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Summary of Technical Meeting To Compare US/French Approaches for Physical Protection Test Beds

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Summary of Technical Meeting To Compare US/French Approaches for Physical Protection Test Beds

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Abstract

In September 2015, representatives of the US Department of Energy/National Nuclear Security Administration, including test bed professionals from Sandia National Laboratories, and representatives of the French Alternative Energies and Atomic Energy Commission participated in a one-week workshop to share best practices in design, organization, operations, utilization, improvement, and performance testing of physical protection test beds. The intended workshop outcomes were to (1) share methods of improving respective test bed methodologies and programs and (2) prepare recommendations for standards regarding creating and operating testing facilities for nations new to nuclear operations. At the workshop, the French and American subject matter experts compared best practices as developed at their respective test bed sites; discussed access delay test bed considerations; and presented the limitations/ constraints of physical protection test beds.

Acknowledgments

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1 INTRODUCTION

In September 2015, representatives of the US Department of Energy/National Nuclear Security Administration (DOE/NNSA) and representatives of the French Alternative Energies and Atomic Energy Commission (CEA) participated in a one-week workshop to share best practices in design, organization, operations, utilization, improvement, and performance testing of Physical Protection test beds in accordance with Project Action Sheet, Physical Protection No. 02 (PAS-PP02). The workshop was held at Saclay and Fontenay Aux Roses, France, September 7–11, 2015. The intended workshop outcomes were to (1) share methods of improving respective test bed methodologies and programs and (2) prepare recommendations for standards regarding creating and operating testing facilities for nations new to nuclear operations.

At the workshop, French and American professionals on test bed operations compared best practices as developed at their test bed sites, i.e., the CEA Saclay Physical Protection Test Laboratory and the Sandia Sensor Testing and Evaluation Center in Albuquerque, New Mexico, respectively. In addition, the workshop included discussions of explosive testing of barriers, a comparison of modeling methodologies for blast effects, and the limitations/constraints of Physical Protection test beds. The participants presented material on their respective methodologies regarding the legal basis, purposes, planning considerations, construction, operation, and implementation of a practical, performance-based testing program. The meeting also provided an opportunity for representatives to visit the existing CEA test bed and the site of its future test bed.

2 OBSERVATIONS

The legal basis and requirements underpinning the need for a physical protection system (PPS) testing laboratory or test bed derive from the sovereign nation's laws, regulations, and guidance on the protection of nuclear and radioactive material and facilities.

The participants discussed and agreed on the necessity of including the following components when considering the operation of test beds.

2.1 Test Bed Planning Considerations

Planning is vital for all test bed functions to support the implementation of a testing facility and performance testing program. Initially, the physical layout of the test bed should be carefully planned. The design should include infrastructure needs to support sensor testing, data gathering, and data recording. These needs include the efficient installation of sensor platforms, lighting, assessment, power distribution, alarm communications, and monitoring and recording systems.

The following items were discussed as Lessons Learned in test bed planning**:**

- A test bed should include facilities to test interior sensors as well as exterior sensors and PPS systems.
- Planning should include a budgeting function to ensure adequate funding for hardware upgrades, testing, and maintenance.
- Clear, thorough documentation of the as-built condition of the test bed layout and infrastructure is essential to ensure efficient maintenance and operation.
- Planners should consider providing for the ability to monitor PPS systems installed at remote locations, including development of a portable device to monitor alarm inputs and monitor/record associated video feeds for assessment.
- Planning should ensure the presence of appropriate tools for testing the PPS components.
- Designs that help minimize the effort to maintain test bed components should be considered during the planning stage.
- Future expansion of test bed capabilities to accommodate new technologies should be considered during planning.
- The CEA uses and recommends a 3-year planning cycle for the performance testing program, test bed management, and allocation of resources.

2.2 Main Uses of Test Bed Facilities

Workshop participants listed several potential uses of test bed facilities, as follows:

- Characterization of PPS components and familiarization with PPS systems, including:
  - Interior and exterior sensors
  - Assessment systems
  - Illumination systems
  - Component platforms such as posts, fences, and towers
  - Contraband detection
  - Access control
  - Alarm monitoring systems
  - Delay systems
- Determining performance data for use in vulnerability analyses
- Component certification to comply with prescriptive requirements (Probability of Detection [P_D], nuisance and false alarm rates [NAR/FAR]). Note that specific installation criteria would be necessary to ensure required performance of a particular PPS for certification.
- Establishing effective installation and/or maintenance recommendations
- PPS component development and/or adaptation for specific applications
- Assessment of new technology
- Supporting the development of (or contribution to) a security policy at either the national or facility operator level
- Conducting training for
  - Installers/maintainers of PPS components
  - Agency inspectors of performance and/or compliance
  - Operators of PPS systems, i.e., Central Alarm Station (CAS) operators
  - People in charge of security surveys
- Demonstration of PPS technology, test bed capabilities, and best practices

2.3 Performance Testing Methodology and Program

An effective PPS performance testing program should include a process in which PPS components are evaluated and selected based on defined criteria. Established guidelines ensure efficient use of resources and provide the rationale for PPS selection, incorporating neutrality in the selection process. The selection process should also consider currently deployed components that may need performance validation to ensure compliance with requirements. During or after the selection process, planners may wish to incorporate information gathered to establish a list of components that have been tested and approved for use.

