MESHING SITE-SPECIFIC AND CROSS-CUTTING SUSTAINABILITY PROGRAMS: CASE STUDIES FROM KURCHATOV INSTITUTE, VNIIEF, AND TRANSPORTATION SECURITY

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ABSTRACT

The U.S. Department of Energy (DOE) supports Material Protection Control and Accountability (MPC&A) upgrades in the Russian Federation through a number of site-specific and functional, cross-cutting project teams, all working toward common programmatic goals. Implementing security upgrades that are sustainable and transitioning related operations to sustainability mode is an important goal. Sustainability activities at all sites are based on a common programmatic sustainability framework. However, the emphasis and specific implementation of sustainability activities may vary considerably from site to site, so the framework can be adapted to each site's unique mission, resources, infrastructure, culture, and environment. Differences in the scope and emphasis between site-specific and national cross-cutting team sustainability efforts may be even more pronounced, since cross-cutting projects must consider regional and national issues that transcend a site's boundary. It is important that these individual sustainability programs fit and work together. Recognizing this, DOE has encouraged early coordination and engagement between site teams and cross-cutting project teams to mesh their efforts for a more effective overall sustainability program. This paper describes the experience of the cross-cutting Transportation Security Project (TSP) team with two MPC&A site teams, the Kurchatov Institute (KI) and VNIIEF teams in such an effort to identify potential interface issues and resolve them. The sustainability framework developed by the Operations and Sustainability support team of the Office of National Infrastructure and Sustainability (ONIS) provided an essential tool in this effort. Sustainability plans and activities for each site and the cross-cut project are compared and contrasted. We describe our assessment process, interface issues that were identified, and approaches to addressing them. We also offer some general observations and lessons learned on the coordination, assessment, and resolution processes. The need for a clear understanding of each organization's roles and responsibilities is a recurring theme.

INTRODUCTION

DOE has established a coordinated program with the Russian Federation (RF) to improve the MPC&A systems in Russia. This program includes joint efforts at individual sites that make up Russia's diverse nuclear enterprise, as well as efforts to work with supporting national, cross-cutting functions. The U.S. program is organized in site teams that work with a particular Russian site, and national, cross-cutting teams that work with their Russian counterparts in these functional areas, e.g. transportation security, regulation, operations and sustainability, and protective forces.

Early in the program, the focus was on upgrading facilities, technologies, and practices to conform to accepted MPC&A standards. But as the initial upgrades are completed, more attention is being given to the infrastructure and activities needed to sustain the desired level of protection for the long

term. However, the specific measures that appear to be important depend upon one's perspective. These different views came into focus during our efforts to coordinate site team and TSP sustainability activities, as it appeared that there were several gaps to be bridged. This paper discusses issues identified at the TSP-VNIIEF and TSP-KI sustainability interfaces, what was done to resolve these issues, and the lessons learned from the experience.

To support individual team activities, the MPC&A ONIS established an Operations and Sustainability support project. The integrated sustainability framework developed by the sustainability team has been applied by the various MPC&A teams and was an important tool in this work.

THE MPC&A SUSTAINABILITY FRAMEWORK

The ONIS sustainability framework envisions a site-level sustainability program, regional and national infrastructure, and national standards. Table 1 summarizes the ONIS site-level elements.

Table 1. Elements of an on-site sustainability program

MPC&A Organization	An independent MPC&A organization is responsible for planning, resource allocation, implementation, and testing and evaluating all aspects of MPC&A operations. An MPC&A organization with the authority to carry out all aspects of its MPC&A duties
Site Operating Procedures	Site has administrative systems, physical controls, or written instructions that aid in minimizing variation in nuclear material access, handling, processing, protection, and control. Site has written operating procedures or instructions that address threats and vulnerabilities, cover key aspects of MPC&A operations, cover emergency situations on site, and are supported by site management.
Human Resource Management and Site Training	MPC&A staff has the requisite knowledge, skills, and abilities to perform critical MPC&A functions. Sites have the capability to assess MPC&A staffing needs. Sites can apply local, regional, and national training resources to meet training needs. Sites have the capability to retrain staff to correct operational deficiencies. Sites have the capability to provide site-specific MPC&A training. Sites have a process to replace MPC&A staff with qualified trained personnel.
Operational Cost Analysis	Operational cost data are collected in consistent and useful ways. Operational costs are understood and data are used for MPC&A system design decisions and for system life cycle management. The installed MPC&A system can be supported by Russian sites. The site has identified revenue sources for MPC&A program/system support.
Preventative Maintenance, Repair and Calibration	MPC&A systems at sites are subject to an ongoing preventative maintenance, calibration, adjustment, and cleaning program to ensure optimal operation. System downtime after failure of critical components is minimized, and operational life of the MPC&A system is maximized.
Performance Testing and Operational Monitoring	A program is in place to periodically evaluate the effectiveness of the system, subsystem, and components of the system; identify and correct deficiencies; and maintain continuous and effective MPC&A operations. The program monitors implementation of MPC&A procedures and correct operational deficiencies.

