Nuclear Security Centers of Excellence in Asia: Opportunities for Collaboration[1]

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The Nuclear Security Summit and the Nuclear Security Centers of Excellence

On April 5, 2009 in Prague, President Obama announced an international effort to "secure all vulnerable nuclear material around the world within four years" and issued an invitation to world leaders to attend a "Global Summit on Nuclear Security" in the United States within the next year.[5] The first Nuclear Security Summit (NSS) was held in Washington, DC in April 2010 followed by three more: Seoul in 2012; The Hague in 2014; and Washington, DC again in 2016. The forty seven participating nations at the inaugural summit issued a communique pronouncing nuclear terrorism "one of the most challenging threats to international security, and strong nuclear security measures are the most effective means to prevent terrorists, criminals, or other unauthorized actors from acquiring nuclear materials."[6] The Summit also

[1] This background paper was prepared for participants of a small workshop co-hosted by the Nuclear Threat Initiative (NTI) and the Japan Atomic Energy Agency (JAEA) in May 2017.

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[5] The White House, Office of the Press Secretary, Remarks by President Barack Obama, Hradcany Square, Prague, Czech Republic, April 5, 2009.

[6] Nuclear Security Summit, *Communiqué of the Washington Nuclear Security Summit*, April 13, 2010.

elicited more than sixty national commitments to take specific actions to enhance nuclear security. Particularly prominent among these were declarations of intention to create Nuclear Security Centers of Excellence (COEs): China, Japan and India[7] committed to establish Centers – South Korea made the same commitment six months later; President Nursultan Nazarbayev went only as far as saying that Kazakhstan would consider hosting a facility. In addition, Italy and France committed to integrating security curricula in their training courses for nuclear professionals (both domestic and foreign[8]) and the United States pledged to request additional nuclear security funding in its Fiscal Year 2011 budget request.[9]

COEs play an essential role in helping countries maintain the security of their nuclear material and facilities and provide a platform for strengthening the regional and global nuclear security architecture. This report examines what the three COEs in Asia do, how they collaborate with each other and international organizations then offers recommendations for future cooperation and integration.

As Salisbury and Hobbs have observed, "the concept of national centers supporting human resource development in nuclear security is not new."[10] The IAEA's International Network for Nuclear Security Training and Support Centers (NSSC) Network and the European Union's Chemical, Biological, Radiological and Nuclear Risk Mitigation Centers of Excellence (EU CBRN COEs) Initiative, for example, predate the Summit process but the NSS COEs have a much broader remit. Designed to build capacity at the national, regional and international level through technology development, human resource development, education and training, activities supported by the COEs include:

1. Sharing best practices to promote effective protection of nuclear facilities and nuclear material against theft and sabotage;
2. Assisting in the development of regulations, procedures, and technologies required to properly account for nuclear materials;
3. Building technical capacity to accurately and appropriately measure nuclear materials;
4. Training, research and development, and joint analysis to identify nuclear material signatures and support the establishment of national nuclear forensics libraries;

[7] India's Global Center for Nuclear Energy Partnership is under construction. Pakistan's Center of Excellence for Nuclear Security is operating.

[8] The International School on Nuclear Security at the International Center for Theoretical Physics in Trieste focuses on training personnel from developing countries. It is co-sponsored by the Italian Ministry of Foreign Affairs and IAEA in collaboration with the Central European Initiative and Kuwait Foundation for the Advancement of Science. Michelle Cann, Kelsey Davenport and Margaret Balza, *The Nuclear Security Summit: Assessment of National Commitments*, An Arms Control Association and Partnership for Global Security Report, Updated & Revised, March 20, 2012, p.10.

[9] Cann, Davenport and Balza, *The Nuclear Security Summit: Assessment of National Commitments*, p.8. Indonesia, Malaysia and Vietnam also have plans for COEs.

