ITWG Nuclear Forensics International Technical Working Group

ITWG
NUCLEAR FORENSICS
UPDATE
Special issue, April 2022

CHAIRPERSONS' ADDRESS

Welcome to a special edition of the Nuclear Forensics International Technical Working Group (ITWG) newsletter, the ITWG Update. This edition reflects a real-world collaboration among ITWG members to investigate radioactive materials discovered outside of regulatory control (MORC). The case study will be presented at the International Atomic Energy Agency (IAEA) Technical Meeting on Nuclear Forensics in April 2022, and we hope those presentations along with the article in this newsletter will illuminate some of the challenges, opportunities and lessons learned when investigating incidents of MORC. In addition, we hope that the collaboration among nuclear forensics investigators that is reflected in this edition and fostered through ITWG activities will inspire the types of transnational collaboration that is needed to address MORC-related threats. Finally, we thank the authors—experts from the German Bundesamt fuer Strahlenschutz, the Dutch regulatory body ANVS, the Nigerian Nuclear Regulatory Authority, and the IAEA Incident and Emergency Center—for sharing their experiences and insights, and we hope they will help inform best practices that can be shared more broadly among international practitioners and captured as appropriate in international guidance.

With best regards,

Klaus Mayer and Michael Curry

INTERNATIONAL RESPONSE TO A MULTI-INCIDENT CASE OF HIGH-ACTIVITY CO-60 SEALED SOURCES FOUND OUTSIDE OF REGULATORY CONTROL

JENS-TAREK EISHEH, VITALY FEDCHENKO, MARTIJN DE MEULMEESTER, KILIAN SMITH, SAIYADI SULAIMAN, NICO VAN XANTEN AND ED VAN ZALEN

DETECTION

Metal recycling companies and the customs authorities, the Netherlands

On 13 November 2018 five highly active encapsulated (sealed) sources were discovered in one scrap metal cargo container that had been shipped from Nigeria. The discovery was made using portal monitors at a metal recycling company in the central Netherlands. The cargo containers displayed an on-surface dose rate of 50 mSv/h. The five cylindrical metal capsules of approximately 10 cm long and 1.5 cm in diameter had an activity of about 25 GBq per source and radiation levels of 7 Sv/hr at the surface. Gamma spectrometry indicated that the sources contained Cobalt-60 (Co-60). Three more radioactive sources of the same type as those found in the scrap metal shipment from Nigeria were found in the port of Rotterdam on 28 January 2019, and a further capsule was found on 7 March 2019.

Big scrap metal companies in the Netherlands hold a license issued by the Dutch Authority for Nuclear Safety and Radiation Protection (Autoriteit Nucleaire Veiligheid en Stralingsbescherming, ANVS) to handle radioactive contamination in scrap metal under pre-agreed conditions. Licensed companies must follow the protocols on the proper handling, separation and disposal of radioactive contamination in respect of both radiation protection and security. Such companies must notify the ANVS when highly active sources are found, at which time the ANVS may impose additional measures. In these incidents, the ANVS was notified after the portal monitors set off an alarm but high radiation levels complicated further characterization. At the request of the ANVS, the Explosive Ordnance Disposal Service photographed the encapsulated sources using robots.[1] The ANVS noted that the cargo manifest for the first shipment

[1] The Explosive Ordnance Disposal Service is part of the Dutch Ministry of Defence.

Continued page 3

13 Nov. 2018

Netherlands
Five sealed (encapsulated) Cobalt-60 (Co-60) sources shipped from Nigeria are found at a scrap metal company in the central Netherlands. Activity is 25 GBq per source.

Nigeria
The NNRA receives notification from the ANVS that a container of scrap metal originating from Nigeria has been found with encapsulated Co-60 sources.

15 Nov. 2018

Netherlands
The ANVS reports to the IAEA ITDB that the five radioactive sources have been taken under regulatory control.

28 Nov. 2018

Nigeria
The NNRA and the Explosives Ordinance Division of the Nigerian Police carry out an investigative inspection at a scrap metal company in Lagos.

11 Jan. 2019

Germany
One sealed Co-60 source, similar to the ones found in the Netherlands, is found in Hamburg as part of a scrap metal shipment originating from Nigeria. Activity is approximately 25 GBq.

28 Jan. 2019

Netherlands
Three sealed Co-60 sources are discovered in the port of Rotterdam among scrap metal shipped from Nigeria.

Netherlands
The ANVS reports to the IAEA ITDB that the three radioactive sources have been brought under regulatory control.

29 Jan. 2019

Nigeria
The IAEA Incident and Emergency Centre reaches out to the NNRA regarding an incident reported by the ANVS linked to the sources discovered on 28 Jan. 2019 in a scrap metal shipment originating from Nigeria.

30 Jan. 2019

Netherlands
The ANVS reports the three radioactive sources discovered on 28 Jan. 2019 to USIE and ECURIE.

