THE UNIVERSITY OF TENNESSEE KNOXVILLE

International Journal of Nuclear Security

Volume 2
Number 1 *Education and Training Issue*

Article 16

11-22-2016

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International Journal of Nuclear Security, Vol. 2, No. 1, 2016

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Abstract

It is essential that states and international organizations provide systematic training in nuclear security in order to reinforce the nuclear security regime nationally and internationally. The Korean government, recognizing the importance of fostering national nuclear security capacities, as well as the value of contributing to international nuclear security governance, established the International Nuclear Nonproliferation and Nuclear Security Academy (INSA) under the Korea Institute of Nuclear Nonproliferation and Control (KINAC) as a Center of Excellence. INSA was established in accordance with the government policy that a sustainable infrastructure for education, training, and processes connected to nuclear security is fundamental to a capacity-building strategy. Ever since its inception in February of 2014, INSA has been designing and delivering domestic and international/regional training programs in order to foster human resource development in nuclear nonproliferation and security. This paper describes several of the new exercise modules which will soon be introduced via INSA training courses to further ensure the objectives of INSA and KINAC, and of the global nuclear security regime.

I. Introduction

Effective nuclear security requires capabilities for preventing, detecting, and responding to unauthorized acts involving implications for nuclear or other radioactive material. If such capabilities are to remain effective, States and organizations must establish them as self-sustaining over the long term **[*1*]** — and this means providing or facilitating systematic training.

To this end, the Korean government established the International Nuclear Nonproliferation and Nuclear Security Academy (INSA) under the Korea Institute of Nuclear Nonproliferation and Control (KINAC) as a Center of Excellence for fostering national nuclear security capacities and for contributing to governance of international nuclear security. In other words, INSA was born through the government policy that the establishment of sustainable education and training infrastructure and processes is fundamental to its capacity-building strategy **[*2*]**. Since February of 2014, INSA has been designing and delivering domestic and international/regional training programs for the purpose of fostering human resource development in nuclear nonproliferation and security. In an article appearing in the first issue of the *International Journal of Nuclear Security*, Dr. Kwan Kyoo Choe developed in detail how INSA was established in the Republic of Korea as a center of excellence for nuclear security. He explains its background, vision, strategy, and domestic and international programs in addition to describing its test-bed activities and equipment configuration **[*3*].**

A challenge in operating training programs of any kind involves determining whether the objectives of a program set in advance will actually achieve the desired results. Gaps between inputs and outcomes of training programs are common. INSA has sought solutions to this problem by evaluating many of its training programs. In the following section, we introduce four new exercise modules and discuss how these modules could diminish the gap between input and practical output of training-based evaluations.

II. Developing New Training Modules

In response to multiple evaluations, INSA is now designing and developing more practical and applicable training modules. These are closely linked with, and can be used at, the trainees' missions/tasks under the 2016 INSA Education and Training Plan for ensuring INSA's sustainability. The new plan is a combined theory-exercise training program that is expected to overcome some limits of classroom training modules **[*4*]**.

The new plan is based on lessons learned from the last two years of providing domestic and regional/international training. INSA always conducts a survey at the end of each training course. Amongst the diverse requests from attendees who responded to the surveys, several things always stood out: trainees strongly hoped to go through additional exercise modules, they recommended that more time be allocated for the existing exercise classes, and they strongly requested lectures incorporating audio/video material **[*5*]**.

Those requests might have been made because most of the current training modules consist mainly of instructor-driven, classroom-based lectures, lacking interactive activities for trainer and trainees. Consequently, we have decided that the current classroom lecturing mode needs to be steadily replaced with interactive modes, and the number of exercise modules needs to gradually increase. Though the classroom lecturing mode will be maintained at a certain level, the ratio of exercise modules will increase as we serve the target audiences/trainees of INSA training programs: government agencies, nuclear facilities, nuclear industries, and customs.

The next section introduces one new exercise module that we started to deliver in 2016, plus four exercise/interactive modules that will start up in 2017.