PPS evaluation may be conducted for the following reasons:

- First, evaluation is used to become familiar with the basic function and characteristics of a single component or a system comprising multiple components.

- Second, testing can be used to identify the proper calibration and/or installation configuration that produces the desired performance metrics, e.g., P_D and NAR/FAR.

Important elements of a testing program include the following:

- Description of the types of tests to be conducted, i.e., ideal testing for P_D, component degradation factors, NAR/FAR, and vulnerability to defeat.
- Description of how the tests are performed, and how data are gathered, recorded, documented, and provided to the sponsor.
- Defined process for writing test plans and reports.
  - The test plan should be comprehensive, ensuring that the data produced will effectively determine the performance capabilities of the PPS component or system being evaluated.
  - A key element is that the test plan, which starts with a basic framework, should be considered a living document so the test plan is flexible enough to incorporate changes based on initial results.
  - Note: A well-written test plan can be easily modified to create the final PPS evaluation report.

Test documentation should include several types of data regarding the devices submitted for testing, such as serial number, hardware and software version (if applicable). This information may be useful for determining that the equipment design (and possibly performance) has been changed even though the equipment version or model has not changed.

2.4 Access Delay

Several factors impact the degree of access delay provided by a physical barrier. When executing performance tests to quantify delay time, it is helpful for the testing facility to maintain an awareness of these factors. They not only impact how the testing facility plans, executes, and documents the results of a delay test, but also impacts how the delay information will be utilized in the subsequent design of a physical protection system. These factors include the following:

- **Adversary (Tester) Knowledge of the Barrier Characteristics**. If it is conservatively assumed that the adversary has complete knowledge of the barrier, then it follows that the delay test would be conducted with the quickest and most efficient tool. Although this approach may be reasonable for simple barriers (like fences), it may not be a realistic assumption for more robust barriers, like vault doors or thick, heavily reinforced concrete walls. Therefore, the test facility should document in detail the tester's knowledge (playing the part of the adversary) of the barrier. This documentation would describe how much time the tester spent studying the barrier features and material types and performing preliminary defeat tests to determine which tool was most effective at defeating the barrier.
- **Adversary (Tester) Defeat Tools.** Tools available commercially are assumed to be known and used by potential adversaries. It is important for the test facility to maintain an awareness of these new or evolving tools and the potential impact they may have on barrier delay times.
- **Adversary (Tester) Skill Using the Defeat Tool**. The delay time afforded by a barrier also depends on the skill level of the adversary using the tool. An adversary with a lot of practice

using the tool knows how to use it in the quickest and most efficient manner. The test facility should utilize personnel with a high degree of experience in using the defeat tool.

- **Number of Adversaries (Testers)**. When conducting barrier delay tests, it is important to note the number of adversaries (testers) involved in the defeat test. Subsequent use of the delay time should be consistent with the Design Basis Threat for the PPS.

- **Barrier Type and Characteristics**. It is important for the test facility to document in detail all characteristics of the barrier being tested, such as physical dimensions of the barrier, material mechanical properties, company proprietary designations, etc. This information is very useful to appropriately catalog the barrier delay time information. It can also be used to inform future modeling and simulation studies when estimates of delay time are needed for special applications, e.g., when the barrier is being applied in a situation that is not identical to the as-tested conditions.

In addition, other factors are known to impact the delay time afforded by a barrier, which are difficult to measure in performance testing. These factors include adversary duress due to response force engagement, adversary tool failure, and the cumulative effect of complex scenarios involving the defeat of multiple barriers.

