that any system/equipment changes will meet or exceed those already in place.

The second phase also calls for the development of a centralized spare parts storage site, where appropriate. The spare parts inventory is to be comprised of critical spare parts and spare parts in general. The storage site is to be a controlled site where parts are checked out according to a select procedure. It was discovered that, in some cases, the whereabouts of a US supplied spare part was not known. This is not uncommon and has been noted at these sites. The US team will periodically buy necessary spare parts for equipment they are directly responsible to procure. A problem occurs when the spare parts are delivered to the Russian counterpart PI and not to a centralized control site because the spare parts become scattered and have no inventory controls. For added assurances, both the US and Russian teams would benefit from a centralized-controlled inventory system.

Training of the MC&A (site personnel) and PP (MVD personnel) staffs is critical to the success of this program. Training classes should be tailored to the specific US supplied MPC&A equipment/systems. An important aid to the technical specialists would be technical service manuals for all US provided equipment. An added benefit would be to have the manuals in the language of the specialists. Oftentimes, the US Principal Investigator responsible for procurement of the equipment fails to consider the maintenance aspects and does not order any technical service manuals and sometimes does not order critical spare parts.

Another essential component for the technicians will be a supply of adequate diagnostic testing equipment and tools for the upgraded MPC&A equipment. The diagnostic equipment will be identified and procured under this program.

Of significance, is the fact that sites such as KI, may be subjected to power outages during peak demand periods. Under such events the MPC&A systems will be inoperable and the old system must be employed. To offset such events, it would be advantageous for these sites to be equipped with their own emergency power generation capability. The value of this contribution should not be overlooked.

Finally, revisions and improvements of the current maintenance program are expected to provide the maximum operations uptime and provide desired assurances to both the US and Russian sides that those systems are protecting SNM 24 hours a day, 365 days each year.

IV. CONCLUSIONS

Upgrading the maintenance programs at these three sites is expected to provide additional assurances to all parties concerned that US funded MPC&A upgrades are to be maintained to maximum operational life. The planned enhancements to the sites existing maintenance programs will be integrated into any existing computerized maintenance program the sites may have in service, if compatible. Application to an existing compatible computerized system is expected to maximize efficiency of the enhanced maintenance program. Providing specialized training on the US provided equipment is also considered essential to the success of the program.

The MIP is the detailed Work Plan that will provide the step-by-step approach for building the enhanced program. The MIP will define the integrated steps for implementation into the existing maintenance programs at those sites. With the inclusion of a Configuration Management Plan into the program, both the US and the Russian sides can expect to have assurance that system upgrades cannot be randomly changed without proper site authorization.

The Preventative Maintenance portion of the program is also expected to contribute to the operational life of the equipment/systems.

It is anticipated that full implementation of the program will take two to three years to complete. It is also anticipated that flexibility will be designed into the program allowing for introduction of new equipment/systems.

Finally, a factor relating to the sustainability component is continuous operations. This includes meeting around the clock power demands that should be met by the local municipal system or, in the event of power outages, the use of an on-site emergency generator. Currently, these sites do not possess this capability.

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