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# UPGRADING RADIOACTIVE WASTE MANAGEMENT FACILITY IN ARMENIA

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## ABSTRACT

Spent sealed radioactive sources in Armenia are managed and disposed of at a "Radon" facility near the settlement of Metzamor, just 40km from Yerevan. Chronic lack of funding since the facility was commissioned in 1982 resulted in serious problems with the buildings, infrastructure, security and equipment of the facility. Some of these problems were addressed within an internationally-funded project aimed at improving radiological safety at the facility.

## I. INRODUCTION

The Armenian Radon facility for the management of radioactive wastes is located in a mountainous area 40 km west of Yerevan, 15 km from the border with Turkey and 100 km west of the border with Azerbaidjan and Iran (Figure 1). Armenia is technically at war with Azerbaijan but no active military action has taken place since cease-fire was declared in 1994.

Spent sealed radioactive sources handled by the facility originate from hospitals, universities and other non-nuclear consignors. The facility does not handle radioactive waste from Armenia Nuclear Power Plant (ANPP) or the Ministry of Defence.

### *I.A. Sealed Radioactive Sources*

Typical activities of sources handled at the facility range from a few 10's of microcuries to 1.5 Curies (370 kBq to 55 GBq). They include both beta/gamma and alpha emitters, mainly Tc-99, Cs-137, Am-241, H-3, Ra-226, Co-60 and Sr-90. The total holdings of wastes designated for disposal is 10 000 Ci (370 TBq calculated for 1.01.2003). At the facility, these sources are

1. Retrieved from original packaging;
2. Encapsulated into cement within 200 litre drums;
3. Placed into underground vaults;
4. Backfilled and covered over with a concrete slab.

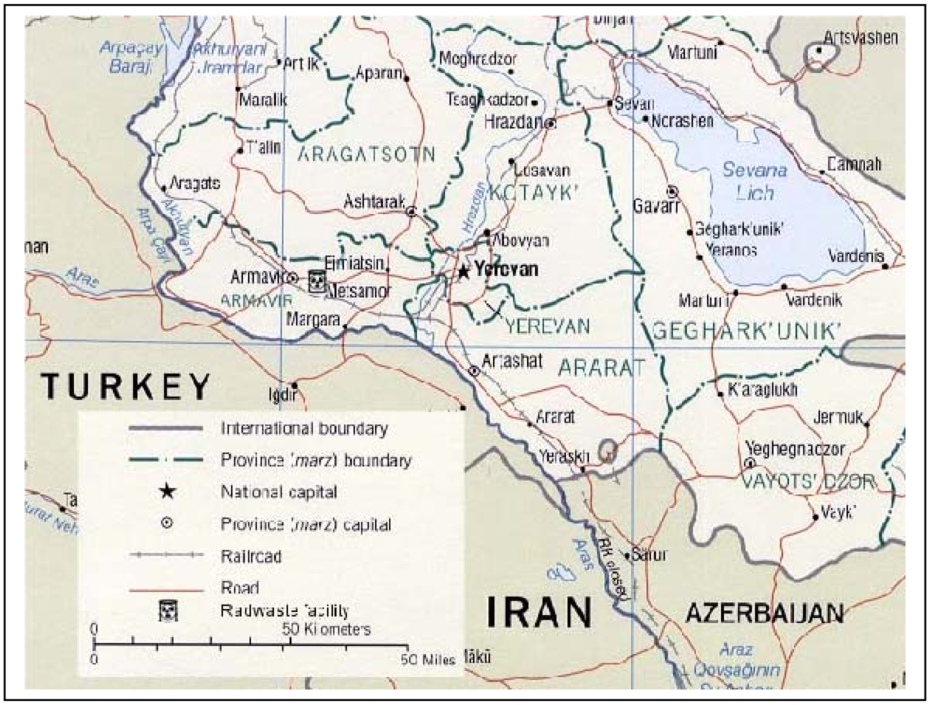



Figure 1. Location of the 'Radon' waste management facility

While sources form the vast majority of wastes accepted by the facility, small amounts of contaminated metals and equipment have occasionally also been accepted.