Jan. 2019

Nigeria
The NNRA and Nigeria's Department of State Service conduct an investigative inspection at a scrap metal company in Lagos.

7 Feb. 2019

Germany
The German authorities report to USIE the discovery of the radioactive source found on 11 Jan. 2019.

14 Feb. 2019

Germany, IAEA
Germany's ITDB point of contact reports to the IAEA ITDB that the source discovered on 11 Jan. 2019 has been brought under regulatory control.

7 Mar. 2019

Netherlands
One sealed Co-60 source is found in scrap metal from Nigeria by the customs authorities in the port of Rotterdam.

11 Mar. 2019

Netherlands
The ANVS reports the source found on 7 Mar. 2019 to USIE and ECURIE.

12 Mar. 2019

Netherlands
The ANVS submitted an Incident Notification Form (INF) on the source found on 7 Mar. 2019 to the ITDB.

21 Mar. 2019

Netherlands
The ANVS posts to USIE an EMERCON Request for Information about the discovered dangerous sources.

21 May 2019

Nigeria
Nigeria requests assistance in the form of a Fact Finding Mission by the IAEA.

4–7 June 2019

IAEA, Netherlands, Germany and the United Kingdom
An IAEA Assistance Mission is conducted in Nigeria by experts from the IAEA, the Netherlands, Germany and the United Kingdom.

June 2019

Germany
The German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection asks the Federal Office for Radiation Protection to initiate a nuclear forensics examination.

Netherlands
The Netherlands State Prosecutor becomes involved.

Jan. 2020

Germany
The source is retrieved from a secure storage location by the Federal Office for Radiation Protection and taken to the Radio Chemistry Munich (RCM) laboratory in Germany for a nuclear forensic examination.

12 July 2021

Germany
The Federal Office for Radiation Protection submitted to the ITDB an update incident report containing the forensic analysis report on the seized Co-60 source.

Sept. 2021

Netherlands
The Dutch State Prosecutor concludes that no criminal offence related to the Co-60 sources took place in the Netherlands.

Figure 1. Timeline of events

ANVS = Autoriteit Nucleaire Veiligheid en Stralingsbescherming (Dutch Authority for Nuclear Safety and Radiation Protection); ECURIE = European Community Urgent Radiological Information Exchange; IAEA = International Atomic Energy Agency; ITDB = Incident and Trafficking Database; NNRA = Nigerian Nuclear Regulatory Authority; USIE = Unified System for Information Exchange in Incidents and Emergencies.

Notes: Encapsulated means that this source contains multiple sealed sources enclosed in one casing. EMERCON is a descriptor referring to the official system for issuing and receiving notifications, information exchange and assistance provision through the IAEA's Emergency Response Centre in the event of a nuclear or radiological emergency.

International Response to a Multi-incident Case… *continued from page 1*

Figure 2. Co-60 source discovered in the Netherlands. Credit: ANVS.

Figure 3. Co-60 source discovered in the Netherlands: Number on the bottom. Credit: ANVS.

was incorrect. (Most notably, the cargo was declared free of radioactive materials.) All three incidents were treated as unauthorized shipments of radioactive material that began outside of the Netherlands. There was no suspicion of illicit trafficking or malicious use. The State Prosecutor concluded that no criminal offence had taken place inside the Netherlands (see figures 2 and 3).

Hamburg, Germany

In January 2019 a scrap metal shipment caused a radiation portal alarm in Hamburg. The dose rate measured on the container surface was 68 mSv/h, which is far above the German legal limit of 0.005 mSv/h for normal packages and well over the highest permissible level of 10 mSv/h for the transportation of radioactive material under special licence.

The relevant competent authority—the Hamburg Authority for Justice and Consumer Protection (Behörde für Justiz und Verbraucherschutz der Freien und Hansestadt Hamburg, BJV)—was informed of the discovery. The BJV concluded that regulations had been breached and a radiation protection company (a qualified private contractor) was called in to find the source of the radiation. The radiation protection company moved the container to a location where the material could be safely examined. A small capsule similar in size to those found in the Netherlands was found to be the source of the radiation. The radiation protection company separated the capsule from the remaining (non-radioactive) scrap, placed it in a transport container (Type A-package) and transported it to a designated interim storage facility under the control of the BJV (see figures 4 and 5). The activity inside the capsule was roughly estimated to be similar to activity inside the capsules found in the Netherlands (25 GBq of Co-60 as of January 2019). Contamination checks were carried out at the site where the scrap was separated and no contamination was found. Regulatory control over the material was

Figures 4 and 5. The use of the Type A container for shipping the Co-60 source found in Hamburg

