

# **U.S.-CHINA RADIOLOGICAL SOURCE SECURITY PROJECT: CONTINUING AND EXPANDING BILATERAL COOPERATION**

Zhu Zhixuan, China Atomic Energy Authority, Beijing, China

Zhou Qifu, Yang Yaoyun, and Huang Chaoyun, China Ministry of Environmental Protection, Beijing, China

James Lloyd and Adam Williams, Sandia National Laboratory, Albuquerque, New Mexico USA 87185

Alexander Feldman, Charles Streeper, and Noah G. Pope, Los Alamos National Laboratory, Los Alamos, New Mexico USA 87545

Mark Hawk and Rick Rawl, Oak Ridge National Laboratory, Oak Ridge, Tennessee USA 37831

Randy Howell, Pacific Northwest National Laboratory, Richland, Washington USA 99352

Catherine Kennedy\*, Office of Global Threat Reduction, National Nuclear Security Administration, U.S. Department of Energy, Washington, DC USA 20585

\* To whom all correspondence should be addressed: [catherine.kennedy@nnsa.doe.gov](mailto:catherine.kennedy@nnsa.doe.gov).

## **ABSTRACT**

The successful radiological security cooperation between the U.S. and China to secure at-risk sites near venues of the 2008 Beijing Summer Olympics has led to an expanded bilateral nonproliferation cooperation scope. The U.S. Department of Energy's National Nuclear Security Administration, the Chinese Atomic Energy Authority and the China Ministry of Environmental Protection are continuing joint efforts to secure radiological sources throughout China under the U.S.-China Peaceful Uses of Nuclear Technology (PUNT) Agreement. Joint cooperation activities include physical security upgrades of sites with International Atomic Energy Agency (IAEA) Category 1 radiological sources, packaging, recovery, and storage of high activity transuranic and beta gamma sources, and secure transportation practices for the movement of recovered sources. Expansion of cooperation into numerous provinces within China includes the use of integrated training workshops that will demonstrate methodologies and best practices between U.S. and Chinese radiological source security and recovery experts. The fiscal year 2009 expanded scope of cooperation will be conducted similar to the 2008 Olympic cooperation with the Global Threat Reduction Initiative taking the lead for the U.S., PUNT being the umbrella agreement, and Los Alamos, Sandia, and Oak Ridge National Laboratories operating as technical working groups. This paper outlines the accomplishments of the joint implementation and training efforts to date and discusses the possible impact on future U.S./China cooperation.

## **INTRODUCTION**

In 1985, the United States and China signed an agreement on peaceful nuclear energy cooperation which, inter alia, allowed for the transfer of radiological sources for medical and similar purposes. In 1998, the U.S. Department of Energy (DOE) and the Chinese National Development and Reform Commission signed a Peaceful Uses of Nuclear Technology or

PUNT agreement which reaffirmed the 1985 agreement and further expanded areas of cooperation.

In 2004, a Statement of Intent (SOI) was signed under the umbrella of the PUNT agreement. The SOI, for the first time, outlined cooperation on radiological security as an additional area of collaboration, reiterated statements from past agreements supporting the physical protection of nuclear materials, and tying the cooperation to counterterrorism efforts. The SOI, bolstered by the preceding agreements, enabled the implementation of joint projects on radioactive source recovery, transport security, and physical protection.<sup>1</sup>

In preparation for the 2008 Beijing Olympic Games, Chinese authorities were undertaking a review of security measures in and around the venues holding Olympic events. DOE's National Nuclear Security Administration (NNSA) had previously provided assistance to ensure radioactive security for the 2004 Athens Olympic Games. Upon a review of this and International Atomic Energy Agency (IAEA) efforts, China and NNSA's Global Threat Reduction Initiative (GTRI) agreed to develop a pilot project to demonstrate U.S. and Chinese cooperation on recovering and protecting radioactive sources, enabled by the aforementioned agreements on security cooperation. Participants included Los Alamos, Sandia, and Oak Ridge National Laboratories (LANL, SNL, and ORNL, respectively) implementing work for GTRI on behalf of the United States and the Chinese State Environmental Protection Agency (SEPA, since elevated to become the Ministry of Environmental Protection or MEP), China Institute of Atomic Energy, and the China Atomic Energy Authority on the Chinese national level and various provincial and regional environmental protection agencies within China.

United States participants were divided into two working groups. SNL heads up Working Group 1 (WG 1), focused on physical protection system (PPS) upgrades for fixed IAEA Category 1 radiological sources, which include medical and industrial irradiators and source repositories. LANL and ORNL jointly chair Working Group 2 (WG 2), which works to remove disused high-activity sources to secure storage and includes oversight of recovery, packaging and secure transport of the sources to a repository.