Configuration Management	The upgraded MPC&A system is adequately documented, and a configuration consistent with threat mitigation is established in a set of system description documents. An administrative system of review is in place to determine if work on or affecting the MPC&A system will change the established configuration and, if so, to determine that changes are reviewed, compensatory actions taken, and documentation updated.

VNIIEF, THE KURCHATOV INSTITUTE, AND TRANSPORTATION SECURITY

VNIIEF: The All-Russian Scientific Research Institute of Experimental Physics (VNIIEF) was formed in 1946 at the historic village of Sarov in Nizhniy Novgorod Oblast, about 410 km southeast of Moscow. VNIIEF was created to design nuclear weapons and is the birthplace of the first Soviet nuclear bomb. There are many historical and operational similarities between VNIIEF and the Los Alamos National Laboratory in the United States. VNIIEF is the oldest Russian nuclear weapons design laboratory. As such, it performs functions of research, design, engineering, fabrication, and assembly and disassembly of nuclear weapons. The Institute also has unique capabilities in both fundamental and applied nuclear research. Since the inception of work at VNIIEF, the Russian team has told its U.S. counterparts that Russian laws and regulations prohibit access by non-Russians to most VNIIEF facilities and forbid the sharing of information regarding the security of those facilities. The limited access of the U.S. Project Team (USPT) to most sites has to a large degree influenced the approach used for the upgrade and the sustainability phases of the MPC&A Program.

Kurchatov Institute: Kurchatov Institute (KI), a research and development (R&D) laboratory, was founded in 1943 as Laboratory No. 2 of the USSR Academy of Sciences. Laboratory No. 2 was the initial site of nuclear weapons research in the Soviet Union. After weapons work was moved to laboratories outside of Moscow, Laboratory No. 2 was renamed the Institute of Atomic Energy. Research activities were expanded to a variety of areas, including fundamental and applied studies in nuclear physics and nuclear reactors, controlled thermonuclear fusion and plasma physics, solid-state physics and superconductivity, and molecular and chemical physics. The laboratory is currently reported to be under the authority of the RF government and the Russian Academy of Sciences. KI is located in northwest Moscow and in 1991 had a peak employment of approximately 10,000 workers. Present nuclear research activities include the design and development of nuclear reactors for the RF Navy, the Russian icebreaker fleet, and space applications. The United States and KI have performed MPC&A upgrades at the KI facility since 1994. KI established the Office of Nonproliferation specifically to interface with the U.S. program. USPT access to KI facilities has enhanced the ability of both the USPT and KI teams to collectively address, plan, and implement needed upgrades. MPC&A upgrades at KI are considered complete, and a commissioning ceremony was performed in May 2005 acknowledging this status. Currently, the site is in the sustainability phase, a period in which the installed systems are operated, maintained, and performance-tested to ensure operational readiness of those systems at the design level.

Transportation Security: Over the last decade, transportation equipment and related systems at a number of sites in the RF have been upgraded to improve the security of the transportation of special nuclear materials (SNM) within and between these sites. Early security improvements focused on rapid MPC&A upgrades to the existing SNM transportation system both at individual sites (e.g., by installing physical security upgrades to cargo railcars) and at regional and federal facilities. More recently, the emphasis has shifted to more comprehensive upgrades designed to

improve the transportation security *system* through automation, better long-range communication, command and control, system integration, and equipment modernization. With the emphasis shifting toward a transportation security system, integration of sustainability efforts was given more attention.

Table 2 highlights some of the characteristics of these three distinct entities.

Table 2. Characteristics of VNIIEF, KI, and the TSP

VNIIEF	Kurchatov Institute (KI)	Transportation Security
Primarily large-scale scientific and technical R&D	Diverse, scientific research and small-to-large-scale technical development	Development and deployment of transportation security technology and infrastructure; technical and operations support enterprises; multiple federal management, regulatory, and oversight organizations
Located in the remote closed city of Sarov	Located in metropolitan Moscow	Central operations in Moscow. National transportation security infrastructure.
Part of the RF nuclear-weapons complex. Weapons complex/industrial production culture. Some similarities to Los Alamos National Laboratory in the United States.	Initially R&D to support weapons research. Now broad R&D with academic culture. Some similarities to Oak Ridge National Laboratory in the United States	Multiple Federal organization and commercial contractors Government/ government contractor culture
A Rosatom site	Under the authority of the RF government, associated with the Russian Academy of Sciences	Rosatom and other Federal entities

APPROACHES TO SUSTAINABILITY

Sustainability activities at all sites are based on the common programmatic sustainability framework. However, the emphasis and specific implementation of sustainability activities may vary considerably from site to site, so the framework can be adapted to each site's unique mission, resources, infrastructure, culture, and environment. VNIIEF's, KI's, and TSP's approaches to sustainability are discussed below.

