



Occupational Dose Assessment for Workers Involved in the Management of Radioactive Waste Generated from Remediation of Adaya Site

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1. Background and Goal of the present work

Adaya site is one of the radioactively contaminated sites in Iraq that require remediation. Adaya site has been selected in 1991 as a temporary burial location for destroyed machines and equipment in Al-Jazeera site. The Adaya burial site lies on the eastern slope of a mountain ridge located about 27 km west of Al-Mosul city and about 23 km south of the Al-Jesira uranium refinement facility, where most of the buried contents originated. The damaged equipment and cemented rubbles generated from destruction of Al-Jazeera site have been buried in hurried manner in deep geological cracks, covered by soil. Most of the dumped materials and equipments are contaminated by yellowcake (ammonium diuranate (ADU)), UO_2 , and UO_3 . The aim of this study is to evaluate the potential occupational radiation exposure for workers involved in the management of radioactive waste generated from remediation of Adaya site.

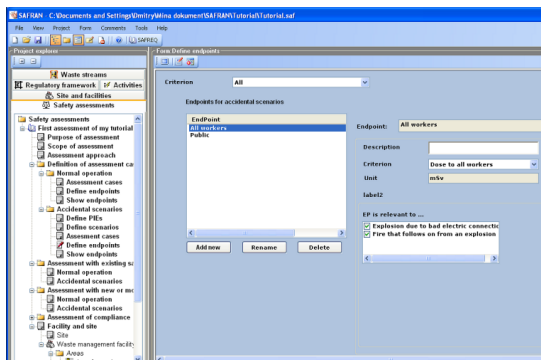
2. Materials and Methods

Soil samples were collected according to a predetermined pattern based on such factors as accessibility and the features of the site.

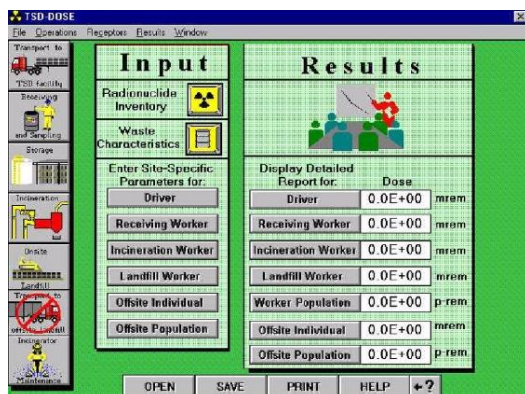
Forty-eight soil samples have been collected for radiometric analysis, as being representative of the entire site.

Collected samples were packaged, labeled with the location code, date and time of sampling, sealed in a plastic bag and shipped to the analytical laboratory for analysis. At the laboratory, the samples were dried, weighted, and counted using a high purity germanium detector with multichannel analyzer to provide radionuclide-specific results.

Two computer codes were used for evaluating the potential radiological impact of radioactive waste management operations: SAFRAN (Safety Assessment Framework) version 2 (2020) was used for estimating radiation doses to workers involved in sorting, compaction, packaging and storage of radioactive waste arising from Adaya site remediation, TSD-Dose Version 2.22 (1998) computer program was used for estimating radiation doses to facility workers from some waste-handling operations for the radioactive waste generated from anticipated remediation activities for Adaya site.



SAFRAN Code



TSD-Dose Code

3. Results and Discussion

It is apparent from the radioanalytical data that ^{234m}Pa and ^{235}U contamination levels in identified hot spots vary considerably within wide range in the surface soil and there is a high deviation to the mean observed level due to non-uniform surface soil contamination.

Total amounts of radioactive waste expected to be received from Adaya site remediation project were estimated as below, based on the assumption that the amount of generated radioactive waste will be 100 ton:

$316629.2 \text{ Bq/kg} \times 100000 \text{ kg} = 3.16 \times 10^{10} \text{ Bq for } ^{234m}Pa$

$21468.2 \text{ Bq/kg} \times 100000 \text{ kg} = 0.21 \times 10^{10} \text{ Bq for } ^{235}U$

The potential radiation doses to personnel involved in radioactive waste management activities during normal conditions vary depending on the tasks they perform.

Results of the dose assessment using SAFRAN and TSD-Dose indicated that no worker would receive a radiation dose of more than 2 mSv/y for the entire quantity of radioactive waste.

The total dose estimates to the workers as a consequence of radioactive waste management activities (2 mSv/y) are well within regulatory limit (20 mSv/y), indicating that it is highly unlikely that the receiving, sampling, sorting, packaging, transportation and storage of the produced radioactive waste resulted in significant radiological health impacts to the waste management workers.

Results of laboratory analysis

Radionuclide	Activity concentration (Bq/kg)	
	Average $\pm \sigma$	Range
^{234m}Pa	316629.2 ± 1122962	16 - 4053700
^{235}U	21468.2 ± 50993	12 - 136700

Potential radiation doses to the workers from radioactive waste management activities

Scenario	Computer Code	Potential doses (mSv/y)
Truck driver	TSD-Dose	0.1
Receiving and sampling	TSD-Dose	0.047
Sorting	SAFRAN	0.435
Compaction	SAFRAN	0.288
Packaging	SAFRAN	0.432
Storage	SAFRAN	0.7
Total		2

4. Conclusions and Acknowledgements

- Results of dose modeling using SAFRAN and TSD-Dose computer codes showed that the occupational dose expected to be received by the radioactive waste management workers (2 mSv/y) was only 10% of the regulatory dose limit for the radiation workers (20 mSv/y).
- Thanks and appreciation to everyone who contributed to the success of this scientific conference