Working with authorities in Beijing, Tianjin and Qingdao, both working groups and their Chinese counterparts worked rapidly and effectively to enhance the security of the radioactive materials identified near Beijing Olympic venues. Following initial successes, the pilot project was expanded into full cooperative pre-Olympic security work, which greatly reduced the potential threat posed by radioactive materials in the region. The joint cooperative effort resulted in the removal of a significant number of vulnerable disused sources from 22 sites totaling over 32,000 curies while physical protection upgrades at 11 facilities across eight sites protected over seven million curies. Cooperative sustainability workshops provided by WG 2

---

<sup>1</sup> The formal name of the 1985, 1998 and 2004 agreements are: (1985) *Agreement for Cooperation between the Government of the United States of America and the Government of the People's Republic of China Concerning Peaceful Uses of Nuclear Energy*; (1998) *Agreement between the Department of Energy of the United States of America and the State Development Planning Commission of The People's Republic of China on Cooperation Concerning Peaceful Uses of Nuclear Technologies*; (2004) *Statement of Intent between DOE and the China Atomic Energy Authority Concerning Cooperation in the Fields of Peaceful Use of Nuclear Energy and Nuclear Non-Proliferation and Counterterrorism*.

to Chinese environmental professionals demonstrated best industry practices for the safe packaging and secure transport of high-activity sources.

### **EXPANDED COOPERATION: FY 2009 AND BEYOND**

Based on the success of the 2008 Olympics-related radiological security cooperation, GTRI, the Chinese Atomic Energy Authority, and MEP initiated discussions on continuing cooperation to include similar efforts across the whole of mainland China. During a meeting in October 2008, MEP provided GTRI with a list of sites across several provinces of China, including sources identified by provincial Environmental Protection Bureaus (EPBs) as needing recovery and disposition or upgraded physical security systems.

This source and site listing greatly expands the scope of cooperation. Instead of sites in only one corner of the country, the list, provided to date, covers 30 provinces (and also includes municipalities and autonomous regions, roughly equivalent administrative levels to a province) spanning nearly the entire mainland. The work planned for the next three fiscal years ending in FY 2011, combined with previous Olympic cooperation, will include all 31 mainland provinces, municipalities, and autonomous regions with dozens of physical protection sites and over 1,600 sources for recovery. Due to the extra workload, a strategic planning process has been initiated to manage the workload and best determine how to apportion it over the next few years. The process will also identify contacts at provincial EPBs and contractors to help streamline work. Cooperative integrated training seminars focused on building a security culture, ensuring sustainability and developing an indigenous capability to ensure safety and security are also planned in the coming years.

The goals for 2009 are similar to the earlier Olympic cooperation. Work will still be managed by the two working groups and proceed across the country in groups of provinces each fiscal year. Fiscal Year 2009 work should cover up to a half dozen provinces, which will provide more experience on how to manage work across a broad geographic range. Lessons learned and any efficiencies identified will then be used to further expand the work in the following years, in order to complete the identified workload on time. Finally, a workshop will be held in August to train a few members each from about half of the regional EPBs.

### **WORKING GROUP 1**

The initial list of sites provided by MEP to WG 1 consisted only of radiological source repositories across the country. WG 1 indicated to MEP that they were also interested in a greater variety of sites and asked for a list of other facilities that use high-activity radiological sources, including commercial irradiators and radiological research facilities. Obliging, MEP provided a longer list that included five repositories with total activity levels ranging from 3,600 curies to over 800,000 curies and commercial irradiators of up to four million curies. After some prioritization discussions, WG 1 and MEP decided on three sites to install or upgrade the physical protection security (PPS) systems in FY 2009; an industrial site and a repository in Shanghai and a repository in Sichuan province.

Working Group 1 conducted the initial site visits of the three facilities in January 2009 with extensive help from federal, provincial, and local MEP officials. Contracts to install the PPS upgrades were agreed upon and signed in April 2009 and the agreed timeframe for completion and final assurance visits was decided to be early August 2009. WG 1 worked closely with federal MEP and provincial EPB officials at each step throughout the PPS design and

installation process. The level of cooperation and collaboration between WG 1 and MEP has increased in several tangible ways, manifesting itself in increasingly detailed preliminary briefings on each facility provided by MEP and EPB, increasingly comprehensive explanations of PPS upgrades and vulnerability analysis from WG 1 and the suggestion that WG 1 and MEP expand cooperation to secure all sites in China with IAEA Category 1 and 2 radiological sources.