VNIIEF: Sustainability of the upgraded MPC&A system has been a major topic of discussion on the VNIIEF Project since 1997. The approach selected by the U.S. team was to build upon the existing VNIIEF system and to modernize the system using Computerized Maintenance Management System (CMMS). The purpose of using CMMS was to permit the United States to obtain portions of the site database for assurance purposes. The site is currently using the MAXIMO software for CMMS.

The sustainability elements that are currently being implemented at VNIIEF include training, procedures development, maintenance of equipment, performance testing, and operational cost evaluation. Development of procedures is usually performed under the implementation contract for a specific location since procedures vary from site to site. In addition, a contract to develop site-wide procedures related to a computerized accounting system has also been completed. Training and maintenance of equipment are supported under a second contract which provides funds to VNIIEF to train the trainers, procure service contracts, and procure spare parts. Under an agreement reached with VNIIEF, the U.S. team provides funds only to train the trainers, and VNIIEF provides funds to train the operators. Service contracts are limited to those systems for which VNIIEF does not possess in-house capability. Service contracts that are currently in place include data processing systems, access control systems, snowmobiles, emergency generators, and mechanical systems of railcars. In the near future, service contracts for the radio system and transportation vehicles will be added to the contract.

Development and implementation of performance testing has been limited to the MC&A system, as VNIIEF has good experience in performance testing of physical protection systems. VNIIEF has completed the development of procedures for testing at component and subsystem levels for the MC&A system. Tests have also been competed at one location using these procedures. VNIIEF is currently developing procedures at the system level.

A contract to develop operational cost estimates for the upgrades system was signed recently. The data from this contract will be used by the U.S. and VNIIEF teams to request funding from DOE and Rosatom during the sustainability phase of the program.

Kurchatov Institute: The MPC&A Program provides technical expertise support, training, equipment, and material protection expertise through its laboratories and contractors. All installation and construction are executed by Russian contractors using primarily Russian equipment. All upgrades were completed by September 2004, and a commissioning ceremony was held in April 2005.

Sustainability of operations through enhancements to organizational and operations plans and procedures and the transition of ownership of MPC&A upgrades to KI are project goals. The USPT engaged KI in the sustainability of those upgrades as early as 1998, when an assessment of the KI maintenance program was performed and follow-on contracts for maintenance were issued. Currently, sustainability activities include performance testing and reporting, maintenance and reporting, spare parts, and training.

After initial rapid upgrades, the USPT introduced maintenance and preventive maintenance concepts for the upgraded systems and equipment. Performance testing training has been provided to KI staff, including actual test demonstrations at various buildings. KI has recently completed its Performance Assurance Program Plan. It requires periodic pre-scheduled testing of various components, sub-systems, and systems and, beginning later this year, issuance of quarterly reports to DOE. Efforts have also included updated organizational and management plans, human resources and training assessments, and upgrades of operations plans and procedures. A sustainability assessment to evaluate each of the sustainability elements is nearing completion; and a sustainability plan is under development in conjunction with the assessment, which will include a complete site-level transition strategy. The assessment report and sustainability plan are expected to be completed this year.

Other contributors to MPC&A upgrades at KI include the Protective Force Project Team (PFPT) and the TSP team. Both have provided significant upgrades. PFPT has provided equipment and training to the security force, MVD-IT. The TSP has provided transportation vehicles and ancillary equipment for transport of nuclear material. Basic mechanical maintenance of this equipment is performed by KI.

Transportation Security Project: Implementing a sustainability program for secure SNM transportation systems presents some additional challenges beyond those typically faced by MPC&A sites. The transportation security system involves coordination and interfaces with multiple individual sites and with multiple national-level organizations. The transportation system is by its nature dynamic, and this transient transportation network can be quite complex. The types and models of transportation security equipment needed to meet individual site needs vary from site to site, so the equipment deployed is a diverse set of armored cargo trucks, escort vehicles, cargo railcars, and communication equipment. An approach that considers the integrated transportation system to help guide implementation was adopted.

A sustainability implementation model was formulated (Welch et al. 2004) that incorporates the elements identified by the MPC&A framework to help guide the prioritization and sequencing of activities.

