Training and Exercising the Nuclear Safety and Nuclear Security Interface Incident Response through Synthetic Environment, Augmented Reality and Virtual Reality Simulations

Edward Waller

Joseph Chaput

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

15 November 2017

Presented at the IAEA International Conference on Physical Protection of Nuclear Material and Facilities

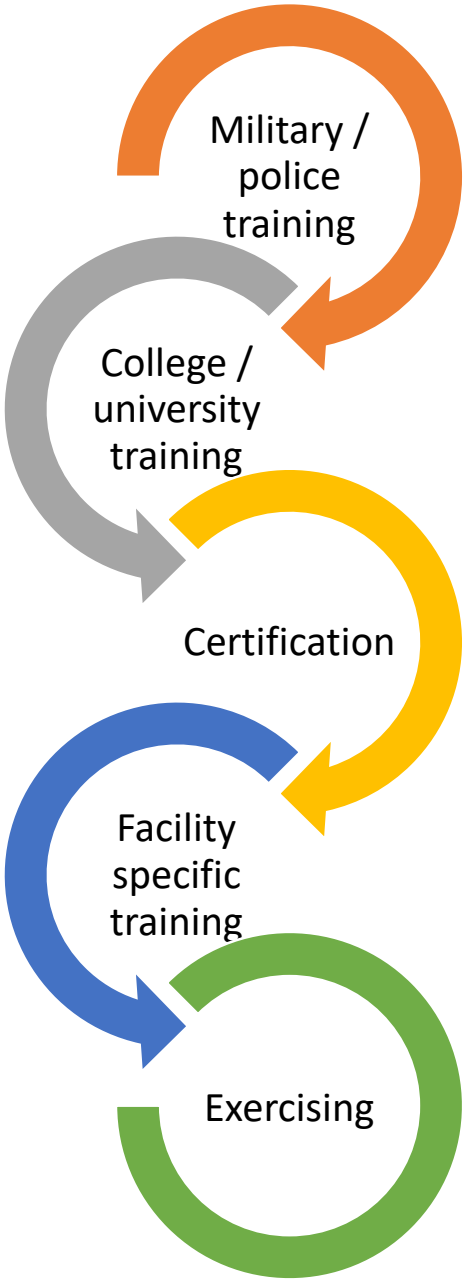
Why we need to train

Interface of Safety and Security

- Some areas of intersection:
  - Communications (*"Need to know vs. Need to Share"*)
  - Security by Design
  - Nuclear Material Control and Accountancy
  - Security Equipment Maintenance
  - Security Contingency Response in the Presence of High Activity Radiological Material
  - Modelling and Simulation