Continued page 4

International Response to a Multi-incident Case... *continued from page 3*

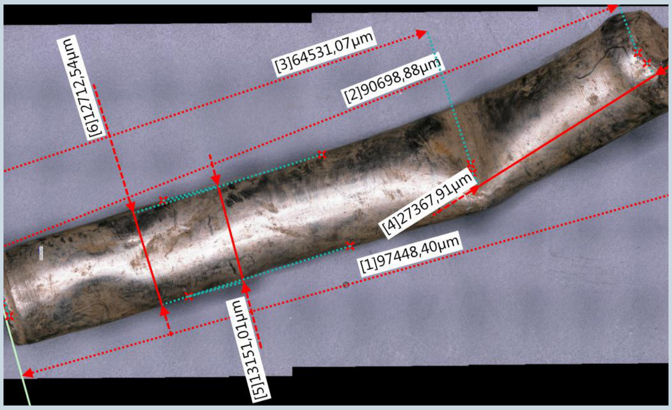

Figure 6. Co-60 source discovered in Hamburg and its dimensions. Credit: BfS.

Figure 7. Co-60 source discovered in Hamburg: Number at the bottom. Credit: BfS.

re-established at this point. The measures to secure the source and restore regulatory control were paid for by the scrap metal importing company.

RESPONSE

Response by the Netherlands: Basic characterization, reporting and disposal

The ANVS conducted a basic characterization of the sealed sources and reported the incidents internationally (see the timeline in figure 1).

The ANVS made several attempts to establish the origin and use of the sources. A match for the sources could not be found in the IAEA International Catalogue of Sealed Radioactive Sources (ICSRS) or in the Incident and Trafficking Database (ITDB). No similar sources have been reported found or missing to the ITDB in the past decade. Specific suppliers contacted by the ANVS and the International Source Suppliers and Producers Association were unable to identify the origin of the sources

The ANVS considered the source geometry and the numbers on the sources indicative of irradiator geometry. A typical irradiator might contain from under 50 to up to 200 source bars. The fairly low level of activity per source probably indicates that they are several decades old, as a higher level of activity might normally be expected.[2] There are concerns that other sources from the same origin may still be circulating in the metal recycling industry.

Once regulatory control over the radioactive sources had been re-established, the ANVS instructed the companies to hand them over to the national radioactive waste depository (Centraal Opvangorgaan voor Radioactief Afval, COVRA).[3] The stored radioactive sources remained available for further examination until the summer of 2021. The costs of securing the sources and restoring regulatory control were covered by the scrap metal importing companies.

Response by Germany: Nuclear forensic investigation

The January 2019 discovery of a Co-60 source in Hamburg was reported to the German law enforcement network and the Hamburg police launched an investigation. The find was also reported to the ITDB and the IAEA Unified System for Information Exchange in Incidents and Emergencies (USIE). The German authorities discovered from communications with the ITDB points of contact and separately with the European regulatory authorities that nine similar sources had been found in scrap metal shipments to the Netherlands. Consultations between the BJV, the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the Federal Office for Radiation Protection (BfS), which maintains the German national register of high-activity sealed sources, led to the conclusion that there might be more capsules with similar levels of activity, which would pose a danger to public health.

A nuclear forensics examination was considered the best way to obtain the further information required to curtail that danger. The BMUV asked the BfS to plan a nuclear forensics examination.

[2] This could explain why a full characterization has to date proved unsuccessful.

[3] It is the policy of the Netherlands to collect all radioactive waste and unused sources, and store these under regulatory control at COVRA.

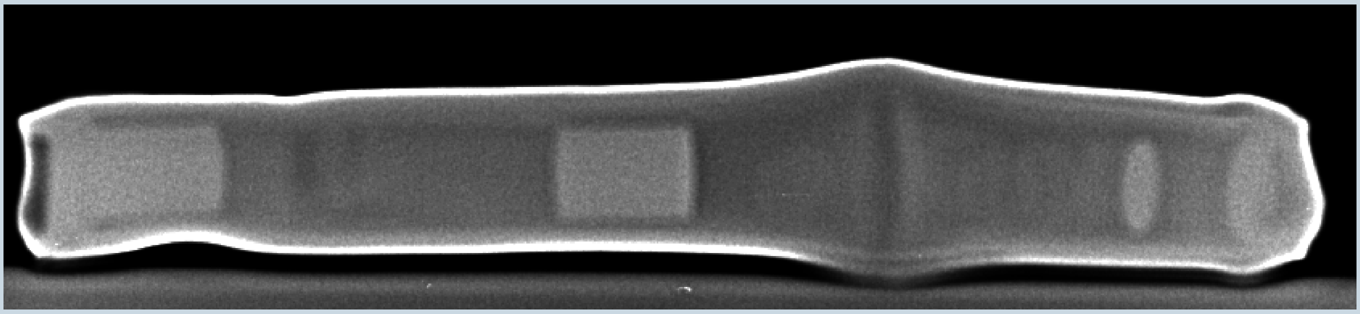

Figure 8. Radiography image of the Co-60 source discovered in Hamburg. Credit: BfS.

