Occupational exposure in the management of radioactive waste in Syria

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1. Background

The main objective of radioactive waste management is to deal with the waste in a proper manner that guarantees the protection of human beings and the environment.

The principal technological steps related to the radioactive waste management are: characterization, classification, treatment, conditioning, and disposal. So, workers managing radioactive waste may be exposed to an important amount of radiation depending on the characteristics, radioactivity, and processing procedures of the waste.

However, all activities related to the management of radioactive waste shall follow the most advanced and safe methods with the aim of preserving the safety of individuals and the surrounding environment from the risks of radioactive contamination at present and in the future.

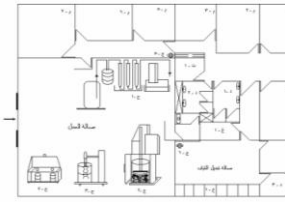
In Syria, a Radioactive Waste Management (RWM) facility was established, at the Atomic Energy Commission of Syria (AECS), to deal with the radioactive waste in the Country.

2. Syrian RWM facility:

The RWM facility receives liquid and solid radioactive wastes from AECS departments, national public and private companies, medical and research centres,…

Many radiation practices are carried out in the RWM facility (e.g. reuse/recycling, handling and predisposal treatment, …) and dealing with various types of sources: ^{60}Co, ^{137}Cs, ^{226}Ra, ^{192}Ir, ^{241}Am, ^{90}Sr,...

Two storage methods of radioactive wastes in the facility



Work sale, laboratories, and offices

3. Individual monitoring service provider

The individual monitoring service (IMS) provider in Syria located at Health Physics section- Protection & Safety Department- AECS; there is only one service provider in the country. The IMS is working according to the requirements of ISO17025; and monitoring about 2000 radiation workers in different fields. The IMS offers the possibility of measuring external exposures from photons and electrons for whole body, extremity, and eye lens; by using Thermo Luminescence Dosimeter (TLD) & Film badge.

A home-made PC program (PERSMONIT) is used for managing and recording the doses for all monitored workers. The operational quantities: personal dose equivalent (Hp(10)) to assess the effective dose, and personal dose equivalent (Hp(0.07)) to assess the dose to the skin and the hands and feet, are reported. The individual recoded doses are kept for 30 years at least.

3.1. Whole body exposure monitoring

TLD (Harshaw, USA) and film badge (FOMA, Czech Republic) are used to estimate the effective dose from external radiation sources. The calibration of those dosimeters is done by using slab phantom and Cs-137 source at the SSDL- AECS.

Harshaw TLD reader 4500 with WinRems software (left), Harshaw TLD with two chips TLD-100 for measuring Hp(10) and Hp(0.07) (right)

3.2. Extremity exposure monitoring

Film badges were used to estimate the extremity exposure by putting the dosimeter on the wrist using elastic band. However, introducing recycling of disused sealed sources into the RWM facility implied the measuring of extremities doses for those workers.

A ring-shaped plastic with TLD-700 chip is used for monitoring the hands of RWM workers. One ring in the middle finger of dominant hand on palm side is used to estimate the extremity equivalent dose. There is no fixed monitoring period for extremity exposure; it depends on the practices carried out by the RWM staff.

Monitoring extremity and eye lens by using film badge.

Ring-shape plastic with engraved hole to place a TLD-700 chip

Ring dosimeters are fixed on rod phatom for calibration

4. Radiation protection procedures

Establishing a comprehensive radiation protection program is mandatory by law for each radiation practice. The Radioactive Waste Management Division elaborated a radiation protection program that complies with ALARA principle (As Low As Reasonably Achievable), the Legislative Decree No. 64, Prime Minister Decree No. 137, Instructions on licensing and safety and security of radiation sources and Regulations for the safe transport of radioactive materials. The radiation protection program covered also emergency plan and response.

Regarding the radiation monitoring, the radiation protection officer is doing a workplace monitoring, for all work and storage sites of the facility, every two months, to avoid any potential exposure for workers.

A dose rate meter is turned on during the whole process of managing radioactive sources in order to monitor any changes in the dose.

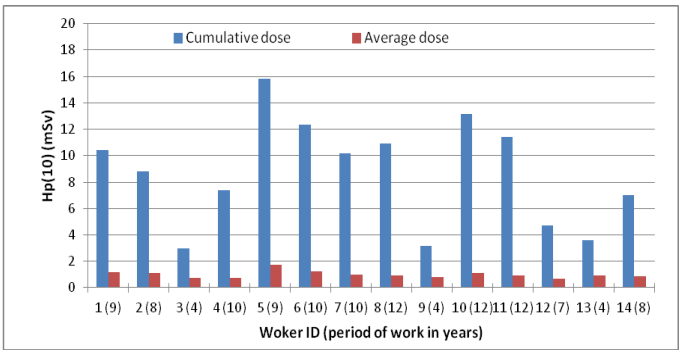
Internal radiation intake is possible when handling liquid radioactive wastes, so, whole body counting is done annually or after processing liquid wastes.

Radon exposure is also monitored through CR-39 detectors distributed in different places in the RWM facility.

As other monitored radiation workers, the RWM workers undergo a health surveillance through annual clinical examination and blood analysis to detect any abnormalities that may be caused by radiation.

5. Results and discussion

Personal whole body (Hp(10)) for 14 workers were recorded every two months from 2006 to 2022. The cumulative Hp(10) values over the respective period of work for each worker were calculated. The average Hp(10) value for all workers was below 1.8 mSv/y. The maximum recorded personal dose, during one monitoring period, was 3.3 mSv for worker 5. All cumulative recorded Hp(10) values over one year were below 6 mSv (investigation level) for all RWM workers during the considered period. However, the worker 5 was requested to explain the cause of receiving 3.3 mSv in one monitoring period, and the Regulatory office was averted for follow up.



The measured extremities doses for each practice, usually not frequent, were below 3 mSv. The annual extremities doses were less than 20 mSv for all workers, too low versus the annual limit 500 mSv.

No internal radiation contamination was observed for RWM workers; as handling liquid wastes is done strictly under fume hood and wearing the appropriate personal protective equipments.

The exposure to Radon gas is very low due to the large dimensions of work places and good ventilation.

No radiation-related medical symptoms were noticed on RWM workers during their work in the facility.

6. Conclusions and Acknowledgements

- The recorded whole body and extremity doses were significantly below the recommended dose limits (20 mSv and 500 mSv per year, respectively). This proves that the radiation protection program followed by the staff of RWM facility complies with the radiation protection requirements and assures safe management of radioactive waste according to ALARA principle.
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