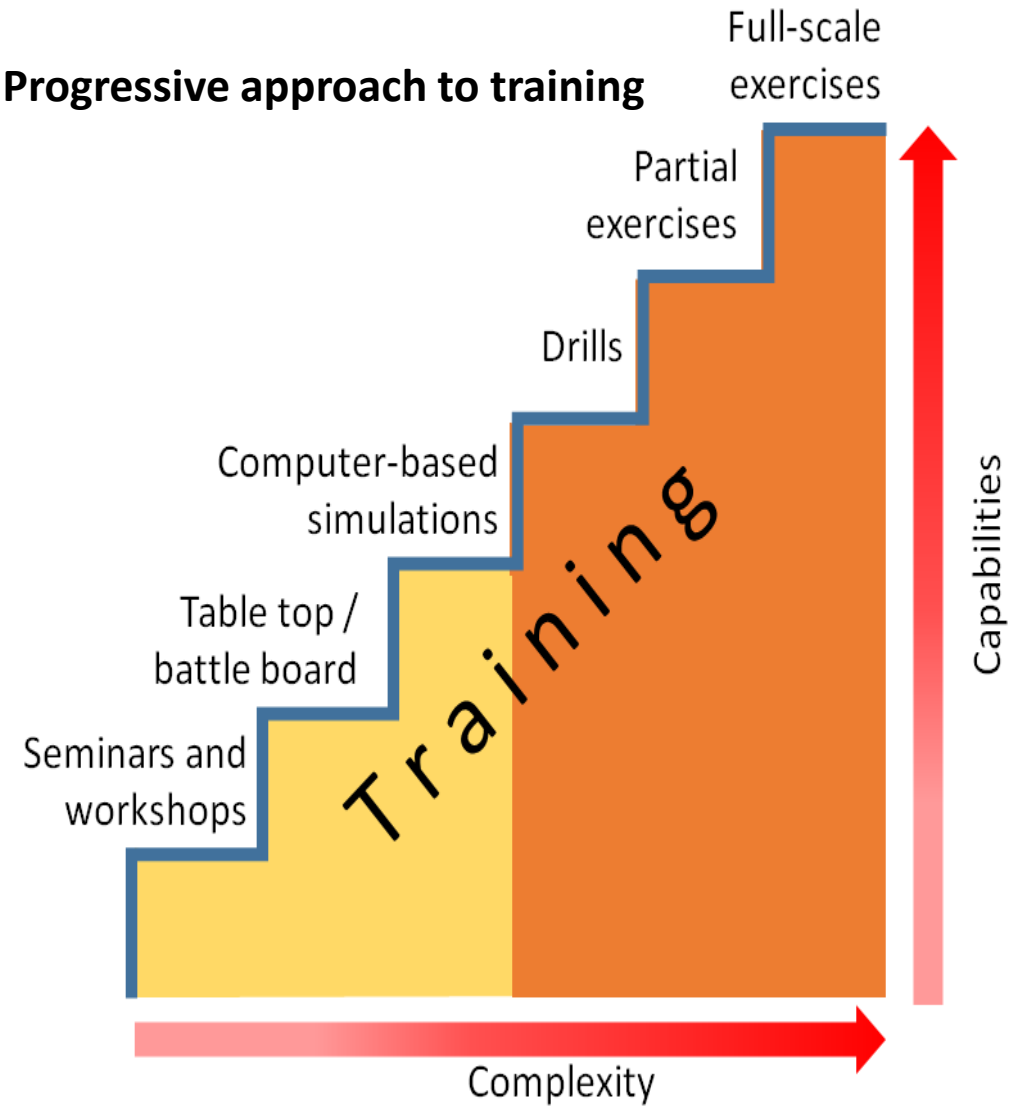
Training

Training for Nuclear Security



Purposes of Exercises

- Exercises are a way of
  - testing,
  - training,
  - evaluating, and
  - demonstrating capabilities in contingency response



Exercises and Associated Purposes

Type	Purposes
Simulation Takes place without field execution	
Table top exercise/battle board	• varies in scope and number of personnel involved • training • interagency coordination • performance testing • testing and evaluating command and control structures
Computer based exercise	• training • decision making • validate vulnerability assessment • testing new concepts, procedures, physical protection measures
Exercise Takes place with field execution	
Drills	• limited number of personnel • training • performance testing
Partial exercise	• limited scope • may include force-on-force engagement • training • performance testing • testing and evaluating command and control structures

Full-scale exercise	• training
	  ○ training of all on-site and off-site agencies
	  ○ training under real time and environmental conditions or simulated
	• coordination with all on-site and off-site agencies
	• based on force-on-force engagement
	• evaluation of capabilities and proficiencies
	  testing and evaluating command and control structures

Disadvantages of Traditional Approach to Exercises

- Complex exercises are **expensive**
  - Require use of facilities/people/radiological material
  - Can take years to plan and arrange
  - Only a small set of players directly benefit with the experience
- Safety or security priorities may dominate the planning and cause an interface exercise to be too **focused in one direction**

Future of Modelling and Simulation for the Safety-Security Interface

- **Synthetic environment**: a computer simulation that represents activities at a high level of realism
- **Augmented reality**: technologies that can project, superimpose or otherwise bring into focus computer-generated information (text, images, video, etc.) onto a view of the real world
- **Virtual reality**: technologies that use computer-generated images, sounds and other sensations to replicate a 'realistic' environment that simulates a user's presence in this environment
- **Immersive technology**: any technology that provides a multi-modal sensory experience to engage and immerse users in a meaningful interactive scenario

Virtual Reality

3rd person view

VR view

Virtual Reality in the Nuclear Industry

- Virtual reality (VR) technology has been in development for decades
- Current technology has hit a point where a VR setup is affordable as a consumer product
- VR is an effective way to engage your audience
- Immersive experiences enhance the user experience
- Recent experiment used VR technology for running emergency transport exercises with industry experts from around the world
  - Very positive feedback

Real Time Assessment of Player Actions Possible (& Desirable)

Video 1

Video 2

Video 3

Video 4

Video 5

Advantages of Leveraging Virtual Reality Technology

- **Reproducibility**: The same scenario can be **replayed** by nuclear safety and security personnel
  - Shared experience with **different perspectives** afterwards
  - Post-exercise discussions enhance **awareness of the others' priorities**
  - **Observing and discussing** while the exercise is taking place is a teaching tool
- **ALARA**: *No radiological sources needed!*
- **Scalability**: Large scale exercises or quick drills are both possible
- **Interoperability**: Enhancing **awareness** of concerns from both sides achieves mutual understanding between both sides

Final words…

- Simulation **cannot replace** hands-on training and exercising, but it can **enhance** both
- Modelling and simulation for nuclear security is a **cost-effective** way to explore security system **effectiveness** and the ramification of system upgrades or changes
- Provision for both **perturbation** analysis AND **reproducibility**
- Virtual environments can **immerse** participants in **realistic** adversary scenarios with
  - **Low cost**
  - **Low physical footprint**
  - **Low probability of injury**

Thank you