

## **REFLECTIONS ON REGIONAL TRAINING EFFORTS IN SUPPORT OF NUCLEAR FORENSIC CAPABILITY DEVELOPMENT IN SOUTH-EAST ASIA**

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### **Abstract**

Many countries in South-East Asia are seeking to develop or enhance capabilities in nuclear forensics. This is part of an overall strengthening of nuclear security architectures in response to increased use of nuclear and other radioactive materials regionally and globally. As a result, there is substantial demand in the region for training and other capability development support. With over two decades of experience in nuclear forensics, Australia is well placed (both geographically and technically) and frequently sought to provide some of this support. On behalf of Australia, ANSTO has provided a range of tailored multi- and bi-lateral training programs to regional partners both independently and in partnership with international bodies such as the International Atomic Energy Agency (IAEA). These programs have utilised a range of training modalities including classroom instruction and practical activities such as table-top exercises and hands-on laboratory and field drills. Whilst activities are led by a team of dedicated nuclear forensic staff, subject matter experts from across ANSTO who provide technical expertise to the national nuclear forensic capability play a key role in delivering training. Further, ANSTO seeks to work with external domestic partners, such as the Australian Federal Police (AFP), to provide high quality activities which are relevant to operations demands. A comprehensive process of continuous review and improvement is a hallmark of ANSTO's training activities. Detailed feedback is sought from both participants and trainers, which is incorporated into after-action reports which seek to identify trends and articulate opportunities for improvement in future activities.

### **1. INTRODUCTION**

As a signatory to INFCIRC No.917 'Joint Statement on Forensics in Nuclear Security', Australia has undertaken to "advance and mature nuclear forensic expertise in other countries through efforts such as providing instruction at or hosting international conferences" [1]. In fulfilling this undertaking, ANSTO (on behalf of Australia) has provided a range of tailored multi- and bi-lateral training programs both independently and in partnership with international bodies such as the International Atomic Energy Agency (IAEA). The focus of efforts to date has been the many countries in South-East Asia which are seeking to develop capabilities in nuclear forensics. This forms part of an overall strengthening of nuclear security architectures in response to increased use of nuclear and other radioactive materials regionally and globally. In addition to a desire to enhance security in partner nations, Australia recognises that regional nuclear security promotes national security.

With over two decades of experience in nuclear forensics (the current status and future plans of Australia's nuclear forensic capability have been described elsewhere [2]), ANSTO is well placed to provide nuclear forensics training. Such practical experience enables ANSTO to deliver upon the guidance of the IAEA that "technical training and human capital development should encompass the complexities of nuclear forensics as a component of preventive measures and as a capability for response" [3]. Just as nuclear forensics is complex, so too is the delivery of fit-for-purpose training to reflect this. Some of the lessons and best practices learned by ANSTO in the delivery of these training activities have been described previously [4]. The paper seeks to elaborate on some key facets of the training program not previously related in the literature.

## 2. EXAMPLES OF NUCLEAR FORENSIC TRAINING IN SOUTH-EAST ASIA

Table 1 provides some examples of nuclear forensic training activities delivered by ANSTO in South-East Asia. These programs have utilised a range of training modalities including classroom instruction and practical activities such as table-top exercises and hands-on laboratory and field drills. The diversity of topics covered reflects the broad scope of subject areas the IAEA recognises as critical when it is observed that “training is an essential component of a sustainable programme in nuclear forensics by providing essential information on the requirements of an investigation of a nuclear security event, recommended methods for analysis and interpretation, and the role of nuclear forensics in a State’s nuclear security infrastructure” [3].