[10] Daniel Salisbury and Christopher Hobbs, "Centers of Excellence in East Asia: Encouraging Collaborative Approaches to National Security," *Stanley Foundation Policy Analysis Brief*, October 2015, p.2-3.

5. Exchanging information and jointly developing methods for detection of nuclear material and nuclear detonations;
6. Training first responders and ensuring harmonized standard operating procedures;
7. Ensuring front-line officers are adequately trained to prevent illicit trade of nuclear technologies; and
8. Supporting the implementation of nuclear safeguards and export controls.

Beyond fostering good governance in other parts of the world, there is also a commercial driver for the COEs: exporting strong nuclear security and safety culture can also promote reactor sales.

China: The State Nuclear Security Technology Center

At the 2010 Summit, China announced its intention to cooperate on the creation of a Center of Excellence and the China Atomic Energy Authority (CAEA) signed a cost-sharing Memorandum of Understanding (MOU) to this effect with the United States Department of Energy (DOE) in January 2011. Construction was completed in December 2015 and the opening ceremony for the State Nuclear Security Technology Center (SNSTC) was held in March 2016. The Center, located in the Changyang Science and Technology Park in the southwestern outskirts of Beijing, is financed and administered by China while the U.S. provides the nuclear-security equipment.[11] The SNSTC has the capacity to train 2,000 nuclear security staff annually.

The COE is a collection of laboratories, test sites, and training facilities. There are six main areas of activity:

1. *Analytical Lab* – Destructive Assay (DA) measures the isotopics of and impurities in nuclear materials through inductively coupled plasma mass spectrometry (ICP-MS), thermal ionization mass spectrometry (TIMS) and wavelength dispersive X-ray fluorescence (XDXRF); Non-Destructive Assay (NDA) measures U-235 content in fuel assemblies, special nuclear material in waste drums through tomographic gamma-ray scanning and plutonium content in waste drums through calorimetry.
2. *Environmental Test Lab* – tests security equipment under different environmental conditions and includes: a vibration deck; water-proof testing equipment; sand and dust blasting equipment; a salt mist box; a temperature-moisture test box; an electro-magnetic test system; and a xenon lamp box.
3. *Physical Protection Testing Field* – consists of an access control facility, a testing facility for intrusion detection devices, a mobile emergency command system and a training system for railway transportation. The Field tests microwave, infrared, vibration and buried cable sensors as well as video surveillance.

[11] "China center on nuclear security to promote int'l cooperation: official," *The China Daily*, April 2, 2016, http://www.chinadaily.com.cn/world/2016xivisitczech/2016-04/02/content_24248877.htm

4. *Response Force Training & Exercise Facility* – provides tactical, including live fire, training for security personnel.

5. *Mock Nuclear Material Bunker* – demonstrates security features including laser tracking, a microwave sensor, a vibration sensor, a thermal camera, delay fixtures and a concertina blanket.

6. *Integrated Training Facility for Nuclear Material Control & Accounting* – includes a bulk facility mock workshop, a material control and accounting training system and an emergency operations center.[12]

The SNSTC is designed as a test bed to detect the smuggling of materials that can either be used in nuclear weapons or dirty bombs. The Center integrates multiple advanced security measures – including enhanced wire fences, camera towers, microwave detectors – that can detect disturbances caused by the weather, plants and animals, as well as infrared detectors around the warehouse that stores nuclear materials. A laser system has been installed to detect and intercept drones. Detectors installed on the center's perimeter fence can spot "invading behaviors" such as people climbing the fence, and there are also "isolation areas" that trap intruders once they enter. The Center works with Pacific Northwest National Laboratory (PNNL), including PNNL's Volpentest Hazardous Materials Management and Emergency Response (HAMMER) training center. PNNL also advises on the physical protection curriculum and instructs the Chinese COE instructors.[13]

The SNSTC is the largest COE in the Asia-Pacific. The initial focus is on building domestic capacity but eventually the Center will provide training for experts from other countries in the region. It also aims to provide a forum for bilateral and regional best practice exchanges and to serve as a demonstration hub for advanced technologies.

