

## **SNSTC's Capabilities and Practices on Performance Testing for Nuclear Security System and Equipment**

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### **Abstract**

The State Nuclear Security Technology Center (SNSTC) was established with the approval of the Chinese central government in November 2011. As an affiliate to China Atomic Energy Authority (CAEA), SNSTC's primary mission is to provide technical support for the government management on nuclear security, nuclear materials control, nuclear export & import control and nonproliferation; and to conduct international exchanges and cooperation. SNSTC is also the operator of China's Center of Excellence (COE) on Nuclear Security. Since the operation of COE in March 2016, SNSTC has received the ISO-9001:2015 QMS certificate and its laboratories have been certified by China National Accreditation Service for Conformity and Assessment (CNAS) and China Metrology Accreditation (CMA) in 2017. With the comprehensive testing capabilities on function/performance, environmental applicability and electromagnetic compatibility for nuclear security related system and equipment, SNSTC has completed more than 450 tests for about 100 sets of radiation detection and physical protection equipment for nuclear facilities, customs, universities and other relevant stakeholders.

As a third-party testing agency, SNSTC was commissioned by General Administration of China Customs to take performance testing and acceptance testing for the radiation portal monitors to be deployed at border ports in 2017-2018. The testing included 46 test items, covered the various aspects such as radiation detection function, radiation detection performance, environmental adaptability, electromagnetic compatibility and long-term reliability, etc. In addition, SNSTC led the technical review and in-field acceptance testing for several physical protection system upgrading projects in China, and conducted the physical protection system effectiveness evaluations for many times as requested by nuclear facility operators. Based on the works above mentioned, SNSTC also developed a series of technical documents, such as the Management Measures on Acceptance of Physical Protection Engineering, the Technical Guidance on Acceptance Test of Physical Protection System in Nuclear Facilities, the Technical Specifications for Central Control Room of Physical Protection System in

Nuclear Facilities, the Technical Specifications of Digital Radiation Imaging Device used for Vehicle Access Control in Nuclear Facilities and so on.

This article will provide a briefing introduction to SNSTC's capabilities and practices on performance testing for nuclear security related systems and equipment. Some typical cases on performance testing in lab and field conditions for radiation detection equipment and physical protection systems should be demonstrated. The general objects, procedures and requirements of performance testing will be introduced. Furthermore, the necessity of and lessons-learned from performance testing, and its importance for nuclear security sustainability on national and facility levels will be discussed.

## 1. INTRODUCTION

The State Nuclear Security Technology Center (SNSTC) was established with the approval of the Chinese central government in November 2011. As an affiliate to China Atomic Energy Authority (CAEA), SNSTC's primary mission is to provide technical support for the government management on nuclear security, nuclear materials control, nuclear export & import control and nonproliferation; and to conduct international exchanges and cooperation. In September, SNSTC has been the Collaborating Center on Nuclear Security of International Atomic Energy Agency (IAEA).

SNSTC is also the operator of China's Center of Excellence (COE) on Nuclear Security. Since the operation of COE in March 2016, SNSTC has received the ISO-9001:2015 QMS certificate and its laboratories have been certified by China National Accreditation Service for Conformity and Assessment (CNAS) and China Metrology Accreditation (CMA) in 2017. With the comprehensive testing capabilities on function/performance, environmental applicability and electromagnetic compatibility for nuclear security related system and equipment, SNSTC has completed more than 1000 tests for about 100 projects of radiation detection and physical protection equipment for nuclear facilities, customs, universities, institutes and other relevant stakeholders. At present, the Environmental Reliability and Electromagnetic Compatibility Laboratory has obtained more than 500 testing projects approved by CNAS and CMA. It has already possessed the functions, performance, environmental applicability and electromagnetic compatibility testing capabilities of relatively complete nuclear security related products, and has laid a solid foundation for testing of nuclear security system and equipment.

## 2. Testing Methods and Industry Standards

In 2016, SNSTC completed the Testing and Evaluation Program of Radiation Portal Monitors (RPMs) according to the national standard GB/T 31836-2015 "Radiation Protection Instrument for Spectral Analysis-Based RPMs for Detecting and Identifying the Transport of Illegal Radioactive Materials", and the development of the "RPMs Performance Testing" Automated Testing System. The system can perform key performance testing such as nuclide identification and radiation response when carrying the radioactive source /nuclear material through the RPMs at different speeds and different heights. The Testing and Evaluation Program of the RPMs and the establishment of the Automated Testing System not only standardize the testing method of the PRMs, but also greatly save the testing time and improve the testing efficiency, and lay a solid foundation for the standard testing of RPMs in the future.