A. X-ray images reading exercise

One exercise module introduced in 2016 is the X-ray images reading exercise module. This is geared for security guards at nuclear facilities. INSA provides education based on article 9.2 of the Act on Physical Protection and Radiological Emergency. For the nuclear facilities' guards and the personnel engaged in nuclear security tasks, training in compliance with this Act is mandatory. Our exercise module builds the

guards' skill and capacity to monitor, identify, detect, and seize prohibited items—things that may not be carried into nuclear facilities. In order to deliver the exercise, INSA is furnished with 40 computers loaded with software for reading X-ray images. This number of computers is enough to give each trainee a workstation. Post-exercise feedback from all trainees and security guards from the nuclear power plants was highly satisfactory, and we particularly welcomed it because it confirmed to us the efficacy of tailoring the modules in reaction to trainee feedback.

INSA is planning to further upgrade the image-reading software, i.e. adding more diverse items into the current images database and subdividing the current images reading levels into levels based on the trainees' capacity. In addition, since the security guards have little opportunity to actually see the prohibited items—such as various types of knifes, guns, explosive devices, etc.—INSA will now use such items (safely adapted) at training. This, we expect, will increase and foster the security guards' practical capacity for their mission **[*6*].**

B. SR-based Field Training Exercise

The second exercise module, which is being developed by INSA, is titled SR-based FTX (Substitutional Reality-based Field Training Exercise) module **[*7*]**. We plan to build an FTX facility at INSA, and the pilot module will start to operate at the end of 2016. The FTX program will serve as a virtual reality device which can drill trainees in critical events that are impossible to simulate in reality—such as terror attacks on the nuclear power plant, actual combat situations, etc. The SR FTX is based on a neurobiological theory that says human behaviors can change through neurobiological "experiences." According to this theory, the human brain has neuroplasticity, i.e. the ability to change/improve its functions through experiences, whether real or, in terms of sensory perception, experienced as "real." Therefore, if the brain can be put through an "experience" via an intense/convincing immersion in virtual reality, it can rearrange and change its functions in response to that experience much as if it had actually undergone those experiences in real life. This allows humans to acquire, eventually, new responses and skills via virtual reality training. For instance, a surgeon may receive a great deal of effective practice for surgery using video. Such theoretical implications underlie INSA's plans for SR-based FTX training in pursuit of its objectives **[*7*]**.

SR FTX will cultivate the human response capacity, which is one of main functions of physical security at nuclear facilities when security guards react to threats and other problems, reducing damage during a critical event. Also, the exercise program itself will not only facilitate trainees' preparation for their missions and enhance their expertise, but it will enhance their satisfaction. Taking into consideration current challenges like the threat of terror attacks or drone attacks to nuclear power plants, we believe that practical exercises using these new technologies will also contribute to raising awareness of nuclear security issues and promote security culture.

C. Developing new SETT exercise modules

Since 2014, INSA has worked to establish a nuclear security test bed: SETT (Nuclear Security Research, Training and Test Facility). As its name suggests, SETT is a multi-purpose facility that has been used successfully for INSA training programs for diverse trainees from both at home and abroad. SETT consists of TB-I (Outdoor Test Bed), CAS (Central Alarm Station), and TB-II (Indoor Test Bed), and it is equipped with various types of sensors. These include sensors that are commonly used at the nuclear facilities as well as sensors that are both newly developed and unused. These new sensors, however, must undergo performance and evaluation tests.

However, the current INSA training modules focus on exercises aimed at testing performance while also evaluating those at SETT TB-I. In this regard, we have planned to develop new exercise modules

regarding alarm performance evaluation in CAS and relating to response forces' drill programs. An exercise module for alarm evaluation will be provided to personnel who are working at the control department in nuclear facilities. The alarm evaluation method will use camera images that have diverse resolutions. Another exercise module, to be introduced in 2017, consists of a drill program that is designed to enhance the response forces' shooting ability. The drill program is expected to be helpful for security guards who will function as response forces during an event. By using this program, the security guards will not only learn MILES usage, but they will also be able to use the information gained from these activities to build their response capacity.