Nuclear forensics examination in Germany

The goal of the examination was to find information about the sources that could be used to establish who manufactured them, their intended purpose and in what type of device they were originally used. After the examination, the source was to be brought back under the control of the BJV and to be kept in the temporary storage facility. Any part of the examination that might affect the integrity of the source, such as filing it or drilling into the capsule, would have had to have been agreed by the BfS, the BMUV, the Hamburg regulatory authority and its temporary storage facility, as well as the relevant authority overseeing the temporary storage. For this reason, the examination focused on non-invasive examination techniques. The majority of the procedures planned would be fairly standard in a conventional forensic science laboratory. However, police forensics laboratories typically do not accept radioactive material. It was therefore necessary to find a nuclear forensics laboratory that could handle the source and carry out the examination.

The laboratory chosen was Radiochemistry Munich (RCM), which is part of the Technical University of Munich (TUM), a state-owned university with experience of carrying out forensic science investigations of radioactive material. As a designated Nuclear Forensics Laboratory (NFL), TUM has supported past investigations of radioactive material intercepted in Germany. The laboratory has a suitable licence to handle sources of this type and level of activity, and a sufficient number of personnel with training and experience in the handling of high-activity sources. TUM also participates in nuclear forensics exercises as part of its quality management and quality control systems.

After the laboratory had been chosen, transportation of the source was planned. This also involved discussions with the laboratory about how it would package and return the source after the examination, and whether the package would differ from its original state. If so, it would be necessary to check whether the package would still meet the conditions of acceptance of the temporary storage facility. It quickly became obvious that the easiest option would be for the BfS to transport the source.

A forensics examination plan was negotiated as part of the contract between TUM and the BfS. A subsequent and corresponding nuclear forensics plan was developed by TUM. During the examination, the source was placed in a lead shielded hot cell where equipment could be remotely operated.

The following examination methods were applied:

1. Dose rate measurement for activity estimation and determination of the maximum dose rate value (evaluation of danger to people inadvertently working with the sources)
2. Contamination control of source and container using swipe samples
3. Documentation of source (photography and digital microscopy)
4. Determination of length and diameter using a calliper
5. 3D-scan with a laser scanner, which also determined length and diameter. For this method to work markings had to be made on the capsule.
6. Mass determination
7. Check for magnetization
8. Radiography
9. Gamma-spectroscopy
10. Autoradiography/Gamma scanning
11. X-ray fluorescence analysis

During the investigation the TUM laboratory, the BfS and the regulatory authority discussed the results and the way forward at regular intervals. The order of the methods applied was changed a number of times, as some steps had to be postponed or repeated because of the technical problems and organizational challenges presented by the Covid-19 pandemic.

Continued page 6

International Response to a Multi-incident Case... *continued from page 5*

Results of the forensic examination

The capsule (see figures 6–8) consists of double encapsulated material with an activity of approximately 19 GBq Co-60 as of December 2021. It contains three inner capsules that seem to have originally been fixed with spacers. The composition of the outer capsule was determined using energy-dispersive X-ray spectroscopy (EDX) analysis to be a standard material type ('V2A steel'). Some properties of the capsule stood out:

- The activity distribution was highly asymmetric for an irradiation source, as one of the three inner capsules had only one-tenth of the activity of the other two.
- The capsule displayed regular tool marks on all surfaces. These were regular and were probably introduced during the manufacturing process of the capsule.
- The number '094' found on the bottom is probably manufacturer-specific. It is not known whether the number '094' is random, or instrument- or fabrication-specific.

Unfortunately, the manufacturer of the source, its intended purpose and in what type of device the source was originally used could not be identified with any certainty. The sources had no unique identification numbers, which would have allowed clear identification of a producer.

International engagement

Both the Netherlands and Germany reported the incidents to multiple mechanisms (for exact dates see the timeline in figure 1).

- *The Unified System for Information Exchange in Incidents and Emergencies* (USIE) is a secure website maintained by the IAEA to enable countries to exchange urgent notifications and follow-up information during an emergency. The IAEA's Incident and Emergency Centre maintains a list of emergency contact points in member states, States Party to the Conventions on the Early Notification of a Nuclear Accident and on Assistance in the Case of a Nuclear Accident or Radiological Emergency, and in other relevant international organizations. Via the USIE website, as well as by telephone, facsimile, email and video conferencing, the centre maintains communication with these