Japan: The Integrated Support Center for Nuclear Nonproliferation and Nuclear Security

The establishment of nuclear material management and nonproliferation institutions in Japan preceded the NSS process. In 2005, the Japan Atomic Energy Agency (JAEA) created the Nuclear Nonproliferation Science and Technology Center and renamed it the Department of Science and Technology for Nuclear Material (STNM) in 2011. At the 2010 Summit, Japan announced its intention to launch a COE. Funded by the Ministry of Education, Culture, Sports, Science and

[12] China State Nuclear Security Technology Center, *Center of Excellence on Nuclear Security*, undated; Gu Zhongmao, "Introduction to China-US Center of Excellence (COE) on Nuclear Security," NTI Developing Spent Fuel Strategies Workshop, Honolulu, HI, August 16, 2016, http://www.nti.org/media/documents/DSFS_-_US-China_COE_Presentation.pdf.

[13] "US and China cooperate on largest nuclear security center in Asia-Pacific," *Global Times*, March 24, 2016, http://www.globaltimes.cn/content/975877.shtml; The White House, Office of the Press Secretary, "U.S.-China Joint Statement on Nuclear Security Cooperation," March 31, 2016, https://obamawhitehouse.archives.gov/the-press-office/2016/03/31/us-china-joint-statement-nuclear-security-cooperation; Annette Cary, "PNNL helps launch China nuclear security training center," *Tri-City Herald*, March 17, 2016, http://www.tri-cityherald.com/news/local/pacific-northwest-national-lab/article66818802.html

Technology (MEXT), managed by JAEA and located in Tokai, the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) was established in December 2010. The official opening ceremony was held in February 2011.[14] In April 2014 several STNM's functions were incorporated into the ISCN. As the name suggests, ISCN is much more focused on regional capacity-building for nuclear newcomers than the Chinese SNSTC and has already engaged with countries such as Vietnam, Malaysia, Mongolia, Kazakhstan, Thailand, Indonesia, Turkey, Lithuania, Ukraine, Bangladesh, Saudi Arabia, Myanmar and the ASEAN Center for Energy.

The main activities performed at the ISCN are:

1. *Nonproliferation technology development* – safeguards, proliferation-resistance technologies and measuring control technology of melted fuel at Fukushima Daiichi;

2. *Material measurement, detection and forensics technology development*

   – demonstration of a spent fuel plutonium NDA system, development of nuclear resonance fluorescence NDA technology using Laser-Compton scattering γ-rays, development of ^{3}He neutron detection technology using a ZnS/B_2O_3 ceramic scintillator and application of neutron resonance densitometry using neutron resonance transmission analysis and neutron resonance capture analysis;

   – elemental, isotopic and impurity measurements, morphology analysis of particles, age determination of uranium and plutonium, attribute evaluation, creation of a domestic database and expansion of this database in cooperation with other countries;

3. *Policy research* – peaceful uses of nuclear energy and nonproliferation;

4. *Capacity-building and infrastructure development support* – including legal systems, regulations and manuals plus training and education;

5. *Transportation and research reactor fuels support* – for JAEA nuclear material movements and procurement/disposal of research reactor fuels;

6. *Domestic human resource development* – cultivating cooperative relationships with universities and the wider populace in Japan; and

7. *Comprehensive Nuclear Test Ban Treaty (CTBT) support* – testing verification technology and establishing an international monitoring system.[15]

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[14] Reina Matsuzawa, "ISCN's Capacity Building Activities for Nuclear Security and Safeguards," Open Seminar on 5th Anniversary of FNCA Workshop on Nuclear Security and Safeguards Project, Kurchatov, Kazakhstan, September 8, 2015, http://www.fnca.mext.go.jp/english/nss/2015_06.pdf; R.G. Anderson and S.L. Frazar, *Sustaining International CBRN Centers of Excellence with a Focus on Nuclear Security and Safeguards: Initial Scoping Session*, London, 23-24 September 2013 – Summary Report, PNNL-22988, November 2013, http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22988.pdf.

