Radiological Emergency Preparedness and Response Training and Capability Development in South East Asia

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Abstract

The collaborative and systematic approach to training for nuclear and radiological emergency preparedness and response is described in the cooperation program between ANSTO and South East Asia partners. The aim of the program is to ensure adequate measures are in place to detect, respond to and mitigate the consequences of any attempted, or actual, malicious use of radioactive sources or nuclear facility sabotage. The main elements of this cooperation are: (a) identifying the priority areas for training through needs analysis; (b) strengthening individual professional expertise through a structured approach to training; and (c) enhancing individual agency and national nuclear and radiological emergency preparedness and response arrangements and capabilities. The standards and criteria being applied are discussed, along with the methods, design and conduct of workshops, and practical and tabletop exercises. Some of the activities and outcomes of ANSTO's cooperation with counterparts in Indonesia, the Philippines, Malaysia, and Thailand are described. It is concluded that the cooperation contributes to the capability, effectiveness, sustainability and willingness to support responses to any nuclear or radiological incident, either safety or security-related, within South East Asian countries.

Key Words

Radioactive sources, nuclear and radiological emergency preparedness and response, counter terrorism, security

1. Introduction

In recent years there has been recognition of the potential malicious use of radioactive material by terrorists [1], [2]. The deliberate dispersal of radioactive or nuclear material using conventional explosives, either as a radiological dispersal device or through sabotage at a facility, could create considerable panic, disruption and area access denial in an urban environment. Radioactive source security to prevent the malicious use of radioactive material is a priority matter being addressed by the international community [3], [4]. In the event that prevention fails, countries must ensure they have adequate measures to detect, respond to and mitigate the consequences of any attempted, or actual, malicious use of radioactive sources.

The Regional Security of Radioactive Sources (RSRS) Project of the Australian Nuclear Science and Technology Organisation (ANSTO) cooperates with several South East Asian countries to develop and improve their national nuclear and radiological emergency preparedness and response (EPR) capabilities. The objective of this cooperation is to ensure an adequate and coordinated EPR with appropriate preparations, procedures, people and equipment to deal effectively and safely with malicious acts involving radioactive materials. This includes conducting needs analyses and developing actions based on the identified and considered needs. The cooperative activities typically include tailored training courses, exercises and train-the-trainer workshops, which lead to the enhancement of responding agencies' capacity to sustainably deliver their own EPR program of training and exercises. The competence, experience and ability of individuals and teams to perform radiation monitoring, source search and recovery, dose reconstruction, and radiological assessment and advice is further developed and enhanced. Participants are from the national nuclear regulators and operators and in some circumstances the military, emergency services, and other government

agencies that would have roles and responsibilities for responding to a nuclear or radiological emergency. As part of the International Atomic Energy Agency (IAEA) Response and Assistance Network (RANET) ANSTO maintains Australia's accredited RANET team and through our regional cooperation we also enable and encourage partner agencies to work towards accreditation of their radiological emergency field assistance teams under the IAEA RANET [5]. This paper describes some of the activities and outcomes of ANSTO's emergency preparedness and response cooperation with counterparts in Indonesia, the Philippines, Malaysia, and Thailand.

2. Emergency Preparedness and Response Training - A Systematic Approach

The training aims to build sustainability within a country's or organisation's EPR capacity. To effectively achieve this aim, the methods of a Systematic Approach to Training (SAT) [6] are applied, including:

- identification of participant and organisational needs according to their roles, responsibilities, prior knowledge and experience;
- development of key learning areas and a course syllabus to satisfy the needs;
- development of specific learning outcomes for each session;
- content development;
- evaluation of content and its delivery; and
- continuous improvement.

