

## **A NEW TECHNOLOGY FOR DECONTAMINATION OF OUTER SURFACES OF BWR CONDENSER TUBES**

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### **ABSTRACT**

This paper describes the development of decontamination process for decontamination of outer surfaces of BWR condenser tubes as well as the results of the respective decontamination campaign in Gundremmingen NPP.

The process uses grinding and brushing to remove the contamination. Approx. 560 t of condenser tubes were decontaminated successfully to unrestricted release level.

Compared to “traditional” decontamination processes a significant reduction in cost and waste could be achieved.

### **INTRODUCTION**

During the refurbishment activities of the units B and C of the Gundremmingen NPP, Germany the turbine condensers were exchanged. The exchange work included the removal of all condenser tubes.

Due to the operational history the tubes were contaminated on the outer surfaces which means, the material has to be treated as radioactive waste. Thus Gundremmingen NPP required the development of a decontamination process, which allowed free release of the tubes after decontamination.

The task of BNN was developing a technology which decontaminates the tubes and reduces the amount of radioactive waste as much as possible. In total about 1,040,000 tubes with a diameter of 21 mm, 4.5 m length, a total weight of approx. 560 t and a contamination of about 5 Bq/cm<sup>2</sup> had to be decontaminated. Other technologies currently available on the market are characterized by complicate equipment and ventilation. Additionally the production of secondary waste had to be taken into account as well as the need of space for the installation of the facility.

## TASKS

During condenser exchange waste as tubes (approx. 130 000) was generated with a length of approx. 4.5 m each. The tubes had a diameter of 21 mm and a wall thickness of 1 mm; the material was CuZn28 Sn1 (Special Brass 71). All tubes were stored in 20'-Containers directly after removal.

The decontamination of tubes had to be performed in Gundremmingen Unit A. Being in the decommissioning phase this unit provides ideal infrastructure for the envisaged decontamination project. Main target was to find an economical decontamination process which allows the unrestricted release of the decontaminated material.

The decontamination processes used previously (abrasive blasting) require relatively high efforts for equipment and ventilation. Besides pure commercial conditions the required space was one of the driving factors to develop a new process.

On the basis of these boundaries BNN investigated several technologies and identified a grinding and brushing technology as the favourite solution. Successful tests were executed to proof the technology.

This technology is characterised as follows:

- The treated material is suitable for unrestricted release
- The individual and collective dose rate accumulated is very low
- The radioactive waste produced is acceptable for final repository
- The production of aerosols is limited to a restricted area
- The costs for the facility are low due to the use of standardised equipment.
  - The investment costs are low.
  - The operational costs are low due to the high degree of automation.
- The effort for preparatory work is low. Tubes up to 4.5m length can be treated.

The equipment installed in Gundremmingen NPP, unit A was located in the former turbine hall of the plant. It mainly consists of

- table for incoming tubes
- brushing and grinding unit in a housing
- discharge table including further size reduction

## EXECUTION OF DECONTAMINATION

The surface of the condenser tubes was decontaminated by means of a brushing/grinding unit (Figure 1).



**Fig. 1. Brushing and Grinding Unit**

For this purpose a 20'-container loaded with tubes was transported in the turbine hall of Gundremmingen A NPP and docked to the containment of the decontamination unit (Figure 2).



**Fig. 2. 20'-Container with Condenser Tubes**

The tubes were removed by bundle and laid down on the input table of the brushing unit. By visual inspection tubes which could not be decontaminated (tubes with cracks, closed tubes and buckled tubes) were segregated. Tubes with kinks caused by extraction from the condenser were treated separately in advance. The kink was cut out with a band saw while the remaining parts of the tube were treated as the others.

Subsequently the tubes to be decontaminated were positioned in a transport device (See Figure 3).



**Fig. 3. Positioning of Tubes in Transport Device**

The automatic feeding device transports the tube through a cone between brush and feeding wheel. After the tube is seized it is put in rotation and fed through the decontamination unit. It consists of a brushing and grinding unit, which removes the outer layer of the tube (removing the contamination).

By means of a buzz saw the decontaminated tubes were cut in pieces of 800 mm length and stored in 200 litre drums. These drums were then transported to the free release measurement device.

### **MEASUREMENT FOR UNRESTRICTED RELEASE**

For measurement for unrestricted release of the 200 litre drums filled with the decontaminated tubes Gundremmingen Unit A has several drum measurement devices available. With these devices the activity is determined nuclide specific. Additionally the surface of approx. 10 % of the tubes was examined in spot tests. After the measurement the drums were emptied into a transport container (See Figure 4).





**Fig. 4. Decontaminated Tubes in Transport Container**

## **HEALTH PHYSICS CONCEPT**

Since during decontamination of tubes the spread of contamination and a release of aerosols had to be taken into account in principle, the whole working area was covered by a tent. In addition the brushing and grinding unit was encapsulated with a housing which was connected to an air extraction filter unit including a pre-filter. In the pre-filter the dust from the brushing unit was intercepted in 200 litre drums.

With a further filter unit (differential pressure controlled) the working area was ventilated. A control of concentration of aerosols was performed continuously by analysis of collected dust samples.

## **CONCLUSION**

The chosen process for decontamination of condenser tubes has proven to be a very economic process. The waste could be reduced to less than 1% of treated material. In connection with a chemical decontamination it was possible to decontaminate parts with cracks, kinks etc. for unrestricted release

The whole campaign lasted 24 weeks.

Due to the successful execution of the first decontamination campaign, a second campaign was executed in 2002. Instead of cutting of tubes with a buzz saw an automatic chopper was used. This improved the economics of the process furthermore.