Preliminary briefings at sites receiving PPS upgrades have been a particularly impressive component of cooperation. Prior to the January visits to the FY 2009 sites, WG 1 requested details such as facility operating hours, normal operating conditions, personnel information, radiological material information and facility drawings. Though WG 1 did not receive any paperwork prior to arriving in China, MEP the first facility provided a one-page summary of the requested information. In the course of the site assessment, facility personnel provided hard copies of facility blueprints. The unexpected blueprints were happily received and greatly enhanced WG 1's analysis, which was communicated to the Chinese partners. This positive reaction led to MEP encouraging the sites to provide more in-depth preliminary background information in their facility briefings. Through MEP efforts, the second site provided an introductory overview presentation, a digital picture walkthrough and schematic layouts of the facility. Similarly, the third site met WG 1 with a seven-page facility summary, as well as hard and soft copies of complete sets of facility blueprints.

Doing its part to increase cooperation on security with China, WG 1 has given MEP and facility officials at each facility an overview of the design and evaluation process outline (DEPO) for PPS upgrades, including what type of information is needed to complete a vulnerability analysis. WG 1 members also spent time explaining how information was going to be gathered during each site visit and included MEP and facility personnel in identifying vulnerabilities and gathering facility-specific information. During each site visit, WG 1 took opportunities to explain different elements of the DEPO process to MEP and facility officials. This increased cooperation and collaboration has enhanced both the quality of information gathered for the vulnerability analyses and MEP and site familiarity with and understanding of performance-based security analysis.

This level of information sharing and collaboration is an impressive indicator of the depth of the cooperative relationship developed thus far and has functioned as an effective confidence-building measure. The success of cooperation in providing upgrades prior to the Olympics and the growing rapport between the various actors will serve as a strong foundation for further successes in providing PPS upgrades at the remaining sites across the country.

## **WORKING GROUP 2**

In consultations with MEP, WG 2 developed plans for source recoveries in five provinces in FY 2009 and the remaining 18 provinces spread throughout FY 2010 and FY 2011. Negotiations for the FY 2009 recoveries began in March 2009 with a technical working group meeting in Shanghai. Site visits in early June to Gansu, Sichuan, Yunnan, and Henan provinces provided assessments and discussions with the local transport specialists on ensuring secure transportation and disposition. This will allow WG 2 to orchestrate the removals over the remainder of the fiscal year, while also providing suggestions and rapid upgrades to transportation infrastructure where necessary.

## **AUGUST TRAINING**

An August 2009 training workshop will be held to explain the process of physical protection upgrades and source removals to members of about half of China's provinces. In the past, training has been given *post hoc* to sites having received upgrades prior to the Olympics. This summer, Working Groups 1 and 2 are presenting concurrent training sessions to members of the regional EPBs set to receive assistance in FY 2009 and FY 2010. The plan is then to hold another training session for the remaining provinces in the future, to give everyone an idea of security best practices and an introduction of the work that will eventually take place in their province.

Working Group 1's workshop track is based on training courses jointly developed by SNL and the IAEA and will balance lectures, hands-on exercises and field trips to offer the Chinese attendees a comprehensive understanding of the DEPO method of conducting vulnerability analyses and designing PPS upgrades. Lectures will include modules on facility characterization, threat definition, path analysis, adversary sequence diagrams, and the detection, delay and response elements of physical protection systems. Workshop participants will also have a demonstration of a commonly used path analysis tool, System Analysis of Vulnerability to Intrusion (SAVI), as well as a visit to the radiological source repository in Sichuan to observe the newly installed PPS upgrades. Upon completion of the workshop, the Chinese officials in attendance will understand how to determine PPS objectives, design and characterize current PPS elements, and analyze PPS redesigns through performance-based analysis to ensure that protection-in-depth and balanced protection is provided to radiological source facilities.

Working Group 2's training course is split between source recovery methods and transport security. This course was also developed in cooperation with the IAEA and highlights the need for security during transport, identifies recommended international guidance, and addresses the application of security approaches to be used for transporting sources. The course also emphasizes the importance of using a transport security plan to ensure proper communications and to ensure that security measures are in place prior to transport to reduce security risks during transport. Classroom training will also be provided on actinide source packaging, which includes follow-up practical demonstrations on use of pipe-over-pack containers and special form capsules.

## **CONCLUSION**

As part of the U.S. and China's bilateral nonproliferation cooperation efforts, parties on both sides have worked since the run up to the 2008 Summer Olympic Games to provide effective security for radioactive sources, either via removal to secure storage or protection in place. Strong cooperative successes have both sides looking forward to continued and expanded collaboration to keep China, the region and the world more secure from the threat of misuse of radioactive materials.