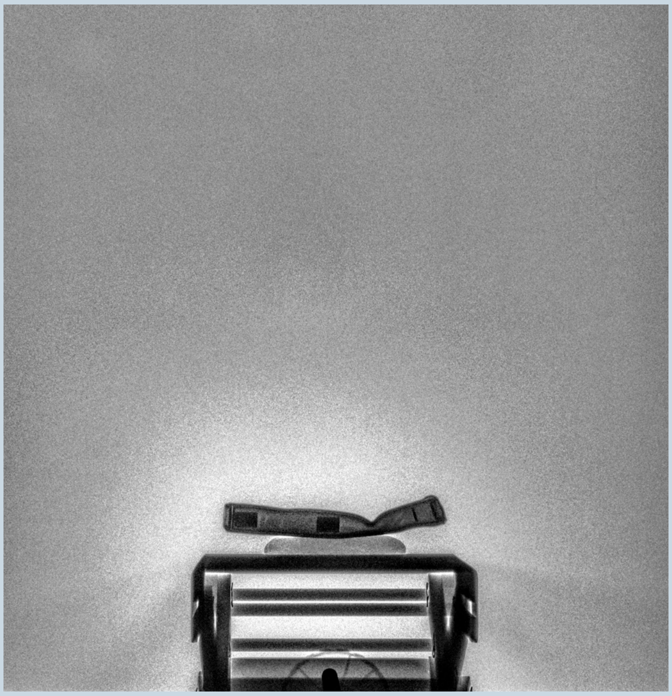

Figure 9. Autoradiography image of the Co-60 source discovered in Hamburg. Credit: BfS.

contact points. Almost 1900 users from 160 member states are currently registered in USIE. The system not only facilitates the exchange of notifications and information between countries during an emergency, it also allows them to request information or international assistance. USIE is also used by officially nominated International Nuclear and Radiological Event Scale (INES) national officers, who access it to share information on events rated using the INES. Germany and the Netherlands reported their events on USIE and the IEC used USIE to facilitate the provision of assistance in response to Nigeria's request for assistance.
- *The European Community Urgent Radiological Information Exchange System* (ECURIE), the technical implementation of a 1987 European Council Decision on EU arrangements for early notification and exchange of information in the event of a radiological or nuclear emergency.
- *The International Nuclear and Radiological Event Scale* (INES), a scale introduced by the IAEA in 1990 for communicating with the public on the safety significance of nuclear and radiological incidents and emergencies. Germany reported this event as an INES-1 level incident (an anomaly; one source), while the Netherlands reported it as an INES-2 level

incident that could have had an impact on people and the environment (nine sources in total).

- *The IAEA Incident and Trafficking Database* (ITDB), a database established by the IAEA in 1995 to share authoritative information in a timely manner on unauthorized acquisition, supply, possession, use, transfer or disposal of nuclear or radioactive material, or attempts thereof, and to collate and analyse incident data on nuclear and other radioactive materials out of regulatory control, in particular those related to trafficking or malicious use. Officially designated points of contact (POC) in the member states report relevant incidents to the ITDB using an online reporting tool (WebINF). Both Germany and the Netherlands reported their incidents as 'unauthorized shipments' as there was no suspicion of intentional smuggling or malicious use.

Response by the IAEA: Coordination and assistance

On 17 November 2018, the ANVS (the Dutch ITDB POC) submitted an incident notification form (INF) reporting the detection at a scrap metal trading company in the central Netherlands of five pen-shaped source holders with encapsulated Co-60 radioactive sources with an estimated combined activity as of 13 November 2018 of 95 GBq. These sources were found in a container of scrap metal that originated from Nigeria. On 28 January 2019 the Dutch ITDB POC submitted an INF to the IAEA ITDB reporting the detection, at a scrap metal trading company in the port of Rotterdam, of three radioactive Co-60 sources with an estimated combined activity of 50 GBq, in a shipment of scrap metal originating from Nigeria. The Dutch authorities assessed the collective dose from all radioactive sources as equivalent to a Category 3 dangerous radioactive source, according to the IAEA system for categorization of radioactive sources.[4]

In response to these notifications, the IAEA's Incident and Emergency Centre (IEC) contacted the nuclear regulator in the Netherlands to confirm the information and to confirm that the radioactive sources were under regulatory control.[5] On 30 January the Netherlands submitted a notification to USIE for the attention of all member states. In addition, the IEC informed Nigeria to enable possible follow-up and further sharing of information.

On 14 February 2019, the German ITDB POC submitted an INF reporting the discovery of a radioactive source in scrap metal on 11 January 2019. The radioactive source was visually consistent with the sources discovered in the Netherlands and also originated from Nigeria. It was identified as Co-60. With the agreement of the German authorities, the discovery was reported on USIE on 7 February, linking it to the event notified by the Netherlands on 30 January.

On 11 March 2019, the Emergency Contact Point from the Netherlands submitted a notification that, on 7 March 2019, a Co-60 source had been detected in a container loaded with stainless steel, originating from Nigeria. On 12 March the Dutch POC to the ITDB (ANVS) also submitted an INF on the same source.