*I.B. Strontium-90 Radioisotope Thermoelectric Generator*

Figure 2: Radioisotope thermoelectric generator, originally containing 30 000 Ci of $^{90}$Sr

In addition to relatively small sources, there is also a single 30 000 Ci (1 Million GBq) Sr-90 source, which is temporarily stored at the facility (Figure 2). In the past this radioisotope thermoelectric generator (RTG) was used to power a meteorological station by producing electric power from radioactive decay. By now Sr-90 activity will have decayed to below 15 000 Ci; however, the source still represents a significant security and radiological safety concern. This Sr-90 source is the only RTG in Armenia, and the country has no infrastructure for safe storage and long-term management of large sources.

*I.C. Plutonium Smoke Detectors*

There are also several Pu-239 sources from smoke detectors of the old Soviet design (Figure 3). It was estimated that the current inventory of fissile material at the 'Radon' facility does not present criticality concerns. However the facility is not allowed to encapsulate or dispose long-lived wastes.


Figure 3: New batch of used smoke detectors, containing very small quantities of $^{239}$Pu

*I.E. International Assistance Project*

The site has fallen into a state of disrepair due to lack of investment since the start of operations in 1982.

In 2003 the UK Government and British Nuclear Group initiated an assistance project to address safety problems at the facility. The services were provided by the NNC group of companies, which include National Nuclear Corporation in the UK as well as Nuclear Safety Solutions and Monserco in Canada. Monserco operates the Canadian facility for management of spent sealed sources.

In June 2003, the project team carried out an audit of the facility. A number of urgent priority measures were defined and, later, implemented within the constraints of the available budget. This involved provision of:

- Repairs to the radioactive waste storage building
- Waste characterisation and provision of modern dosimetric equipment
- Improved means for transporting radioactive materials.
- Site security system
- Training to facility staff

## II. OPERATIONS AT THE "RADON" FACILITY

When the project started, the facility processed approximately 2 consignments a month. Facility staff were responsible for collecting spent sealed sources from consigners as well as for transfer to the facility of located "orphan" sources.

Personal vehicles of the facility staff were used to collect the sources from the consignor. There was usually a passport (certificate) associated with the sources, which described the age, type, activity, isotope content, manufacturer and other information. If the certificate was absent, the sources were delivered to the Armenian Nuclear Power Plant prior to being consigned to the facility. The source was packaged by the consignor in the appropriate container for transport, but occasionally the facility had to use its own transport container. The source was loaded in the boot of a Lada car using either the consignor's crane or manually. There were no means of checking the integrity of sources or dose rates.

To access the disposal facility, vehicles were required to pass through the main ANPP barrier on a site access road and through the gate on the perimeter of the disposal facility. Both entrances were manned 24 hours a day by armed guards. On delivery to the facility, the container was immediately unloaded in the waste store building. The source was then stored within the transport container for a period of up to 24 hours.

Prior to conditioning, the source was transferred manually into a small lead pot. This pot was then placed into a prepared void in a concrete lined 200 l drum. The drums were filled with one or two sources, depending on their activity. The concrete was mixed manually because the grouting facility had been out of operation since commissioning. The hand-mixed grout was added to complete the encapsulation. When the grout cured, the drum would be transferred for disposal.

The filled drum was placed in a purpose built concrete vault and covered over by a concrete slab. The drums were placed within the vault in two layers. Once the first layer of the vault was full, it was backfilled with concrete. This process was repeated for the second layer. Each layer has capacity for 50-60 drums.

There was no radiation, waste characterisation, personal dosimetry or contamination surveys undertaken during this process due the lack of equipment.

## III. REPAIRS TO THE RADIOACTIVE WASTE STROAGE BUILDING

At the south end of the site, there are three waste storage/disposal buildings of which only one is used for management and disposal of radioactive wastes. By June 2003, window frames on either side of this building rotted, one of the wall panels was missing and the asbestos sheets covering the roof were broken and missing (Figure 4a). In places, the concrete paving around the facility crumbled as a result of frost.

Provision of the roof and missing wall panel and repair of the windows to prevent leakage in the facility addressed the top priority requirement within this package (Figure 4b). In addition the crushed concrete slab in front of the entrance to the facility was replaced to prevent dust resuspension.