[15] JAEA, "Integrated Support Center for Nuclear Nonproliferation and Nuclear Security: Missions," undated, https://www.jaea.go.jp/04/iscn/org/intro_en.html; Matsuzawa "ISCN's Capacity Building Activities for Nuclear Security and Safeguards"; Kensuke Yoshida, "Activities of the Integrated Support Center for Nuclear Non-

In terms of capacity-building, ISCN training courses (lectures, seminars, and hands-on exercises) include security, safeguards, material control and accounting and the international nuclear non-proliferation framework. The Center also contains a variety of training tools including a virtual reality (VR) system and a training field: VR offers an interactive experience while the training field provides real equipment such as security sensors, fences and monitors.[16]

The ISCN cooperates with DOE's National Nuclear Security Administration (DOE-NNSA) and the national laboratories on: training course development; demonstration of a spent fuel Pu-NDA system; development of nuclear resonance fluorescence NDA technology; nuclear forensics R&D such as uranium age dating measurements (also with the EU); nuclear fuel characterization; and the development of a national forensics library. The ISCN works with a number of agencies including, but not limited to, the Vietnam Agency for Radiation and Nuclear Safety on safeguards and security, legal and human infrastructure development through training and with the IAEA and European Commission Joint Research Center (JRC) on nuclear security and safeguards training, human resource development and nonproliferation technology development. ISCN holds joint workshops with the World Institute for Nuclear Security (WINS) and coordinates its work with the Forum for Nuclear Cooperation in Asia (FNCA) and Asia-Pacific Safeguards Network (APSN).[17]

Republic of Korea: The International Nuclear Nonproliferation and Security Academy

In September 2010, the Republic of Korea announced that it would open an international nuclear security training center. The International Nuclear Nonproliferation and Security Academy (INSA) was established by the Korea Institute of Nuclear Nonproliferation and Control (KINAC) in Daejeon in February 2014. KINAC's mission is to promote transparency and nonproliferation objectives in Korea's nuclear operations and it reports to the Ministry of Education, Science and Technology. Like the Japanese COE, the INSA has a strong international focus. Activities at the INSA fall into four broad but mutually reinforcing categories:

1. *education and training*;
2. *sharing best practices*;
3. *R&D activities*; and
4. *technical support including technology transfer*.

Proliferation and Nuclear Security," G8 Global Partnership Meeting, Center of Excellence Working Group, Boston, MA, March 14, 2012, https://2009-2017.state.gov/documents/organization/187421.pdf.

[16] JAEA Integrated Support Center for Nuclear Nonproliferation and Nuclear Security, "Activities: Capacity Building," undated, https://www.jaea.go.jp/04/iscn/iscn_old/04_activities_en.html#Technical

[17] Yoshida, "Activities of the Integrated Support Center for Nuclear Non-Proliferation and Nuclear Security"; Kazuko Hamada, "Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) Nuclear Security Centers of Excellence in Northeast Asia," Council for Security Cooperation in the Asia Pacific, Nuclear Energy Experts Group Meeting (NEEG), Da Lat, Vietnam, November 11-12, 2013, https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/attachments/131111_Session%204_Hamada.pdf.

INSA offers three kinds of education and training course: security, safeguards and export controls. Each course is held once a year for five days and is pitched at three different levels of expertise: basic, intermediate and advanced. The nuclear security course focuses on the design and evaluation of physical protection systems. The safeguards course covers the IAEA's Guidelines for States' Systems of Accounting for and Control of Nuclear Materials. The export controls course addresses such issues as the Nuclear Supplier Group's trigger list and strategic trade controls. Participating countries include Vietnam, Malaysia, Mongolia, Philippines, Bangladesh, Saudi Arabia, UAE, Indonesia, Thailand, Turkey, Egypt, Jordan, Algeria and Myanmar. INSA also hosts regional and international training courses on nuclear safeguards and security with IAEA experts.