As indicated in Figure 1, this approach provides a step-by-step, iterative process for the development and continuous improvement of training programs as a whole, as well as the constituent parts such as the needs analysis, develop syllabus, learning outcomes, and content topics. As each development step is conducted, outputs can be reviewed against the identified needs and the key learning areas. This allows feedback and improvement to be incorporated in the training material at each step of the development stage. This evaluation continues following training delivery, allowing the experience gained to further improve the content of such training to meet the needs of participants, including often changing or newly recognised needs.

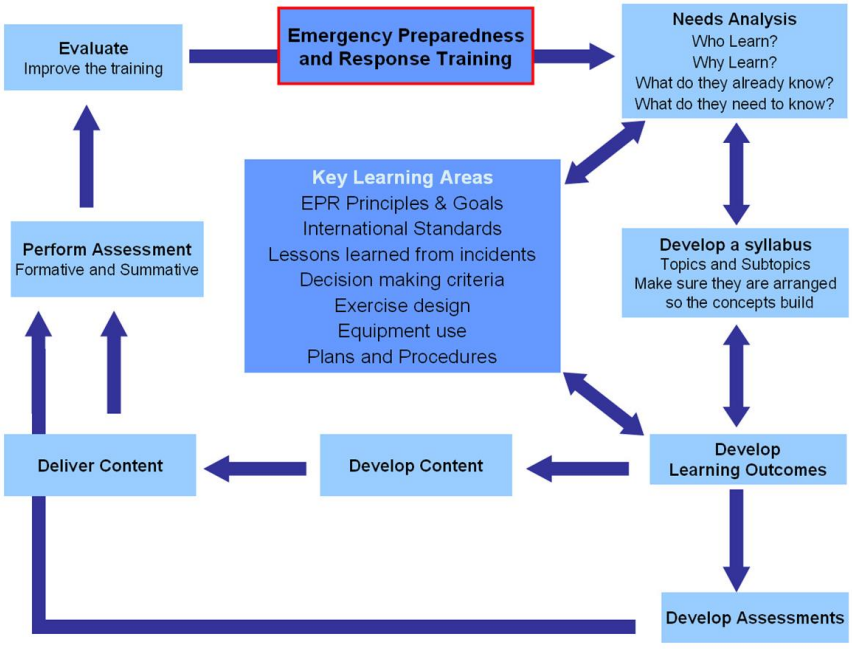

Figure 1: Systematic Approach to Training development loop.

Embedded in this process is the means for participants to identify their own needs and constraints at an individual professional level and to recognise how this relates to organisational or national EPR goals and arrangements.

The key learning areas that generally apply to enhance the knowledge, skills and experience of participants include:

- the goals, roles and responsibilities of EPR;
- the scope of a response structure needed for a malicious incident involving nuclear or radiological materials;
- the effective use of radiation detection equipment in such incidents;
- the relevant international guidance, decision-making criteria, and procedures; and
- training and exercise techniques.

Each of these areas can be covered by a complementary mix of lectures, tutorials, discussion sessions, and practical and tabletop exercises. A list of potential topics that ANSTO covers in an EPR syllabus is in Appendix 1. Additional topics are included if identified through needs analysis. The training includes lectures developed and adapted from IAEA guidance material giving the participants a detailed overview of EPR concepts and their application [5] - [10]; and lectures on radiation detection equipment and its effective use in response to malicious acts.

A set of competencies needed at each stage of an emergency response to a malicious act involving nuclear or radiological material has been developed as in Appendix 2. Each competency is a set of skills, knowledge and attitudes or behaviours required for an effective response by a person in a particular role and responsibilities (such as a Radiological Assessor). Practical exercises are designed to test these competencies using small radioactive sealed sources and short-lived radioactive contamination, including: (a) radiological exposure device (RED) search and recovery; (b) airborne radioiodine release from reactor sabotage; and (c) radiological dispersal device (RDD or "dirty bomb") incident. These exercises allow field assistance teams to practice radiation measurement, assessment and decision-making skills through the use of equipment and have clearly defined learning outcomes that describe what the learners should know or be able to do following completion of the exercise, thus demonstrating the associated competencies.