In the following weeks, intensive consultations took place with the IAEA. The high level of activity and the numerous incidents in which Co-60 sources were found were considered extraordinary. The ANVS asked the IAEA to send out an EMERCON Request for Information (RFI) on 21 March 2019.[6]

The RFI was sent to all member states and international organizations and comprised the following questions:

1. Do you have information on recent events involving possible radioactive material, especially Co-60, in harbours, scrap metal yards or steel works?
2. Please verify and inform the IAEA accordingly if there are indications that: (*a*) not all industrial gauges and/or research irradiators, self-contained irradiators or panoramic irradiators and similar types of irradiators in your country are under the control of your regulator; (*b*) not all gamma-knife devices in your country are under the control of your regulator.

One international organization (INTERPOL) and 78 member state Emergency Contact Points responded to the IAEA, confirming that they had no information involving possible radioactive material in scrap metal yards, harbours, recycling facilities or steel works, and no information that any such sources might be missing, stolen or out of regulatory control.

[4] IAEA, Categorization of Radioactive Sources, General Safety Guides, 2005.

[5] The IEC is the IAEA focal point for emergency preparedness and response for nuclear and radiological safety- or security- related emergencies, threats or events and the IAEA centre for coordination of international emergency preparedness and response assistance.

[6] EMERCON is a descriptor referring to the official system for issuing and receiving notifications, information exchange and assistance provision through the IAEA's Emergency Response Centre in the event of a nuclear or radiological emergency.

Continued page 8

International Response to a Multi-incident Case... *continued from page 7*

On 13 May 2019, the IAEA IEC received an EMERCON Request for Assistance from the Nigerian Nuclear Regulatory Authority (NNRA) with regard to dangerous radioactive sources discovered in shipments of scrap metal from Nigeria at a scrap metal facility in Rotterdam, the Netherlands and the Port of Hamburg, Germany. Nigeria requested assistance from the IAEA, in the form of a fact-finding mission: (*a*) to determine possible actions to be taken by Nigeria in relation to the dangerous radioactive sources discovered; and (*b*) to provide advice on strategies to prevent further occurrences of such events.

A fact-finding mission was conducted on 4–7 June 2019 by an Assistance Mission team of experts from the IAEA, Germany, the Netherlands, and the United Kingdom.[7] The Assistance Mission achieved the proposed objectives outlined in the Assistance Action Plan to provide advice on possible actions to be taken by Nigeria in relation to the dangerous radioactive sources discovered at scrap metal facilities in Rotterdam and the Port of Hamburg; and strategies to prevent further occurrences of such events. The IEC prepared an Assistance Mission Report outlining the scope of the mission, the activities performed and the mission conclusions, which was shared with all the members of the Assistance Mission.

Response by Nigeria: Investigation and capacity building

The NNRA, established by the Nuclear Safety and Radiation Protection Act 19 of 1995, has responsibility for nuclear safety and radiological protection regulation in Nigeria. The NNRA also performs all the necessary functions that enable Nigeria to meet its national and international safety, security and safeguards obligations in the application of nuclear energy and ionizing radiation.

On 13 November 2018 the NNRA received notification from the ANVS that a container originating from Nigeria had triggered a radiation alarm of the portal monitor at a scrap metal yard in the central Netherlands. A scrap metal container with five radioactive source holders with encapsulated Co-60 sources had been shipped to the Netherlands by a metal trading company in Nigeria. On 16 November 2018, the ITDB notified the Nigerian ITDB POC about the INF submitted by the Dutch ITDB POC on 15 November regarding this incident.

While the investigation was ongoing, the NNRA was notified by the IAEA ITDB on 29 January 2019

[7] Germany and the United Kingdom are registered in the Response and Assistance Network (RANET), which provides a compatible and integrated network for the provision of international assistance to minimize the actual or potential radiological consequences of a nuclear or radiological emergency and to protect human life, health, property and the environment. States parties can fulfil their obligations under the Assistance Convention by registering their capabilities to assist in RANET. The IAEA encourages member states and international organizations to participate in ConvEx-2b (Convention Exercises) exercises, which are designed to allow them to practice the operational arrangements for international assistance in the case of a nuclear accident or radiological emergency.

Figures 10 and 11. Fact-finding work by the IAEA Assistance Mission, Nigeria, 4–7 June 2019

Figure 12. Discussion between the Nigerian Authorities and the IAEA Assistance Mission, Valley Front View Hotel, Lagos, Nigeria, 5 June 2019

concerning the incident reported to the ITDB by the Dutch ITDB POC—that a container from Nigeria had triggered a radiation alarm of the portal monitor of a scrap metal yard in the Port of Rotterdam. Three radioactive source holders with encapsulated sources had been discovered in one shipment. The sender of the material was the same metal trading company from Nigeria that was responsible for the first incident.