TABLE 1. EXAMPLES OF NUCLEAR FORENSIC TRAINING ACTIVITIES DELIVERED BY ANSTO IN SOUTH-EAST ASIA

	BATAN, Indonesia	IAEA Regional Training Course on Practical Introduction to Nuclear Forensics	Ministry of Home Affairs, Singapore
Who	Indonesia’s national nuclear energy agency	Participants from Indonesia, Malaysia, Thailand, Vietnam, New Zealand, Philippines, Singapore and Australia (Figure 1 shows participants from the 2019 offering)	Ministry of government which includes Police, Civil Defence Force and Office of the Chief Science and Technology Officer
Context	Supported by the Australian Department of Foreign Affairs and Trade Australia-Indonesia Security Cooperation program	Part of a program of nuclear forensics training offered by the IAEA	Funded by Singapore’s Ministry of Home Affairs
Key content	<ul style="list-style-type: none"> <li>Establishment of a nuclear forensics capability (including the development of interagency relationships)</li> <li>Nuclear forensic analytical planning</li> </ul>	<ul style="list-style-type: none"> <li>Nuclear forensics laboratory analysis</li> </ul>	<ul style="list-style-type: none"> <li>Radiological crime scene management</li> <li>Nuclear forensics laboratory analysis</li> </ul>
Delivery modalities	<ul style="list-style-type: none"> <li>Workshops</li> <li>Table-top exercise</li> <li>Documents</li> </ul>	<ul style="list-style-type: none"> <li>Presentations</li> <li>Table-top exercise</li> <li>Practical laboratory activities</li> </ul>	<ul style="list-style-type: none"> <li>Presentations</li> <li>Table-top exercises</li> <li>Practical activities (laboratory and crime scene)</li> </ul>



FIG. 1. Participants in the 2019 IAEA Regional Training Course on Practical Introduction to Nuclear Forensics, pictured with ANSTO CEO Dr Adi Paterson and course staff.

### 3. LEVERAGING EXISTING CAPABILITIES TO DELIVER OUTCOMES

Nuclear forensics training offered by ANSTO emphasises the importance of leveraging existing capabilities within a nation for the development of a robust and sustainable national nuclear forensic capability. This paradigm is also applied to the delivery of training. Whilst activities are led by a team of dedicated nuclear forensic staff, subject matter experts from across ANSTO who provide technical expertise to the national nuclear forensic capability play a key role in delivering training. For example, during the IAEA Regional Training Course on Practical Introduction to Nuclear Forensics experts in techniques such as gamma and alpha spectrometry, radiochemistry and scanning electron microscopy delivered presentations and practical activities which complemented the modules on physical examination and traditional forensics delivered by nuclear forensics staff. For the nuclear forensic staff (many of whom are early career scientists) and subject matter experts these courses provide a valuable professional development opportunity, enhancing their skills the design and delivery of training. Training activities also provide a valuable opportunity for scientists to reflect upon and enhance technical capabilities, as well as build international networks.

Utilising enabling functions within ANSTO such as security, safety, international relations and event management is also critical to the success of these training activities. Further, ANSTO seeks to work with external domestic partners. Building upon an existing operational partnership, fingerprint experts from the Australian Federal Police (AFP) have collaborated with ANSTO nuclear forensics staff to deliver the traditional forensic module of the IAEA Regional Training Course on Practical Introduction to Nuclear Forensics participate. This collaboration enables the delivery of high quality activities which are relevant to operations demands, whilst also demonstrating the importance of such partnerships in national nuclear forensic capability development. Some training activities have been made possible by funding from the Australian Government Department of Foreign Affairs and Trade. Drawing together these diverse parties provides a real-world demonstration to training participants of the importance of development of relationships with diverse domestic stakeholders both within and outside their organisation; in a similar spirit ANSTO strongly encourages multi-agency participation in training activities. It is also a pragmatic measure; it would be resource prohibitive for ANSTO to rely solely on dedicated nuclear forensic staff to deliver such activities.

In addition to ANSTO, there are numerous providers of nuclear forensic capability development activities in South-East Asia globally. International entities such as the IAEA, INTERPOL, the Global Initiative to Combat Nuclear Terrorism (GICNT) and the Nuclear Forensics International Technical Working Group (ITWG) all have important capability development roles, as do national or regional bodies such as the United States' National Nuclear Security Administration and the European Union's Joint Research Centre among others. Key challenges moving forward will continue to be ensuring the most efficient deployment of these many, but ultimately finite, efforts and achieving consistency in content and messaging whilst still respecting the unique contexts, perspectives and relationships of the various providers and participants. As international efforts in nuclear forensics training continue to grow coordination of effort may benefit from a formal consultation process, although a mechanism by which this may occur is as yet undetermined.

### 4. CONTINUOUS REVIEW AND IMPROVEMENT

A comprehensive process of continuous review and improvement is a hallmark of ANSTO's training activities. Detailed feedback is sought from participants using feedback forms, an example of which is given in Figure 2. From these results, the participants' self-assessed gain in knowledge is calculated from the difference between their understanding before and after completing the unit. This metric can be easily presented visually (see Figure 2), enabling at-a-glance assessment of unit performance. Feedback is also sought from trainers, typically through structured interviews or e-mails.