D. Theatre/Forum-based workshop

Raising awareness regarding the roles and responsibilities of various stakeholders involved in the safe and secure operation of nuclear facilities also serves as an important desideratum. Providing practical techniques, skills, and knowledge in nuclear security to stakeholders for their implementation would be a main reason why INSA designs, plans, and operates diverse training programs. These goals cannot be separated, however, from fulfilling and enhancing the integrity of the priorities of INSA training programs.

In this context, INSA plans to introduce a brand-new training method, which we have both called the "theatre-based workshop" and "forum education." Recently, Korea has used innovations in the field of industry especially to find solutions or to raise awareness and sympathies among members of the organization concerning current issues or company visions. In the field of nuclear security, WINS (World Institute of Nuclear Security) developed the theatre-based workshop about diverse themes in nuclear security, and WINS is now performing it at Japan, US, and UAE, etc.

The WINS workshop uses theatre performed by a group of experienced actors as well as pedagogical methods such as role-play, simulation, and small group discussions to explore the best practices for understanding these complex security issues and to encourage both trainees and experts to share their experiences. It is structured into 4 sessions to explore the various aspects of the topic. The scenarios engendered for this curriculum are usually written by a professional scriptwriter who is working in close cooperation with WINS based on the needs of the coordinator. In order to learn more about the participants and their opinion and concerns, an electronic voting system (e-voting) is used throughout the workshop **[*9*].**

It is expected that the event will eventually serve as an opportunity to identify and share the best practices for approaching different security scenarios, including but not limited to: security incident management and response, effective security governance and oversight, coordination between security and safety insider threat mitigation, nuclear security culture, communicating with the public, etc.

The theatre model has some pedagogical advantages for specific topics/themes. In particular, it will allow all participants (the trainers and trainees) to interact with one another during the entire process, through the medium of theatre, and to discuss the subject being covered. Trainees will also be encouraged to work collaboratively to solve specific scenarios related to the field. Ultimately, the goal of the workshop is to maximize the involvement of participants as well as their ability to work and to learn from their trainers.

III. Conclusion

This paper has introduced new exercise modules that INSA is developing for training in nuclear security. The modules are responsive to evaluations from previous trainees. These have improved our systematic

approach to training and strengthened INSA as a Nuclear Security Center of Excellence, helping to support nuclear security regimes nationally as well as globally.

The three pillars of IAEA's nuclear security training and support centres (NNSC)'s are: providing national training in a systematic manner, providing specific technical support for use and maintenance of nuclear security technical systems, and providing scientific support during and after a nuclear security events. INSA's contribution is to pillar #1, providing national training in a systematic manner. Given the demand for capacity building in nuclear security, INSA will continue not only to provide training courses to stakeholders at home and abroad—in particular, to the nuclear newcomer countries—but also to develop and improve its programs to meet the needs of trainees.

IV. Notes and References

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7. SR combines VR technology, cognitive science, and brain science. It allows humans to perceive certain experiences in virtual reality as real ones—a very advanced technology-strengthened immersion and interaction activity. In other word, SR can be defined as experiential VR that uses positioning data collected by motion tracking technology to maximize a participant's immersion through interactive activities between a trainee and a character in virtual reality. A participant can experience live scenes and previously recorded scenes as equally realistic, such that everything in these scenes seems to exist in the surrounding physical reality. The SR system implements and extends several techniques that have been used in virtual or mixed reality (VR or MR) systems: a headmounted display (HMD) and a panoramic video camera. VR/MR systems have been broadly and successfully used in psychology, cognitive neuroscience, and various therapies. [Sanghoon Park, 2016 '*K-ICT Digital Contents Open Campus*' VR-Lab Assistance Project Plan. Feb. 2016.] In this context, SR technology is different from the VR (virtual reality) or AR (augmented reality) technologies. SR technology distorts the human recognition processes and lets people recognize a virtual reality as a real one. The greatest difference between SR and VR/AR would be that SR makes possible the interaction among participants under a specified event situation "without scenario," while VR is based on the ready-made scenarios using artificial intelligence technology without interaction functions.

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