INSA provides a domestic training program that includes courses on physical protection and nuclear non-proliferation for facility operators and courses for nuclear security and nuclear safeguards inspectors. INSA also provides e-learning courses in security/nonproliferation and a public awareness program.

The Center augments its education program through MOUs with universities and other educational institutions. For example: the 'Nuclear Control and International Cooperation' course at Seoul National University's Nuclear Engineering Department; the 'Nuclear Issues in Global Affairs' course at Yonsei University's Graduate School of International Studies; the 'Nuclear Material Controls' course at KEPCO International Nuclear Graduate School; and the Nuclear Nonproliferation Education and Research Center at the Korea Advanced Institute of Science and Technology (KAIST).

INSA hosts a number of training facilities:

1. a radiation portal monitoring and entry control system with vehicle inspection system;
2. mock conventional physical protection systems including fences, active/passive infrared & magnetic field sensors and closed-circuit television;
3. a test field for an advanced physical protection system including thermal/laser cameras, sonar detection and a laser fence;
4. a simulation facility for force-on-force exercises; and
5. a destructive test facility including fence cutting and crash barrier tests.

Collaboration among the Centers of Excellence

The differences in focus and approach at each of the centers can be explained by distinct national priorities and the fact that they are run by functionally different organizations. The INSA is managed by KINAC whose central mission is nonproliferation whereas the Japanese ISCN is managed by JAEA which is primarily an R&D organization. The SNSTC is a technical support organization under CAEA hence its focus on the operational, technical, and procedural aspects of operating nuclear facilities. In a collaborative environment, these differences are an asset: the complementarities enable the COEs to address a larger set of problems at a greatly

reduced cost compared to each center working in isolation. INSA and ISCN already cooperate on education and training: sharing of course schedules, lecturer support and having observers sit in on courses. Expanding this cooperation to include the SNSTC is a logical next step. Eventually, the COEs could also serve as multinational labs for joint technology R&D.

Collaboration among existing and planned COEs was the subject of two 2014 workshops sponsored by the Center for Strategic and International Studies (CSIS) Proliferation Prevention Program together with the Stanley Foundation and the Vienna Center for Disarmament and Non-Proliferation (VCDNP). Several topics were identified as particularly suitable for cooperative work: peer reviewing training courses, developing an accreditation process through the IAEA, sharing non-sensitive information, using simulation and table-top exercises, innovating and standardizing best practices, testing approaches to observable confirmation of performance to build security confidence (i.e. remote monitoring), radiological source security, developing criteria for personnel certification and networking with universities and diplomatic academies.[18]

In July 2016, CSIS and the ISCN co-hosted a workshop on possible collaboration between COEs and civil society, with a particular emphasis on the growing cyber threat to nuclear facilities.[19] South Korea's INSA has also identified cyber security as an important training topic for nuclear newcomers. Cyber security may be a productive area for joint COE activity due to the complexity and fluid nature of the challenge and the high cost of developing solutions.

In December 2016, ISCN, the Permanent Mission of Japan to the International Organizations in Vienna (PMJ) and the VCDNP hosted a panel discussion entitled "Nuclear Security Centers of Excellence in Asia: Progress and the Way Forward". Recommendations included: increasing joint training, ensuring agreed nuclear security measures are adopted and reproducing the ISCN-INSA-SNSTC cooperation in other regions.[20]

The main incentives for regional cooperation are knowledge transfer, capacity-building, cost-sharing as well as the credibility gained and results achieved by bringing together the leading experts in the field. There may be some areas that inherently lend themselves to regional collaboration, such as developing information security standards.[21] Working together, the COEs can also create a more integrated institutional framework for international nuclear security. The United States can play an important role in catalyzing this collaboration (see below).