TSP sustainability achievements include

- Deployment of interim spare-parts to multiple sites including VNIIEF
- Delivery of near-term training to multiple sites
- Design and evaluation of a comprehensive training program
- Working with site teams, including VNIIEF and KI, to coordinate transportation security and sustainability of transportation security systems
- Support of Russian working groups to bring transportation integrators and suppliers, other national and local transportation-related organizations (Rosatom, the railroad authority, the Situation Crisis Center), and sites together
- Feedback on reliability and performance, e.g., maintenance and repair experience, operability
- Performance testing, including components, “table-top” simulations, and a large-scale “Sarov 2003” exercise
- Identification of equipment and process improvements to update standards, specifications, and designs
- Development of a comprehensive sustainability implementation plan

Future activities will increasingly emphasize integration and good practices:

- Integrated parts supply and maintenance for transportation system/Automated Transportation Security System (see Welch et al. 2005)
- Training program implementation
- Periodic status appraisals and performance testing

SITE TRANSPORTATION SECURITY INTERFACES

The MPC&A sustainability framework identifies seven elements that are typically considered in site sustainability programs. Though these elements may be important to a particular site, they may not be as significant with respect to the interface to the national transportation security program. Since the interest here is the significant interactions at these interfaces, we examined and rated the degree of coupling at each interface for each sustainability element. In the remainder of this paper, we focus the discussion on those elements that appear to have the most significant coupling between programs—training, procedures, performance testing, and maintenance and repair.

Table 3 compares completed and present efforts for VNIIEF, KI, and transportation security related to these four elements.

Table 3. Completed and present efforts related to elements considered for sustainability

	VNIIEF	KI	TSP
Training	- Onsite MC&A, including training on intra-site transfers - Radio operation - Operator training provided with delivery of vehicles	- MC&A, including training on intra-site transfers - Operator training provided with delivery of vehicles	- Interim training on ATSS operation at VNIIEF - Comprehensive training program has been designed. Will provide training on ATSS, procedures, and maintenance at a training center and onsite
Procedures	- MC&A including preparation, packaging, handling, documentation, and transport	- MC&A, including preparation, packaging, handling, documentation, and transport	- National-level procedures under development - New joint efforts with sites to develop site-specific procedures - Equipment operating procedures provided with upgrades
Performance testing	- Table-top simulations of onsite transfers	- Tabletop simulations of onsite transfers	- Tabletop simulations at VNIIEF and KI for onsite and offsite shipments - Sarov 2003 exercise - Periodic performance appraisals
Maintenance	- Railcar mechanical system maintenance	- Basic maintenance on trucks - Major mechanical maintenance by service provider - Maintenance program review	- Periodic inspection and maintenance of railcar ATSS - Integrated parts supply and maintenance - Distributed (central/onsite) spare parts

MESHING SUSTAINABILITY PROGRAMS

Early coordination on maintenance services, spare parts, and training indicated several gaps that needed to be bridged. This motivated a more thorough joint review of the interface among programs for all sustainability elements. The performance testing activities at both interfaces appeared to be closely coupled and complementary. At the VNIIEF-TSP interface for training, procedures, and maintenance, several areas for improvement were identified, and a few more were identified at the

KI-TSP interface. Overlapping efforts did not appear to be a significant issue, although a few minor cases were identified and resolved.

Table 4 lists some of the strengths and issues identified at the sustainability interfaces considered here.

A variety of coordination activities were helpful in addressing these interfaces. Face-to-face working meetings between site teams and TSP team members were essential. As a standard practice, the TSP assigns a team member to work with each site team, serving as the point of contact, providing technical support, and often participating in site team activities such as site visits and technical reviews. The TSP Site-team Interface Plan describes interface roles and responsibilities, activities, and functions in some detail. Coordination on the Russian side through working groups and dialogue was also helpful.

Table 4. Strengths and issues identified at sustainability interfaces

Sustainability element	**Sustainability program interface: Strengths and efforts to address issues**
Training	- Comprehensive training program plan in place - Roles and responsibilities have been clarified
Procedures	- Applicable standards and regulations are being developed - Working to incorporate top-level requirements into site procedures
Performance testing	- Complementary site and TSP efforts
Maintenance	- Integrated parts and maintenance activity for transportation/ATSS - Roles and responsibilities have been clarified

CONCLUSIONS AND RECOMMENDATIONS

Coordination at the sustainability interface between projects benefits each organization by raising awareness of required interactions there and by ensuring that significant elements of each program are effective and complete. Management and funding organizations benefit by ensuring that efforts are not duplicated and, from a systems perspective, that protection of SNM will remain effective. In this coordination effort, several areas for improvement were identified, and solutions have been implemented or are planned. The unique character, functions, and interactions of the organizations involved must be considered. An initial systematic assessment of all elements to identify the critical interfaces is a useful first step, and the need for a clear understanding by all parties of each organization's roles and responsibilities is a recurring theme.

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