2.5 Development of an Access Delay Test Bed(s)

Delay performance tests on barriers involving high explosives and ballistic impact are typically performed at more specialized sites than those for hand/power tools. The specialized sites typically have safe standoff requirements to support delay testing activities, including the need to safely transport and store the high explosives ammunition. Such sites are normally located in rural areas that are isolated, away from people and existing structures. These sites also typically have robust, re-useable test fixtures to secure the delay barrier (high-security vault doors, blast-resistant windows, etc.) during testing; the re-useable test fixtures help reduce repeat test costs. The personnel executing these types of tests are normally military-trained explosive-ordnance technicians (active or retired, with in-depth experience handling, transporting, and detonating high explosives). Planning and reporting on these tests normally involves Explosive Test engineers, who understand the shockwave physics involved. Physical security professionals from the test bed knowledgeable with a system-based approach to security should also be a part of the test planning, execution, and reporting process. These professionals help assure the important Access Delay factors are captured in the performance tests.

Delay performance tests on barriers using basic hand, power (electric and hydraulic), and thermal tools do not require the same isolation as tests involving explosives. These types of delay tests can be safely executed near other operations and can be performed indoors or outdoors, depending on the type of tool in use. These tests also involve re-useable test fixtures to securely fix the barrier during test execution, although they generally are much smaller and less robust than the fixtures used for explosive tests. The personnel executing these types of test are generally civilian building tradesmen (e.g., carpenters, pipe-fitters, welders, machinist, locksmiths), who have in-depth, hands-on experience with the defeat tool in use.

3 SHARED BEST PRACTICES

This section summarizes the best practices discussed by the participants during the meeting.

3.1 Practices Presented by SNL and Noted by CEA

All test plans should be thorough and well documented during the test. This practice facilitates final report preparation, as it consists primarily of the test plan plus the test results.

Where prescriptive performance requirements have been dictated by the governing authority (P_D, NAR/FAR), the testing program must allow for the statistically required number of tests to validate that the components tested meet that standard for P_D and confidence level. If no requirements have been defined, then acceptable performance may be proposed using expert judgment and/or the governing agency.

Because the CEA testbed was developed and equipped primarily for exterior sensors, rather than for interior sensors, facilities planned to support interior component testing will be incorporated into the future test bed.

SNL does not test vehicle barrier crash resistance. These tests are carried out by organizations dedicated to transportation safety research with the intent of quantifying vehicle penetration. However, in the context of vehicle delay barriers used in physical protection applications, SNL tests their resistance against other adversary tools and breaching methods to quantify delay time.

SNL suggests that a test bed should be utilized more widely for training purposes, including hands-on exercises, i.e., participant training using field equipment.

3.2 Practices Presented by CEA and Noted by SNL

The CEA recommends that a data sheet (2 to 3 pages) summarizing the test results of a particular component is an effective way to disseminate information on a general level. SNL noted that a 2- to 3-page data sheet could be an effective way to disseminate information and promote test bed activity.

The CEA documents the delay times as determined in barrier performance tests in an electronic database and, in addition, includes other important factors that contribute to delay time:

1. Adversary (tester) knowledge
2. Adversary tools
3. Barrier characteristics
4. Links in the database to all test information, including media support

SNL can benefit from this type of database approach. Although SNL has an access delay database of sorts—the Access Delay Technology Transfer Manual—updating this printed volume and disseminating the information to Physical Protection specialists who are designing PPSs is not as efficient as it could be.

The CEA provided an assessment of the SNL training course materials: “Establishing, Implementing, and Operating a PPS Performance Testing Regime.” SNL will use the comments from the CEA subject matter experts to improve and clarify the course materials and presentation. A detailed list of these comments for each module/slide has been provided to SNL and NNSA.

The CEA subject matter experts recommended that the SNL training course describe in greater detail the methodology for test bed personnel to determine and test any tools that may be effective in defeating or bypassing the PPS under evaluation. This methodology can assist in evaluating any identified vulnerabilities of the PPS.

4 CONCLUSION

The participants (CEA, NNSA, and SNL) agreed that the best practices workshop was beneficial. The professionals from the CEA Saclay Physical Protection Test Laboratory and the Sandia Sensor Test and Evaluation Center and Access Delay Office shared Lessons Learned, which each organization could incorporate into its test bed operations to improve training programs, design, usage, and reporting.

The participants of this workshop propose to offer the information in a more comprehensive form to the International Atomic Energy Agency (IAEA) for possible incorporation as a new recommendation in the Nuclear Security Series (NSS) concerning the creation, implementation, and operation of a physical protection test bed and performance testing program. Such a document, along with guided training by experts, would be of great benefit to nations new to nuclear operations, which may need to establish such a facility to support the security of its nuclear material and nuclear facilities.

The workshop partners suggested the following topics for future action sheets: (1) discussion and workshop on comprehensive assessment of a nuclear facility, (2) sharing of best practices on fast-running modeling tools (software) of blast effects for accurate assessment of barrier and structural resistance, and (3) discussion of the portion of the target that is reduced to powder when barriers are breached explosively.

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