The RED search and recovery exercise provides training in some of the competencies important in dealing with uncontrolled radioactive sources, including those placed in public places with the intent to expose people to radiation. The focus is search techniques and the use of radiation detection equipment for locating and recovering radioactive sources. Participants are required to develop an effective plan for dealing with a RED incident by considering site features, equipment, survey design, people and tasks, and present it to the Exercise Controllers; to safely locate any radioactive sources, measure dose rates, to identify found sources and advise the Incident Commander (played by an Exercise Controller) of actions required to make the area safe from the radiological hazard. Following advice, if requested by the Incident Commander, participants safely recover any found radioactive sources. The measured dose rates are used to set dose constraints and the maximum exposure times. Source recovery should be practised to ensure any expected exposures for recovery personnel are minimised and kept within constraints.

The exercise on airborne radioiodine release from reactor sabotage is designed for participants to develop the competencies to monitor and assess simulated Iodine-131 airborne radioactivity (as a

marker radionuclide) and to recommend protective actions. Radiological assessors in the field assistance teams are required to effectively deploy monitoring teams to conduct measurements of simulated airborne Iodine-131 concentrations and to recommend protective actions based on the simulated monitoring results. Other field assistance team members gain an understanding of the monitoring team deployment procedures and practice the use of monitoring equipment and reporting results. Every participant has the opportunity to carry out each of these roles and practice accurate data transfer by radio communications.

The RDD incident exercise builds on the skills acquired by field assistance teams through conducting the RED and airborne release exercises. This exercise is designed for participants to develop the competencies to provide effective radiological advice to other responding agencies and support in dealing with uncontrolled radioactive material in a contaminated environment. The aim is for participants to assess the incident notification information and to then determine the field assistance team organisation's role and provision of support, provide radiological safety advice for the Incident Commander to protect responders and public at or leaving the scene, and make a plan to respond to the incident including transport, equipment and personnel considerations. At the incident scene participants are required to erect an inner cordoned area or "Hot Zone" barrier, locate and identify any radioactive sources, assess the radiological hazard, recover any items requested by the police and advise the Incident Commander on the precautions that all responders should take when working in the area. As part of the extended response phase, participants make the area safe from the immediate radiological hazard and when requested by the Incident Commander, safely recover any found radioactive sources. The field assistance teams' on-scene response is completed by briefing the Incident Commander on any further actions required (for example: transport and storage) and writing a debrief report describing advice given, actions taken and their justification.

A further method to identify national EPR needs and develop competencies is a tabletop exercise on the interoperability between radiological assessors and response agencies. This is a discussion exercise which identifies and reviews the roles, responsibilities and actions that organisations take in managing a radiological terrorist incident. The exercise provides participants with an opportunity to consider the application of international guidance in a national context and to better understand the roles, responsibilities, interfaces and procedures of other responding agencies. Participants review initial information regarding an incident and identify the nature of the radiological hazard; use national or IAEA guidance to recommend appropriate actions to protect responders and the public; demonstrate an understanding of the priority for life saving actions and any precautionary medical follow up; and consider the impact on the routine operations of emergency services by the presence of radioactive contamination or materials.

The practical and tabletop exercises reinforce the EPR principles and goals, highlighting key components required for a successful emergency response. These allow the participants to apply their knowledge and skills in an effective manner to the task of developing a competent field assistance team capability.

3. Emergency Preparedness and Response Cooperative Activities

Cooperation with South East Asian countries' agencies to develop, maintain and sustain their physical and human resources for EPR continues to be a priority. Partner agencies are developing and implementing the systematic approach to their own capacity-building and training, and exercise

design, conduct and evaluation for nuclear and radiological emergency preparedness and response focussed on security-related scenarios. The following provides recent examples of these cooperative activities.