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[18] Center for Strategic and International Studies and Stanley Foundation Workshop Report, *Collaboration Among Centers of Excellence in Asia*, 2015, https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/150319_COE_Workshop.pdf

[19] ISCN-CSIS Washington Workshop 2016, *Nuclear Security Collaboration Between CoEs and Civil Society: Filling the Gaps*, Workshop Report, Washington DC, September 2, 2016, https://csis-prod.s3.amazonaws.com/s3fs-public/publication/160903_CoE_Workshop_Report.pdf.

[20] Vienna Center for Disarmament and Non-Proliferation, *Nuclear Security Centers of Excellence in Asia: Progress and the Way Forward*, December 7, 2016, http://vcdnp.org/nuclear-security-centers-of-excellence-in-asia-progress-and-the-way-forward/

[21] CSIS and Stanley Foundation Workshop Report, *Collaboration Among Centers of Excellence in Asia.*

Collaboration between the Centers of Excellence in Asia and international organizations

COE connectivity with international bodies like the IAEA's NSSC Network and International Nuclear Security Education Network (INSEN), WINS and the EU's CBRN COE Initiative is important because it will complement bilateral associations between the host and those bodies, enhancing information sharing and outreach to other countries.

ISCN and WINS have hosted workshops for Japanese operators and related governmental agencies with various themes like nuclear security and corporate governance, collaboration with outside organizations for strengthening nuclear security, information disclosure and insider threat, and synergy between nuclear security and safety. The workshops included a theater-based session in which professional actors performed a nuclear-security-event scene based on a specific scenario, followed by discussion among participants. Participant feedback indicated that this sort of experience provided a more realistic sense of situations and threats than more conventional lectures or presentations.[22]

In May 2011, the European Union and Japan strengthened cooperation on mitigation of radiological, nuclear and other risks by exchanging information between the former's CBRN COEs and the latter's ISCN. Topics included detection and nuclear forensics R&D, training and technical support in the areas of safeguards, security and non-proliferation, including curriculum development, exchange of lecturers, co-sponsor training and coordination of support to third countries.[23]

The IAEA supports "train the trainer" programs. There is some interest for developing an IAEA accreditation system for the COEs to ensure that their programs match IAEA standards. ISCN is also co-hosting regional workshops with the IAEA including nuclear security culture workshops, inspector training courses on safeguards in reprocessing plants and DCVD training for spent fuel verification.

The INSA International Training Program is staffed by KINAC as well as experts from the U.S. national laboratories and the IAEA. INSA hosts IAEA regional courses on accounting and control of nuclear material for newcomer countries) and regional/international courses on nuclear security that include protective and preventive measures against sabotage, forensics, and physical protection of nuclear materials and nuclear fuel.

Collaboration between the COEs at the Back End of the Fuel Cycle?

One of the biggest challenges for the nuclear enterprise globally is the disconnect between safety and security. While significant progress has been made, this is still particularly evident at

[22] Matsuzawa, "ISCN's Capacity Building Activities for Nuclear Security and Safeguards"; Yoshida, "Activities of the Integrated Support Center for Nuclear Non-Proliferation and Nuclear Security."
[23] Yosuke Naoi and Said Abousahl, "EU and Japan, Good Collaboration Practices in Nuclear Security," 19th Japan-EU Conference, Brussels, September 23, 2016, http://www.eias.org/wp-content/uploads/2016/03/PPT_Presentation_Naoi_Abousahl_23.09.2016.pdf.

