



Nuclear Forensics Case Studies

IAEA Regional Training Course on Practical
Introduction to Nuclear Forensics

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Science. Ingenuity. Sustainability.

Objectives

- Describe Australian operational nuclear forensics cases
- Identify key lessons learned from Australian operational nuclear forensics cases



University dormitory, ACT



Background

- University student called an ambulance to his dorm room, complaining he was feeling unwell after he dropped a beaker of what he said was cyanide
- The response included:
 - Evacuation of several hundred residents
 - Bomb Squad attendance



Items Seized



Images courtesy
of ANSTO

ANSTO

Items Seized



Images courtesy
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Findings

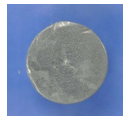
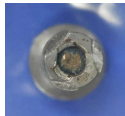
59 Dealing with regulated radiation source without licence

(2) A person commits an offence if—

- (a) the person deals with a regulated radiation source; and
- (b) the dealing by the person is not authorised under a licence in relation to the radiation source; and
- (c) the person, in dealing with the radiation source is negligent about whether—
 - (i) the radiation source is a regulated radiation source; or
 - (ii) the dealing by the person is not authorised under a licence in relation to the radiation source.

Maximum penalty: 500 penalty units, 1 year imprisonment or both.

Radiation Protection Act 2006



2.57×10^4 Bq ($\pm 5\%$) of
Am-241

Similar to Am-241 sources
found in commercial
ionisation-type smoke
detectors

Images courtesy
of ANSTO



Outcome

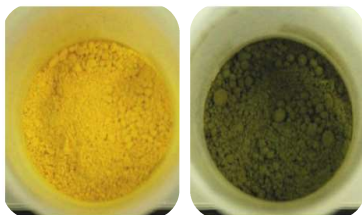
- The offender plead guilty to negligently dealing with a regulated radiation source without licence contrary to Section 59(2) of the *Radiation Protection Act 2006* (ACT)
- He received a non conviction order
- Media coverage highlighted the presence of radioactive material at the crime scene



Storage facility, Victoria



Background



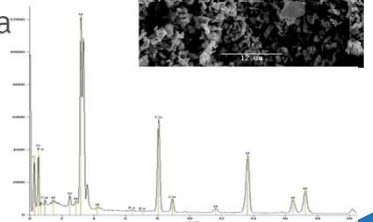
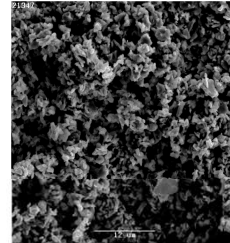
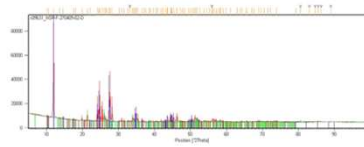
- Several sites, including clandestine drug laboratories, were raided during police investigations in 2009
- Two uranium samples (~100g) were seized along with various glassware and chemicals
- Suspect refused to divulge why he possessed uranium
- Initially charged with conducting a radiation practice without a licence - an offence carrying a \$180,000 fine - in addition to drug offences
- Attracted significant media attention

Images courtesy
of ANSTO



The analysis

- Samples were depleted in ^{235}U
- Samples contained ^{232}U and ^{236}U indicating the material had been in a nuclear reactor
- Chemical form of each sample indicated different production history
- Materials did not originate in Australia
- Country of origin was an advanced nuclear state (e.g. former Soviet Union)
- Depleted uranium has many legitimate uses so it was likely imported legally before falling out of regulatory control



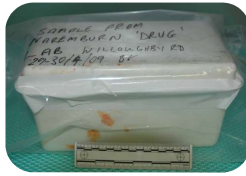
Images courtesy of ANSTO

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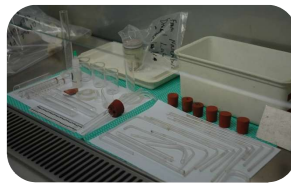
Clandestine drug lab, NSW

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Background



A white plastic tool box was seized by police during a raid of a clandestine drug laboratory



Amongst the laboratory glassware and equipment was a jar labelled 'Gamma Source' containing ~43 g of a green/grey powder