3.1. Indonesia

Recent cooperation with the Indonesian National Nuclear Energy Agency, BATAN (Badan Tenaga Nuklir Nasional) includes a workshop in Serpong, Indonesia, in April 2011 to assess their needs and to understand the technical and organisational requirements necessary for a successful emergency response to a terrorist event. The workshop discussed and reviewed BATAN's current technical basis, experience and capacity to prepare for and respond to radiological terrorism, following international best practice. It also analysed the need and opportunities for enhancement of those EPR technical and organisational capabilities; determined the priority topics and methods to address these; and developed a cooperative work plan.

Implementation of the cooperation plan commenced with a workshop for BATAN radiological assessors in July 2011 at ANSTO in Sydney for senior BATAN staff. The workshop enhanced BATAN radiological assessors' expertise and capability, and provided suggested methods for preparing and presenting training programs and exercises aimed at BATAN field assistance team members and other emergency response agency personnel (Figure 2).

Figure 2: BATAN radiological assessors conducting practical exercises for security-related radiological incidents.

BATAN recognised the Systematic Approach to Training as an essential tool in assessing training needs and producing EPR training materials. BATAN identified priority radiological EPR areas for further development in terms of the Indonesian national situation and their organisational structure and operations, including the need to:

a) integrate the BATAN technical response arrangements with other Indonesian response agencies via the development and review of technical and procedural arrangements, training and exercises;

b) develop and maintain the knowledge, skills and equipment required for effective emergency response during security-related radiological incidents through a systematic competency based training program;

c) regularly implement training and preparedness exercises covering the range of security-related radiological scenarios for first responders and other responsible agencies;

d) develop plans and standard operating procedures to support the roles, responsibilities, coordination and interactions of all agencies involved in security-related radiological incidents, recognising BATAN's specialist technical competency base.

To facilitate some of these identified needs a cooperative workshop for BATAN field assistance teams was subsequently developed and conducted with BATAN staff. This workshop was held in November 2011 in Yogyakarta for health physicists and radiological assessors from each of the four BATAN operated sites at Bandung, Pasar Jum'at, Serpong, and Yogyakarta. Prior to the workshop, a structured cooperative needs analysis was conducted to identify what radiation detection equipment was required to complement and supplement BATAN's existing nuclear and radiological emergency response equipment capability. Equipment identified as a priority was donated by ANSTO and delivered for use by BATAN's field assistance teams. As the workshop progressed it was evident that the practical exercises improved participants' skills when using radiation monitoring equipment, employing search techniques and coordinating team activities to achieve an effective response (Figure 3).

Figure 3: BATAN field assistance teams conducting a RDD incident practical exercise, including conducting source search, contamination monitoring and source recovery.

Participants demonstrated good commitment and cooperation as part of a team to effectively apply the roles, responsibilities and expertise for field assistance teams and radiological assessors, consistent with identified competencies. BATAN recognised the need for ongoing internal site drills and activities to maintain their readiness and skills. They also demonstrated a more complete understanding of the roles and responsibilities of other agencies responding to an incident that is not on a BATAN site.

3.2. Philippines

Following ANSTO EPR workshops conducted in 2008 and 2009 with the Philippines Nuclear Research Institute (PNRI), they developed an instruction manual for their emergency response teams which we peer reviewed. It is based on IAEA guidance consistent with the development of competencies and operational requirements to support national response teams [10] - [13]. Using this instruction manual we conducted a *Train-the-Trainer Workshop on Emergency Preparedness and Response* at ANSTO in Sydney in August 2010 for senior staff from the PNRI. The success of this train-the-trainer workshop and the sustainability of the training provided are shown by PNRI developing and hosting their own EPR workshop for their *Radiological Emergency Monitoring and Control Teams (REMCON)* in Bataan, Philippines, in January 2011, where ANSTO provided peer review and further technical tuition. The workshop was successfully conducted by PNRI with good lessons learned and future additions proposed for the PNRI Instruction Manual for Radiological Emergency Monitoring and Control, with on-going ANSTO support and peer review.