the back of the back end of the fuel cycle; that is, spent fuel and high level waste storage and disposal. The political, technical and financial challenges of spent fuel management are well understood but the important security/nonproliferation dimension is often ignored or minimized. Spent fuel needs to be stored for extended periods of time while it cools before repositories can begin accepting it – perhaps 40 years or more. In addition, increasingly high burn-up fuel and large dry storage canisters make moving spent fuel stored in such canisters problematic in the short to medium term because the allowable thermal and radiation limits for transportation can be substantially lower than the limits for storage, requiring an extended period of aging before the canisters have cooled down enough to be moved. In most cases it will be decades before repositories are open and able to accept waste in sufficient quantities to begin to significantly draw down inventories. The longer spent fuel is stored, the less self-protecting it becomes as the strongly radiating shorter lived isotopes that provide the protection continue to decay, and thus as it becomes less radioactive, the greater security risk it presents. In addition, lack of disposal options has led some countries to conclude that recycling spent fuel for use as mixed oxide (MOX) fuel is an alternative to long-term storage/disposal, at least in the short to medium-term. However, even a mature and efficient recycling program does not obviate the need for a repository and reprocessing can produce separated plutonium that might be diverted to a nuclear weapons program or acquired by non-state actors for use in nuclear explosive devices or diverted into illicit state-run nuclear weapons programs.

A number of important back end problems could be addressed through collaboration between the three COEs. Highlighting the national security dimension of spent fuel management could help mitigate difficult public acceptance challenges and alleviate the efforts to solve the nuclear waste disposal problem. There are a number of security concerns that have to be addressed, including: transportation (road, rail and sea); reprocessing/recycling; HLW treatment; and SNF/HLW storage and disposal. Risk analysis for back end nuclear security should determine the vulnerabilities at each stage and identify a menu of the technical and non-technical measures that could be employed to overcome those vulnerabilities. Joint R&D efforts to address vulnerabilities to and risks of sabotage and terrorist attacks on spent fuel storage sites, including in pools, may also be beneficial. A key issue is the need for an appropriate approach for evaluating the security risk of spent fuel storage for the timeframe of extended storage (tens of decades to several centuries), involved by the factors that change over the time, including self-protection, material attractiveness, adversary technologies (e.g. improved breaching tools and robotics) as well as aging of containers and fuel. International cask sabotage experiments to develop data on spent fuel dispersal would need joint resources and cost sharing and may be appropriate to be developed and conducted in collaboration with the COEs.

The Chinese and Japanese COEs could possibly act as a platform for regional collaboration given their R&D programs that include NDA waste work, particularly the SNSTC that has a Nuclear Waste NDA lab. All the three COEs can play a valuable role in assessing where countries, especially newcomers, lack capabilities and then help build capacity.

Conclusion

Creation of the first generation of Centers of Excellence was a signal achievement of the now-defunct Nuclear Security Summit process. The COEs play an essential role in helping each country maintain the security of its nuclear material and facilities; they also act as an important platform for strengthening the regional and global nuclear security architecture. Notably, at the 2016 Summit, President Xi Jinping declared China's intention to conduct research and exercises with other countries to enhance capacity for addressing nuclear terrorism. Cooperation between the SNSTC, ISCN and INSA is already occurring, enabling the Centers to utilize finite budgets more efficiently, share resources and draw on a wider pool of expertise. This cooperation should be both deepened between the three COEs and broadened to other parts of the world. The United States has a critical role to play given DOE-NNSA's long-standing engagement with all three countries and COEs. Ensuring that the COEs thrive, integrate and multiply in the future will be an important test of the international community's commitment to improving global nuclear security.

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About the Nuclear Threat Initiative

The Nuclear Threat Initiative works to protect our lives, environment, and quality of life now and for future generations. We work to prevent catastrophic attacks with weapons of mass destruction and disruption (WMDD)—nuclear, biological, radiological, chemical, and cyber. Founded in 2001 by former U.S. Senator Sam Nunn and philanthropist Ted Turner who continue to serve as co-chairman, NTI is guided by a prestigious, international board of directors. Ernest J. Moniz serves as chief executive officer and co-chairman; Des Browne is vice chairman; and Joan Rohlfing serves as president.