While the NNRA was taking action to locate this company and its owners, the third incident was reported through the IAEA USIE platform on 11 March 2019: a container loaded with stainless steel originating from Nigeria had triggered an alarm of the customs portal monitor in Rotterdam harbour. This incident was also reported via the ITDB on 12 March 2019.

Investigative activities undertaken by the Nigerian government

On 28 November 2018 a team made up of personnel from the NNRA and the Explosives Ordinance Division of the Nigerian Police carried out a visit to the known address of the scrap metal company associated with the shipments from Lagos, Nigeria. It was found that there was no scrap metal company operating at the address given in the shipping documentation. Interviews of the employees of other companies located in the neighbourhood proved unproductive, as no one knew anything about the suspect scrap metal company.

A further investigation conducted in January 2019 by a team made up of personnel from the NNRA and the Department of State Service found that the suspect scrap metal company was not registered with the Corporate Affairs Commission. The NNRA traced the manager of the company in Lagos through social media. The NNRA would like this person detained by the Nigeria Immigration Service (NIS) and handed over to security services personnel for interview.

The NNRA has written to the Nigeria Customs Service (NCS) to request its assistance. In addition, the NNRA has written to the ANVS and the scrap metal yards in the Netherlands requesting more information on the identity of the owner of the Nigerian scrap metal company. The NNRA has also contacted the Office of the National Security Adviser (ONSA) to request it to direct:

- the NCS, the Nigeria Port Authority (NPA) and other security agencies to temporarily halt further shipments of scrap metal from Nigeria until NNRA inspectors are able to monitor each consignment for radiation and certify it for shipment;
- that the identified manager of the suspect scrap metal company be apprehended by the NIS and handed to the security services for interview;
- the NPA to: (*a*) designate a particular port and terminal for the export of scrap metal from Nigeria; (*b*) ensure that no consignment of scrap metal is exported from Nigeria unless it has been inspected by the NNRA and certified that it does not contain radioactive material; and (*c*) designate a point of contact for further discussion on such matters.

The NNRA has reported the issue to the ONSA and is determined to continue its investigation. Nigeria has engaged with the IAEA through the Integrated

Continued page 10

International Response to a Multi-incident Case... *continued from page 9*

Figure 13. Fact-finding work by the IAEA Assistance Mission, Nigeria, 4–7 June 2019

Nuclear Security Support Plan (INSSP) mechanism to develop a draft roadmap for Nigeria and an action plan on the implementation of the roadmap.

The NNRA is also working with ONSA to reconstitute the National Nuclear Security Committee, which would consider issues referred to it by the NNRA Director General that might affect the security of nuclear and radiological installations, and radioactive sources, as well as violations of NNRA Act 19 of 1995.

CONCLUSIONS AND LESSONS LEARNED

- In this specific case, both the authorities of Germany and the Netherlands submitted an INF to ITDB, reported the incident using the USIE and ECURIE systems, and brought the materials back under regulatory control. The Dutch authorities characterized the sources radiologically and externally in order to communicate and alarm others. They disposed of the sources at the COVRA facility (the radioactive sources stored at the COVRA remained temporarily available for further examination). The German authorities undertook a further nuclear forensic investigation on the source found in Hamburg, and shared the outcome with, among others, the IAEA, the Netherlands and Nigeria. In the summer of 2021 the Dutch authorities concluded that it was unlikely that investigations on the sources at COVRA would add to the German results, and the sources were treated as 'normal' radioactive waste.
- Following the mission to Nigeria and discussion with the Dutch authorities, the German authorities concluded that a nuclear forensics examination of the radioactive source was necessary. This consultation process took time. To speed up the process in future, the incident reporting procedure for radioactive material in Germany has been enhanced. The new procedure involves a wider set of authorities and information is now directly linked to an investigation.
- The regulatory authorities in Germany focus on securing sources rather than conducting nuclear forensics examinations. Nuclear forensics examinations should generally be driven by the police investigation.
- All temporary storage facilities need a procedure for receiving and/or releasing sources for investigative purposes. This should include the option to inspect containers while in storage (e.g. on transport arrangements).
- If an orphan source is not needed as evidence in a police investigation, it can be difficult to obtain the funds for a nuclear forensics examination. A special mechanism is needed for investigating orphan sources in order to gather information pertinent to combating a loss of regulatory control.
- Most nuclear forensics laboratories focus on nuclear material. They are not necessarily capable of handling material with strong radiation fields. As a consequence, some of them are not prepared to handle high-activity sources and not all their procedures are applicable to high activity sources.
- A list of 'typical' examination steps for non-nuclear radioactive material and sealed sources would be useful.

