

Characterisation of SVAFO's legacy, low-level waste using non-destructive gamma assay and x-ray examination technique

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Over 7000 drums containing legacy, low level radioactive waste are stored at four SVAFO facilities on the Studsvik site. The vast majority of the waste drums (>6000) were produced between 1969 and 1979. The remainder were produced from 1980 onwards.

Characterization of the waste was achieved using a combination of non-destructive techniques via mobile equipment located in the AU building at the Studsvik site. Each drum was weighed and a dose rate measurement was recorded. Gamma spectroscopy was used to measure and estimate radionuclide content. Real time x-ray examination was performed to identify such prohibited items as free liquids.

AB SVAFO is responsible for the remediation, decommissioning and management of Sweden's historic, radioactive waste and nuclear facilities. The waste streams have arisen from nuclear power, medical and research activities. The legacy waste is in need of further characterisation before it can be brought to the final repository for long lived, low and intermediate radioactive waste (SFL), which will be operational around the middle of the 21st century.

It is critical that the presence or absence of free liquids is determined. These are not allowed in current Swedish repositories and it is expected that this will be the same for the SFL repository.

- RTR examination enabled the operator to identify:
- Objects containing free liquids and an estimate of the total volume of liquid.
 - Glass containers, or similar, that could hold liquids.
 - Denser objects (possible fissile material or mercury).
 - Containers found in the waste matrix that are too dense to image (possible radiation shielded containers).
 - Any other items of interest such as possible pressurised containers (e.g. aerosol cans).
 - Drums with a density too high to be penetrated and effectively imaged using energies of 450kV.



One of five test drums that were manufactured in the US to evaluate the x-ray method.



With high resolution gamma spectroscopy (using ISOCS) and a turntable, the following data were recorded:

- Date, time, unique drum identification number, gross weight and gamma dose rate at mid-height at 1 m.
- Acquired gamma spectrum.
- Gamma spectrum analysis report.
- A text file reporting the calculated activities with measurement uncertainties, or Minimum Detectable.
- Activities (MDAs), of several key radionuclides plus any others identified above their MDAs in the SVAFO nuclide library.

The following information for each drum was recorded in a spreadsheet:

- Date, time, unique drum identification number, operator name and DVD number.
- Total estimated liquid volume.
- Approximate percentage of drum volume that can be imaged adequately.
- Number of radiation shielded containers.
- Suspicion of fissile material.
- Any other observations and any problems encountered.

Results

- 7303 drums representing SVAFO's entire legacy were characterised between November 2009 and August 2011.
- The average production rate was approximately 17 drums per working day using two qualified operators
- All waste drums were characterised using a fixed live time of 15 minutes.

