Volume Reduction of Large Components – Minimising Waste Volumes by Maximising Recycling

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1. Introduction

Studsvik, Sweden, has been recycling contaminated metals from the international nuclear industry since 1987. Accepted metals are stainless steel, carbon steel, aluminium, copper, brass and lead.

The recycling concept comprises segmentation, decontamination, melting and clearance for recycling. Both metal scrap and large components are treated. The objective is to reduce the volume and weight of the waste and to recycle as much material as possible in order to reduce costs for storage in repository. Clearance of metals is applied in accordance with the European Commission's Recommendations for nuclear specific clearance, RP-89, Table 3.

During the years, the demands for reduction of waste volumes have lead to improved techniques for pre-treatment of large components prior to melting as well as minimisation of the waste volumes generated from the processes. In addition, the environmental aspect of a process that allows for recycling of valuable metals has become increasingly important.

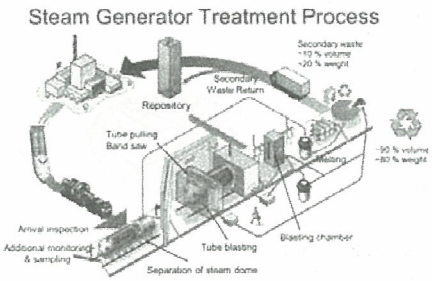
One example of a successful achievement is treatment and volume reduction of a full size 310 MT PWR steam generator. It began as a R&D project in co-operation with the Swedish nuclear power plant Ringhals and resulted in a unique concept for volume reduction and recycling of metal from steam generators.

2. Development

In many countries there is no possibility for disposal of large components in one piece due to the limited space available at final disposals. A Ringhals steam generator weighs 310 MT and the storage volume would be about 400 m³. Considering the high disposal costs per m³ in existing or planned repositories, reduced volumes are almost mandatory.

2.1 Treatment Concept

It was assumed that the Inconel 600 tube material would not be subject to clearance or recycling, only to volume reduction. However, most of the materials, such as the outer shell, the steam dome, the tube plate and water chambers etc were subject to melting and/or clearance and recycling.



The objective was to obtain less than 40 m³ of residual waste. Material which could not be recycled by clearance would have to be volume reduced and packaged for final disposal. Furthermore, the steam generator treatment method should be optimised to fulfil the demands for continuous conditioning of steam generators by Studsvik.

The Ringhals steam generator had the following dimensions.

- Length 21 m
- Diameter 4.5 m
- Weight 310 MT
- Storage volume 400 m³

The estimations of the radiation exposure to the operators were based on measurements. Co-60 was in the range of 0.65 TBq. For the long-lived isotopes, Ni-63 was the dominant in the range of 16 TBq.

3. Conclusion

Focusing on systematic development in the area of waste treatment and recycling of radioactive metals Studsvik has established new techniques and logistics. The investments made have led to the development of methods for treatment of steam generators and other large components that have generated interest from utilities worldwide.

The project objectives were to develop methods and techniques to achieve minimum waste volumes from the treatment of the Ringhals full size steam generator. Prior to treatment the steam generator had a weight of 310 MT and a storage volume of 400 m^3. The treatment resulted in less than 35 m^3 waste to be sent to repository, less than 9%.

4. References

[1] Swedish. Rapport id 1855395. Underlag för projekt SÅGA – Beräkning av källtermen i en utrangerad ånggenerator Ringhals 2. Strålskyddsunderlag i form av beräkning av arbetsdoser, exemplifiering av strålskärmning, några relevanta strålskyddsaspekter för ALARA-optimering. English. Report id 1855395. Basis for project SÅGA – Calculation of the source term in a disposed Steam Generator from Ringhals 2. Basis for Radiation Protection in form of calculation of work doses, exemplification of radiation shielding to summarize some relevant radiation protection aspects for ALARA-optimization.

[2] Paper 7130 - Co-operation development project for new treatment of STEAM GENERATORS's – Impact on final disposal volumes and recycling in Northern Europe. Bo Wirendal, Anders Lindström, Maria Lindberg Studsvik Nuclear AB and Tommy Hansson Ringhals AB

[3] Paper 7131 - NEW TREATMENT CONCEPT FOR STEAM GENERATORS – TECHNICAL ASPECTS. Anders Lindström, Bo Wirendal and Maria Lindberg Studsvik Nuclear AB