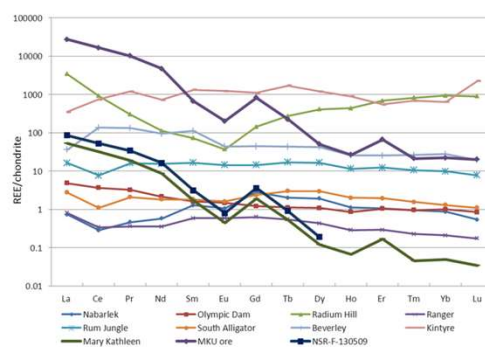


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The analysis

- The sample was found to be a natural uranium ore concentrate – the product of the first step in the processing of uranium after mining



- It likely came from Mary Kathleen, a now-closed uranium mine in northwest Queensland
- It is unknown how the material came to be in the clandestine laboratory

Image courtesy of ANSTO

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An uncharacterised pellet



Background

- A glass jar containing a pellet and some fragments was received by ANSTO with a request to:
 - identify the radioactive material
 - determine the provenance of the sample

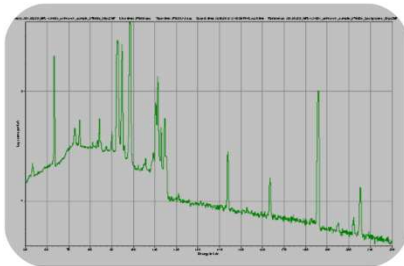


Images courtesy
of ANSTO



The analysis

- The pellet had been damaged but one end was clearly concave
- The density of the material was close to that of UO_2



- The material was natural uranium, with no evidence of neutron irradiation
- The material was of high purity

Images courtesy
of ANSTO



The interpretation

- Utilised recollection of long-term staff and historic reporting
- The pellet was similar to those produced between the mid 1970s and early 1980s as part of the fuel fabrication research program at what was then known as the Australian Atomic Energy Commission
- The possibility that it originated from another research institute undertaking similar programs could not be excluded



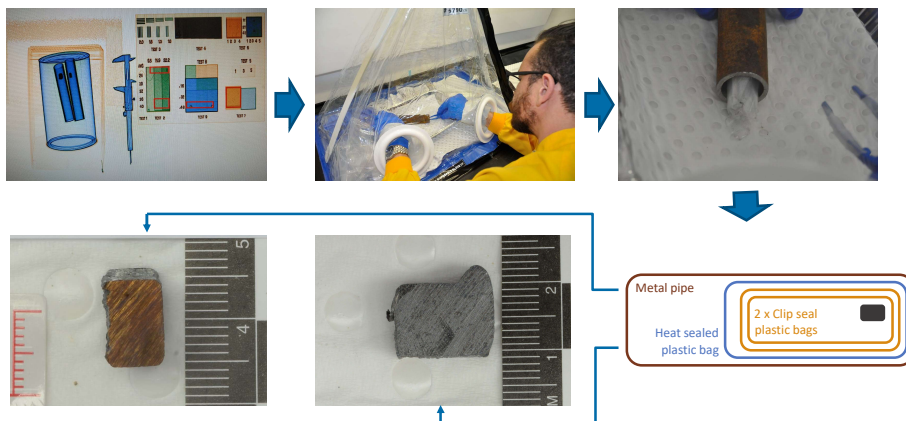
Images courtesy
of ANSTO



CMX-6



Unpacking the evidence



Images courtesy
of ANSTO/AFP



Fingerprint examinations

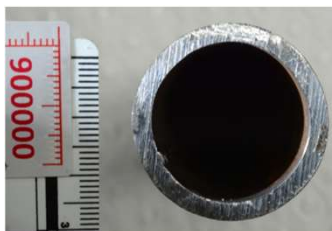


Fingerprints
linked two of
the samples

Images courtesy
of ANSTO/AFP

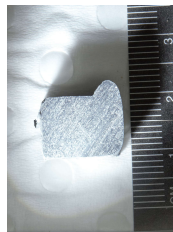
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Tool mark examination



Pipes were cut using
straight bladed
mechanical saws – not
possible to determine
if both were cut with
the same saw

Sources were cut with a
high speed cutting or
grinding tool; not possible
to determine if both were
affected by same cutting
or grinding tool



Images courtesy
of ANSTO/AFP

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LESSONS LEARNED



Image from Unsplash





Partnerships and collaborations

Image from Pexels



Differences in culture and perspective



Image from Pixabay





Image from Pixabay

Exercise

