

European, Trans boundary Projects for Transport, Treatment and Recycling of Large Retired NPP Components in Studsvik – 14365

Arne Larsson* and Gregor Krause*
*Studsvik Nuclear AB

ABSTRACT

When the metal treatment operations at the Studsvik site started in the late 1980's the objects were fairly limited in size, with low dose rates and low levels of contamination. In the 1990's Studsvik started to treat larger components such as large heat exchangers and turbine casings from BWR's. Those projects gave considerable experience in lifting, transportation and treatment of large components.

Today, Studsvik has developed and is an international supplier of waste processing services for large components with relatively high radioactivity concentrations and/or complex geometries such as PWR steam generators and Magnox boilers. For each of these projects there is a licensing process involving several authorities. All transports are carried out according to international transport regulations for road, sea and railways. This paper will focus on the achieved results from treatment of the large components from the European countries.

INTRODUCTION

As early as in 1988 the first large components (i.e. objects that do not fit into a 40 ft ISO freight container) from the international market arrived to Studsvik for treatment. This first shipment consisted of low pressure pre-heater and moisture separators, in total 300 Mg. In these early days the selection of segmentation tools was not as wide as is currently available.

Over the years, several retired components from international customers such as BWR turbines, different types of heat exchangers including PWR steam generators and Magnox have been treated. The purpose of the waste processing projects is to minimize the waste volumes for final disposal, mainly by metals recycling.

METHODS AND CONCEPTS FOR TREATMENT OF LARGE COMPONENTS

The treatment concept for large, retired components encompasses the whole sequence of preparations including licensing/licensing support, heavy lifting, packaging and transportation. The treatment of the components prior to melting covers decontamination, segmentation and segregation using specially developed tools. The melting is performed in the Studsvik induction furnaces. Finally is the specific activity in the metal determined and if possible the metals are cleared for free release or for re-melting. The residual waste is packed into customer-specific packages suitable for final conditioning, storage and disposal.

Most large components from nuclear installations include challenges in a waste processing perspective. One example is the handling and efficient segmentation of BWR turbine casings and rotors. Another example is the decontamination, segmentation and handling of thousands of contaminated tubes inside PWR steam generators.

Cold segmentation methods are preferred to minimize spread of contamination and to minimize the amounts of residual waste. The tailored usage of the available dry decontamination techniques including tube blasting as well as blasting cabinets and tumbling blasting machines combines a high decontamination factor with low secondary waste production.

The challenges with large complicated components such as steam generators, with a weight up to 300 Mg each or more, begins already in the planning and licensing phase. The first steam generator treatment step is the separation of the steam dome in order to dock the rest of the steam generator to a specially built treatment cell. Thereafter, the decontamination of the tube bundle is performed using a remotely controlled manipulator, followed by cutting of the tubes and the heat exchanger shell.

Experience shows that for most materials treated clearance is achieved for 90 – 97 % (weight) of the tonnage treated including BWR large components as heat exchangers and turbines. Similar values are achieved for Magnox boilers. For PWR steam generators the mass reduction is lower but the volume reduction is in the range of 90%.

EXAMPLES OF TRANS BOUNDARY PROJECT OF LARGE RETIRED COMPONENTS

Over the years a large number of retired components from international customers have arrived for treatment in Studsvik. The components have been retired as a result of power upgrade projects, ageing of components or due to ceased operation (i.e. part of decommissioning project). Some examples of such components include:

- 15 Boilers, each 300 Mg, from UK Magnox station
- BWR Heat Exchangers from Finland
- Several BWR Heat Exchangers, largest 60 Mg, from Spain
- BWR turbine components, in total 300 Mg from Switzerland
- 4 Steam Generators, each 165 Mg from Germany
- Several Main Circulation Pumps from Germany
- Several Heat exchangers from Germany



Fig. 1. Steam Generator, arriving at Studsvik harbor

TRANSPORTATION

Transports of contaminated large components are fairly complicated but possible. If possible, water routes should be first choice. Transportation on road or rail is more limited with regards to weights and dimensions but in most cases possible. For licensing of domestic and international transports several authorities have to be involved such as:

- Radiation safety authorities
- Transport authorities
- Harbor authorities
- Environmental authorities
- Other country specific authorities and organizations

In countries outside the European Union, even the customs and national import/export regulation have to be considered. Often, involvement of the transport authority is necessary to establish detours and secure the transports roads of large components.



Fig. 2. 300 Mg Boiler during the transport to the export harbor in UK.

The transports are carried out according to the European Transport Regulations for road, rail and sea transports.

Most large components are transported as surface contaminated object (SCO) as per the regulations. In certain cases a transport has to be classified as Special Arrangement as per the regulations. In such cases the vessel, for example the closed heat exchanger shell, becomes the package and may have to be qualified and/or certified as package to verify integrity in case of incidents during the transports. As an example the entire steam generator has to be qualified as IP-2 (industrial package as per IAEA Transport Regulations) and the resistance towards different scenarios have to be demonstrated by computer simulations or physical tests.

VOLUME AND WEIGHT REDUCTION

As mentioned above it has been proven that treatment of large components in a specialized facility will give a significant reduction of the disposal volume. This reduction is not entirely a saving of disposal volume. It has also a major impact on the repository handling arrangements such as access roads, lifting capacity etc. but also on the efforts required to minimize the void in the repository. In most cases voidage above a certain percentage in a repository is considered unacceptable as per the Waste Acceptance Criteria. Large components, especially heat exchangers, contain large empty volumes.

Over the last 25 years several large components originating from European countries have been treated at the Studsvik Melting Facility. The treatment has contributed to reduce volume, void and cost related to final disposal. Table 1 below exemplifies the volume and weight reduction for some of these large components.

TABLE I Volume and weight reduction for some large components.

Component	Total	Volume			Weight		
	Treated units	Initial volume m ³	Waste for final disposal m ³ net	Volume reduction % net	Initial weight Mg	Recycling Mg	Recycling %
BWR Pre-heaters, Finland	4	2000	75	96	704	629	90
BWR Heat Exchangers, Spain	3	146	5	96	118	6	94
Magnox Boilers, UK	10	6000	80	98	3100	2960	95
Steam Generators incl. other steel components, Germany (Inconel tubes as secondary waste)	4	800	86	89	708	433	62
BWR Heat Exchangers, Germany	6	200	16	92	244	230	95
BWR LP Turbine components, Switzerland	4	400	17	96	300	286	95
BWR Heat exchangers Switzerland	2	86	3	97	43	41	95

CONCLUSIONS

Over the years an extensive know-how has been built up within the Studsvik Group regarding handling and treatment of contaminated, large components including how to minimize the waste for final disposal including clearance of material. These experiences span over several, very

diverse areas covering everything from transport and physical handling of components to decontamination methods, cutting techniques, secondary waste treatment and clearance procedures.

The in-house development and improvement of decontamination and segmentation concepts including tools as well as their application is always of high priority within Studsvik. The aim is always to find new techniques that will allow further reduction of the waste volume for disposal but also to be able to treat components with a higher contamination grade for further recycling.