In 2017, three internal control standards for nuclear security, namely, "intrusion detection

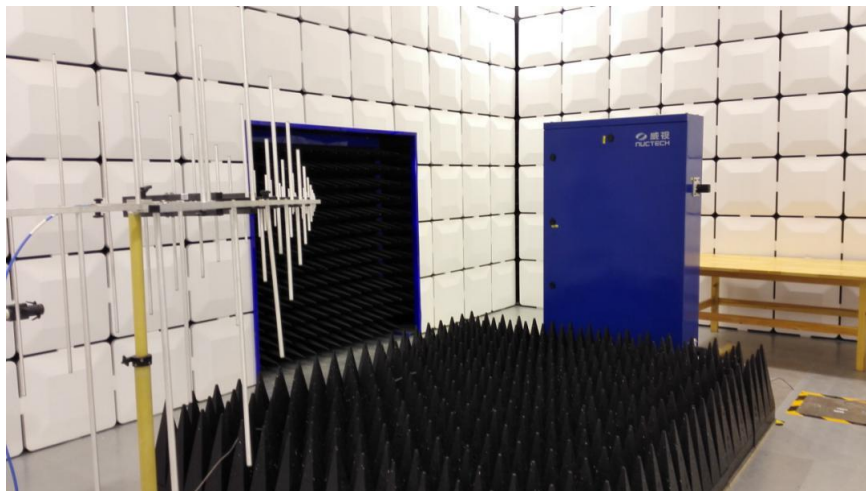
equipment testing standards - general provisions", "testing standards for portal radiation detection system based on spectral analysis" and "testing standards for handheld radiation detection equipment", were completed. In 2018 SNSTC completed "the Portable Trace Explosives Detector Testing", "X-ray Security Inspection Equipment Testing" and "the Hand-Held Metal Detector Testing" three internal control standards on nuclear security. The above documents provide standards and specifications for the future testing of nuclear security equipment, and provide a technical basis for the standardization of the nuclear security equipment industry.

### 3. Testing of RPMs

As a third-party testing agency, SNSTC was commissioned by General Administration of China Customs to take performance testing and acceptance testing for the radiation portal monitors to be deployed at border ports in 2017-2018. The testing included 46 test items, covered the various aspects such as radiation detection function, radiation detection performance, environmental adaptability, electromagnetic compatibility and long-term reliability, etc.



*FIG. 1. Performance Testing.*



*FIG. 2. Electromagnetic Testing.*

According to the Testing and Evaluation Program for new-type RPMs, the testing items are mainly divided into five categories: product configuration testing, radiation detection function testing, radiation detection performance testing, environmental adaptability testing and long-term reliability testing. Each major test is divided into several specific testing scenarios. The scenarios are shown in Table 1.

TABLE 1. Testing Scenarios

Testing Items	Testing Scenarios	Scenarios No.	Testing Sample No.
Product Configuration Testing	Gamma-Ray Detector	A1	1#
	Neutron Detector	A2	1#
Radiation Detection Function Testing	Basic Function	B1	1#
	Detailed function	B2	1#
Radiation Detection Performance Testing	False Alarm	C1	1#
	Gamma-Ray Response	C2	1#
	Neutron Response	C3	1#
	Background Effect	C4	1#
	Nuclide Identification - Single	C5	1#、2#
	Nuclide Identification -	C6	2#
	Nuclide Identification – Nuclides	C7	1#
Environmental Adaptability Testing	Temperature Testing	D1	3#
	Humidity Testing	D2	3#
	Dust Proof Testing	D3	5#
	Waterproof Testing	D4	3#
	Vibration Testing	D5	4#
	Electrostatic Discharge Testing	D6	3#
	Radio Frequency Immunity Testing	D7	3#
	Radio Frequency Emission Testing	D8	3#
	Conducting Disturbance Testing	D9	3#

Testing Items	Testing Scenarios	Scenarios No.	Testing Sample No.
	Magnetic Field Immunity Testing	D10	4#
	Surge Impact Testing	D11	3#
	Electrical Fast Transient Burst	D12	3#
	Sand Blowing Testing	D13	5#
	Salt Spray Testing	D14	5#-A1~5#-A4
Long-term Reliability Testing	Passive Detection Testing	E1	6#~15#
	Active Detection Testing	E2	6#~15#

This testing activity is the first comprehensive and systematic testing of the functions, performance, environmental applicability and electromagnetic compatibility of new-type RPMs in China. It has pioneered the overall performance testing of RPMs and laid a solid foundation for testing similar products in the future. SNSTC has been highly praised by the General Administration of Customs.

#### 4. Coordinated Research Projects of IAEA

From August 2017 to May 2018, SNSTC undertook the IAEA Coordinated Research Projects (CRP) " Building Fast Assessment Method of Initial Alarm from Vehicle Radiation Detection Portal Monitor (CRP J02005)". SNSTC prepared research programs, collected alarm data, constructed theoretical models, analyzed statistical data, etc., and provided core data and model support for IAEA's development of TRACE software. This work helps to improve the performance of RPMs, reduce false alarm rate, and improve radiation detection efficiency at customs ports. Currently, IAEA has applied this method in 24 countries on 5 continents.

#### 5. Summary

In addition, SNSTC led the technical review and in-field acceptance testing for several physical protection system upgrading projects in China, and conducted the physical protection system effectiveness evaluations for many times as requested by nuclear facility operators. Based on the works above mentioned, SNSTC also developed a series of technical documents, such as the Management Measures on Acceptance of Physical Protection Engineering, the Technical Guidance on Acceptance Test of Physical Protection System in Nuclear Facilities, the Technical Specifications for Central Control Room of Physical Protection System in Nuclear Facilities, the Technical Specifications of Digital Radiation Imaging Device used for Vehicle Access Control in Nuclear Facilities and so on.

In the future, as the IAEA Collaborating Center on Nuclear Security Technology, SNSTC will carry out more and more nuclear security equipment performance testing projects, provide technical

support for IAEA, and work with other organizations to contribute to the worldwide security capacity building.