(a) (b)

Figure 4: Roof of the waste disposal facility. (a) – Before the project (b) After the project.

## IV. PROVISION OF HEALTH PHYSICS EQUIPMENT

### *IV.A. Situation at the start of the project*

The facility had no Health Physics capability due to the lack of functioning Health Physics equipment apart from Soviet-made multi range gamma dose rate meter model number USSR CONTR SRP 68-03 that was made in the 1960s. Other old dosimeters were inoperable (Figure 5a).

A site survey was undertaken annually using this doserate meter. This would provide indicative information on gamma contamination. There were no capabilities to detect beta/alpha contamination. Therefore a comprehensive programme of health physics radiation and contamination surveys was not undertaken.

A hand and foot monitor was provided by the IAEA during an earlier project but this was not in use as there was no functioning changeroom or reliable water supply to decontaminate staff if any contamination was found. There was also a Canberra Easyspec gamma spectrometer provided by the IAEA, but the display was broken. Another dose rate meter supplied by the IAEA had been broken prior to delivery.

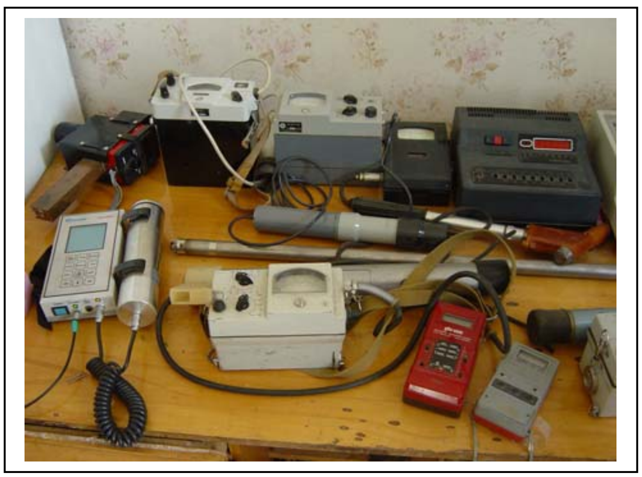
Surveys for fixed and non-fixed contamination were not undertaken so the integrity of the source could not be confirmed at any stage of handling. The potential for an intake of radioactivity when handling sources and source containers by members of staff due to surface contamination or airborne activity was not quantified. Such surveys could not be undertaken due to the lack of probes and dose rate meters and alpha and beta draw counters for the measurement of smears. Total reliance was placed on the paperwork provided by the consignor, which was not always available.

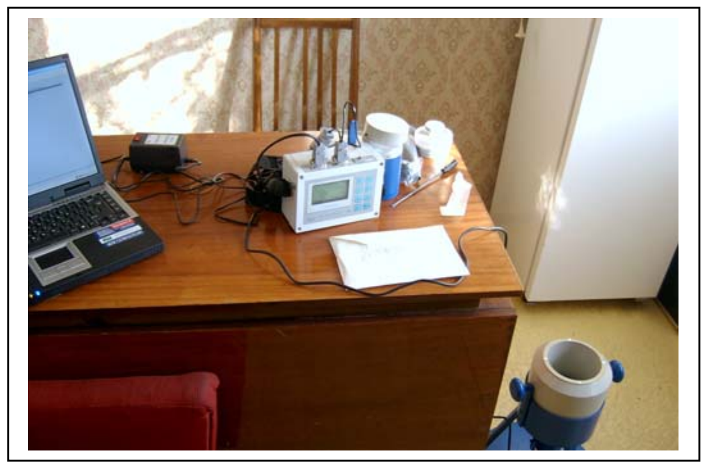
*IV.B. Provided equipment*

The acquisition of the portable Gamma spectrometer (Figure 5b) and associated training provided the facility with a means of making gamma spectroscopic measurements. The assay of gamma emitting waste is now possible. Furthermore, it provided the facility with the means of making Beta measurements.

The spectrometer package included a portable computer, software for processing information and documentation package in Russian.