As a result of the areas identified for improvement during this workshop PNRI developed an on-going schedule of training activities for their on-call response teams including: (a) equipment familiarisation training for all REMCON members and new trainees; (b) practical drills and exercises using live sources and contamination practicing using personal protection equipment and instrumentation to bring the exercise scenarios under control. We continue to support and peer review the PNRI REMCON Team training and exercises, most recently in Baguio City, Philippines, in February 2012, at which the PNRI response teams effectively designed and conducted three EPR exercises.

The Director of the Philippines Nuclear Research Institute acknowledged the benefit gained from international cooperation with the RSRS Project and the positive effects that contributed significantly to PNRI's ability in the Philippine's response to the Fukushima accident in Japan - "We wish to express our deep appreciation to the RSRS Project for all the technical assistance provided, for without which, the PNRI would not have responded as well to the Fukushima nuclear accident" [14].

3.3. Malaysia

The February 2010 cooperation with the Malaysian Atomic Energy Licensing Board (AELB) provided a practical introduction to nuclear and radiological emergency response within an all hazards emergency response system. The workshop developed and conducted exercises for radiological assessors and first responders to work together in security-related radiological incidents. Following this we returned to Selangor to conduct a second workshop hosted by AELB on *Nuclear and Radiological Emergency Preparedness and Response* in March 2011 as part of our ongoing cooperation program. Participants included experts from the AELB, the Malaysian Nuclear Agency (Nuclear Malaysia), Royal Malaysia Police, Department of Health, and the Chief Government Safety/Security Office. The workshop and exercises enhanced AELB and the other agencies' EPR

expertise and provided recognition of the coordination and command needed within an all hazards emergency response system. During this workshop the Fukishima incident was unfolding and this provided a poignant reminder of why agencies should prepare for emergency response situations and that the skills applied during security-related scenarios, particularly the airborne radioiodine release from reactor sabotage exercise, are the same that would be used to respond to a much larger event.

3.4. Thailand

In cooperation with the Thai regulator, the Office of Atoms for Peace, a workshop on *Emergency Preparedness Skill Augmentation for Radiological Assessors* was held in Rayong, Thailand in April 2010. This workshop included participants from the Office of Atoms for Peace, the Royal Thai Army Chemical Department, and the Department of Disaster Prevention and Mitigation. The workshop developed and conducted exercises for radiological assessors and first responders to work together in security-related radiological incidents. Following this ANSTO conducted a Train-the-Trainer Workshop on EPR at ANSTO in Sydney in July 2010 for senior staff from the Thailand Institute of Nuclear Technology and the Office of Atoms for Peace. This workshop focussed on their technical expertise and methods for development and delivery of EPR training to their own staff and other agencies who would respond to a malicious act involving nuclear or radiological material within Thailand. Using the skills and materials developed during this workshop Thailand successfully held a *National Radiation Emergency Exercise* in June 2011. The Thais demonstrate good self-sufficiency and sustainability of EPR resources and infrastructure.

4. Conclusions

The cooperation on security-related nuclear and radiological emergency preparedness and response training and capability development in South East Asia has:

a) enhanced the relevant regional, national and local agencies' relationships,
b) improved expertise on radiation detection equipment for a range of potential emergency situations,
c) provided for better identification, development and implementation of emergency response roles, responsibilities and procedures including appropriate decision-making criteria, and
d) improved integration of the radiological response into an all hazards approach and related inter-agency interoperability.

Further, through the application of Systematic Approach to Training methods, the cooperation has:

e) increased the local maintenance, development and self-sustainability of resources and expertise,
f) enabled national needs identification and development of appropriate local training courses and exercises, and development of related materials and techniques to address those needs,
g) improved testing of the effectiveness of EPR manuals and procedures, and
h) enabled systematic assessment and review, with lessons learned incorporated to ensure continuous improvement of agencies' EPR capabilities.