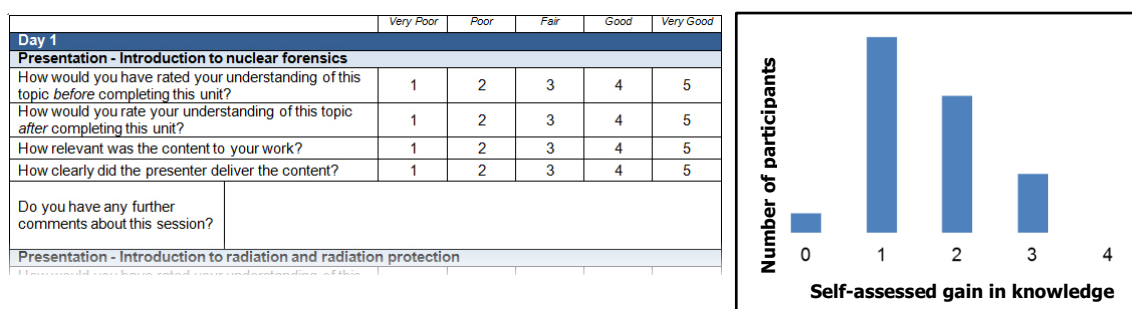


FIG. 2. Examples of a feedback form for an individual unit in a training course (l) and a visual presentation of the participants' self-assessed gain in knowledge (r).

All feedback collected is incorporated into comprehensive after-action reports which seek to identify trends and articulate opportunities for improvement in future activities. These reports address not only the academic components of a course but also the logistics of its implementation, which have often been highly complex (e.g. participants from multiple States or training delivered abroad). The anonymous participant feedback is shared with the ANSTO staff involved in the course. Receiving feedback which articulates how participants will take the learning from this course and apply them to their role encourages trainers to be involved in future training activities. The identification of both strengths and opportunities for improvement in the training further enhances the professional development value for ANSTO staff of supporting these courses. Aspects of the after-action report may also be shared with training delivery partners such as the IAEA. When there have been opportunities for repeat implementations of some activities, such as the IAEA's Regional Training Course on Practical Introduction to Nuclear Forensics, substantial changes have been made in response to feedback. For example, the program of this course was completely restructured for the second iteration of this course at ANSTO (see Table 2). Changes included reducing the amount of content covered on the first day when participants remain fatigued from travel, interspersing practical activities with classroom content and grouping practical modules to more closely reflect the workflow of a nuclear forensic examination. The value of this feedback process has been clearly evident in the improved quality of both the training delivered and the experience for trainers.

TABLE 2. ORIGINAL AND REVISED PROGRAMS FOR THE IAEA REGIONAL TRAINING COURSE ON PRACTICAL INTRODUCTION TO NUCLEAR FORENSICS HOSTED BY ANSTO

	Original Program		Revised program	
	Morning	Afternoon	Morning	Afternoon
Monday	Classroom lectures	Classroom lectures Table top exercise	Classroom lectures	Classroom lectures Table top exercise
Tuesday	Practical Activities A <sup>1</sup>	Practical Activities B <sup>2</sup>	Practical Activities A	Practical Activities A
Wednesday	Practical Activities A	Practical Activities B	Practical Activities A	Classroom lectures
Thursday	Practical Activities A	Practical Activities B	Practical Activities B	Practical Activities B
Friday	Table top exercise Classroom lectures		Practical Activities B	Table top exercise

<sup>1</sup> Practical Activities A include Physical Examination, Traditional Forensics and Radiochemical Sample Preparation

<sup>2</sup> Practical Activities B include Gamma Spectrometry, Alpha Spectrometry and Scanning Electron Microscopy

## 5. CONCLUSIONS

The provision of tailored fit-for-purpose nuclear forensics training to regional partners is, and will remain, a key component of the remit of ANSTO's nuclear forensic capabilities. Demand from these partners increases in lockstep with the increased use of nuclear and other radioactive materials worldwide. With such growing demand, it is critical that ANSTO makes efficient use of resources to deliver training and utilises a process of continuous improvement to deliver programs which best contribute to enhanced regional nuclear security.

## ACKNOWLEDGEMENTS

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