In addition EPD Mk2 Grey personal dosemeters were supplied to staff involved in hazardous operations. These dosemeters were selected because they are easy to use, do not require specialised software, have the capability to measure both $\gamma$ and $\beta$ dose rates as well as accumulated dose and use standard AA batteries, which are available in Armenia.





(a) (b)

Figure 5: (a) – Inoperable Soviet health physics equipment from 1970s.
(b) – Portable spectrometer supplied to the facility.

## V. PROVISION OF VEHICLE FOR TRANSPORTING RADIOACTIVE MATERIALS.

*V.A. Situation at the start of the project*

From the initial audit and calculations, it was concluded that the transport containers provided sufficient shielding to comply with IAEA regulations for the Safe Transport of

Radioactive Material for type A packages; however, there was no manufacturer's documentation to support this statement. The radioactive transport containers vary in total mass from 1.5 kg up to a maximum of 80 kg of lead, depending on the type of sources that were being transported.

There was a Soviet-manufactured heavy duty truck, which was over 20 years old. The vehicle had lead lining of the whole goods compartment with a carrying capacity of at least 5 Te. The placard on the truck was permanent and not in compliance with IAEA transport regulations.

The vehicle was not used for the routine collection of radioactive sources due to its high petrol consumption, poor state of maintenance and old age. Instead the sources were transported in a Lada vehicle, belonging to the facility director.

### *V.B. Provision of a new vehicle*

The acquisition of a GAZel 27057 light goods vehicle with an additional passenger compartment provided the facility with a reliable vehicle of appropriate capacity to collect consignments. The Russian-made vehicle can be easily maintained in Armenia due to the availability and low price of spare parts. The vehicle was modified to ensure that the transport containers are adequately fixed during transport and external markings satisfy the requirements of IAEA transport regulations.

## VI. IMPROVEMENTS TO SITE SECURITY

### *VI.A. Situation at the start of the project*

The perimeter wall consisted of a 3.4 m wide by 2.3 m high and ~0.1 m thick concrete slabs, which were in good condition. The concrete slabs rested on the ground and, in some places, there were gaps between the slab and the ground. The vibration/intruder detection system proved to be susceptible to false alarms from birds and rain and was not in use.

There was a perimeter lighting system in use, but it was in poor condition with lamps missing and unsafe wiring (bare live conductors protruding from junction boxes). The lights were mounted on the perimeter wall, some 3 m from the ground.

At the time of the audit, there was no intruder detection or alarm system and no CCTV surveillance in place.

### *VI.B. Supplied physical protection system*

The procurement and installation of the security system addressed primary security needs identified in the initial audit, including:

- Upgrade to the existing perimeter barrier by closing of the gaps under the existing wall and provision of a personnel access gate.

- Provision of an effective perimeter intruder detection system to alarm in the security office with a battery backed power supply to allow time for alternative security measures to be implemented in the event of a power outage.

- Provision of a CCTV system to cover the perimeter areas that cannot be observed from the security office.

- Provision of an effective perimeter lighting system to allow CCTV / visual observation during hours of darkness.

- Provision of an intruder detection system on the waste store building.

## VII. TRAINING

"Radon" facility staff were trained in the use of all the equipment supplied within the project. In addition, they were provided with a 2-week training course which included modules in

- Health Physics
- Transport of radioactive waste
- Emergency planning
- International waste management regulations
- Waste categorisation, exemption and clearance
- Best international practice in Radioactive waste management
- Operational and Post Closure safety cases for a near-surface repository
- Quality Assurance

Each module involved practical sessions, which included demonstration of equipment and methodology.

## VIII. CONCLUSION

Within its limited timeframe and budget this project provided tangible benefits to safety of staff of the Armenian waste management facility. This was achieved within the framework of the international project by implementing repairs and providing the facility with the equipment and training to

- Characterise radioactive waste
- Monitor dose rates and total effective dose of personnel
- Transport spent sealed radioactive sources
- Ensure security of wastes stored on site.

Further improvements are required at the Armenian 'Radon' and other similar radioactive waste management facilities in Eastern Europe to ensure that they provide a required level of protection to workers and general public.

## ACKNOWLEDGEMENTS

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