Viewed from individual, organisational and national perspectives, the cooperation contributes to the capability and willingness to support responses to any nuclear or radiological incident, either safety or security-related, within South East Asian countries. Such shared capabilities and willingness engenders mutual confidence, trust and understanding within the region on nuclear programs generally.

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Appendix 1 – EPR Topics

Fundamentals

a) Goals of emergency response
b) Expected phases of a response (including relevance to on- and off-site operations)
c) Lessons learned in radiological incidents
d) Overview of the IAEA First Responder Manual
e) Overview of roles of First Responders
f) Role of Incident Commander (what the radiological assessor can expect)
g) Role of Radiological Assessor (on- and off-site)
h) Radiation monitoring and air sampling instrumentation
i) First Responder decontamination monitoring of people and equipment
j) Emergency medical and field triage of casualties Basic plume modelling and calculations
k) ERAIMS: Plume modelling software and the ANSTO experience
l) Monitoring team deployment principles (airborne I-131 as an example)
m) Exercise Planning
n) RANET – a benchmark

Criteria and Procedures

a) Generic and Operational Intervention Levels (GILs and OILs)
b) EPR Plans
c) Introduction to dose assessment (Section E of TECDOC 1162 as an assessment resource)
d) Managing radiological response: Procedure D0 from TECDOC 1162
e) Source recovery / removal: Procedure D1 from TECDOC 1162
f) Decontamination of people and equipment: Procedure D2 from TECDOC 1162
g) Removal of radioactive wastes: Procedure D3 from TECDOC 1162
h) Tutorials for each of the above criteria and procedures sessions

Train-the-Trainer a) Learning Outcomes b) Structure & Assessment c) Exercise Planning: review of target audience and competencies d) Competency review and propose outline of classroom and exercise training (Who? What? How? Why?) e) Devise an exercise (practical or tabletop) for a future workshop f) How to evaluate an exercise	*Exercises* a) Radiological exposure device (RED) search and recovery practical exercise b) Airborne radioiodine release from reactor sabotage practical exercise c) Radiological dispersal device (RDD or "dirty bomb") incident practical exercise d) Interoperability between radiological assessors and response agencies tabletop exercise e) Debrief and a review of learning outcomes following each exercise

Appendix 2 – Competencies

Summary list of essential (E) and desirable (D) competencies for the radiological assessors (RA) and other field assistance team (FAT) members [5] - [10].

	Competencies	RA	Other FAT
1.	Follow organisational Standard Operating Procedures relating to support for a malicious act involving nuclear or radiological material.	E	E
2.	Obtain and assess the information required to determine the support the field assistance team organisation can provide.	E	E
3.	Confirm the field assistance team's role in support to external agencies.	E	E
4.	Identify and assess the potential hazards from uncontrolled nuclear or radiological material.	E	E
5.	Select equipment and PPE for use by the field assistance team.	E	E
6.	Identify and recommend protective actions from nuclear or radiological hazards for responders and members of the public (National or IAEA guidance).	E	D
7.	Internal communications are accurate, timely and understandable.	E	E
8.	Communicate advice and information to the Incident Commander or designee, in simple understandable terms.	E	D
9.	Ensure that the safety of field assistance team members from non-radiological hazards is covered by the on-scene arrangements (e.g. fire, explosives, etc).	E	D
10.	Effective use of radiation monitoring equipment.	E	E
11.	Determine and implement radiation monitoring to support the response.	E	D
12.	Ensure inner cordoned area meets national/IAEA criteria.	E	E
13.	Conduct radiological protection procedures for all people and equipment entering and leaving the affected area.	E	E
14.	Assess identified hazards based on measurements from uncontrolled nuclear or radiological material.	E	D
15.	Plan and implement safe recovery of identified nuclear or radiological material.	E	E
16.	Identify and implement storage and transport requirements for nuclear or radiological material and waste.	E	D
17.	Produce reports as soon as possible after termination of deployment.	E	-