- Finding a commercial transport company able to handle a radioactive source that is also evidence proved difficult. The necessary security arrangements, and the lack of information about the source and the state in which it would be returned led to much discussion. Transport by the BfS, which already uses the required safety and security personnel in its normal operations, proved to be the most flexible and cost-efficient option. A pre-prepared licence would make this even more efficient in the future.
- A nuclear forensics investigation is a multi-agency and multi-company undertaking. It requires regular discussion with the regulatory authority, the nuclear forensics laboratory and all the companies involved in the transport of the source before it was detected and regulatory control was re-established. The laboratory and the regulatory authority should frequently discuss the nuclear forensics plan and adapt it as necessary. This is especially important before destructive analysis is conducted, as this might have implications for the transportation of the source.
- The lessons learned in Germany improved the understanding of important procedures, in the BJV, the customs authorities and the BfS. This led to additional information being provided to customs personnel in order to improve nuclear safety and security. As a result, information about emergency radiation-controlled areas at container terminals in Hamburg is now more widely distributed.
- To achieve effective prevention of, or detection of and response to a nuclear security event, Nigeria is also developing and will implement its Nuclear Security Detection Architecture. This will promote a holistic and integrated state-level approach to the detection of Materials Out of Regulatory Control, as well as other radioactive material, and associated facilities and activities to ensure the security of such material in use, in storage or in transit.
- To combat illicit trafficking and to detect missing or lost radioactive and nuclear materials, the NNRA has plans to procure and install radiation portal monitors at all international airports and seaports. The NNRA is also planning to enhance international cooperation through bilateral and multilateral agreements, and to intensify training for its staff.
- The IAEA reminds member states to use the USIE platform for the notification of nuclear and radiological safety- or security-related emergencies, threats or events, and to report authoritative information on incidents involving illicit trafficking and other related unauthorized activities involving nuclear and other radioactive materials to the IAEA ITDB once appropriate information on an incident has been collected by the ITDB POC. The ITDB is a repository of information that can help to identify similar materials or similar incidents, their statistical relevance, the circumstances surrounding the loss of regulatory control or their return to regulatory control, and how states resolved the cases. •

Figure 14. IAEA Assistance Mission on scrap metal at Valley Front View Hotel, Lagos, Nigeria, June 2019

CONTENTS

NUCLEAR FORENSICS

Nuclear forensics is an essential component of national and international nuclear security response plans to events involving radioactive materials diverted outside of regulatory control. The ability to collect and preserve radiological and associated evidence as material is interdicted and to conduct nuclear forensics analysis provides insights to the history and origin of nuclear material, the point of diversion, and the identity of the perpetrators.

THE NUCLEAR FORENSICS INTERNATIONAL TECHNICAL WORKING GROUP

Since its inception in 1995, the Nuclear Forensics International Technical Working Group (ITWG) has been focused on nuclear forensic best practice through the development of techniques and methods for forensic analysis of nuclear, other radioactive, and radiologically contaminated materials. The objective of the ITWG is to advance the scientific discipline of nuclear forensics and to provide a common approach and effective technical solutions to competent national or international authorities that request assistance.

ITWG PRIORITIES AND ACTIVITIES

As a technical working group, the priorities for the ITWG include identifying requirements for nuclear forensic applications, evaluating present nuclear forensic capabilities, and recommending cooperative measures that ensure all states can respond to acts involving illicit trafficking and unauthorized possession of nuclear or other radioactive materials. An objective of the working group is to encourage technical peer-review of the nuclear forensic discipline. These goals are met through annual meetings, exercises, and informal and formal publications.

Outreach is a primary goal of the ITWG. The working group disseminates recent progress in nuclear forensic analysis and interpretation with the broader community of technical and security professionals who can benefit from these advancements. Affiliated international partner organizations include the International Atomic Energy Agency (IAEA), the European Commission, the European Police Office (EUROPOL), the International Criminal Police Organization (INTERPOL), the Global Initiative to Combat Nuclear Terrorism (GICNT) and the United Nations Interregional Crime and Justice Research Institute (UNICRI).

ITWG MEMBERSHIP

Nuclear forensics is both a technical capability as well as an investigatory process. For this reason the ITWG is a working group of experts including scientists, law enforcement officers, first responders, and nuclear regulators assigned by competent national authorities, affiliated contractors, and international organizations. The ITWG is open to all states interested in nuclear forensics.

ITWG participating states and organizations recognize that radiological crimes deserve thorough investigation and, when warranted, criminal prosecution. The ITWG encourages all states to possess the basic capability to categorize nuclear or other radioactive materials to assess their threat. As an international group, the ITWG shares its expertise through its membership to advance the science of nuclear forensics as well as its application to nuclear security objectives.

http://www.nf-itwg.org/

The 'ITWG Nuclear Forensics Update' is produced by the Stockholm International Peace Research Institute (SIPRI) on behalf of the Nuclear Forensics International Technical Working Group and with the financial support provided by the United States Department of Energy, National Nuclear Security Administration. The content and the views expressed here belong to the authors.