Free liquids

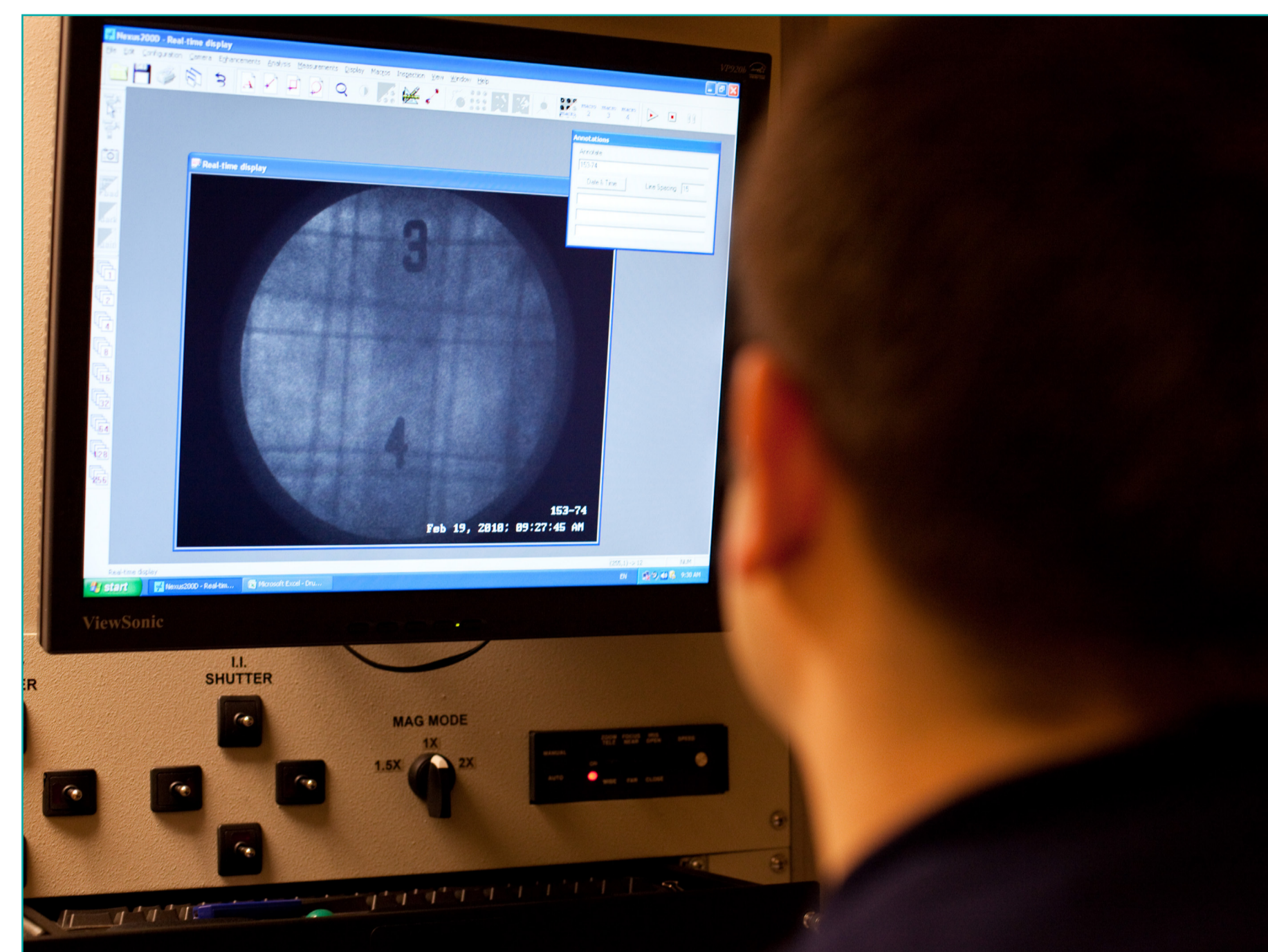
- Many more drums have been found to contain free liquids than there were believed to be prior to the start of the characterisation project.
- The total number of drums containing free liquids is 2068.
- The minimum liquid volume which could be detected reliably is approximately 5 ml. The largest volume detected is 100 l.
- 86.2 % of the total estimated liquid volume was found in just 7.0 % (510) of the drums. These drums contained at least two litres of liquid each.

Radiation shielded containers

- A total of 3041 radiation shielded containers were found among the 785 drums examined. The contents of these was not possible to determine within the x-ray project.



Handling of drums in the x-ray vault for real time radiosopic (RTR) examination.



On-going x-ray examination.

Key measurement results from RTR examinations

Parameter	Number of drums	Percentage of drums
Containing free liquids	2068	28.3
Total estimated liquid volume	≈ 4727 litres	
Containing radiation shielded containers	785	10.7
Containing mercury	65	0.9
Possible pressurized containers	69	0.9

Conclusions

SVAFO's legacy, low level waste is in need of further characterisation before it can be brought to Sweden's SFL repository in order to resolve some of the discrepancies between the present government regulations and the existing waste documentation. It is recognized that information gained by this characterisation project could be used by SKB during development of the waste acceptance criteria for the future SFL repository.

Information regarding the presence of items currently prohibited from being introduced into Swedish final repositories, such as free liquids, will enable informed, cost-efficient and ALARA based choices to be made regarding waste disposal. For example, the prohibited items could be removed from the waste or, alternatively, the waste characterisation data could be used in the design of an SFL repository able to accept the unremediated waste.

AU facility during the project: Drums were brought forward, id checked, re labeled using age resistant stickers and final contamination check prior to RTR and gamma assay.



The AU building at Studsvik will become the interim storage facility for all characterised drums until their final disposal at the future SFL repository. An electrically controlled, racking system enabling access to each and every characterised drum is currently being installed as shown in the photo below.

