Application of European Large Component Technology in the United States - 12561

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ABSTRACT

The European nuclear community currently has safer, more environmentally-friendly disposal options for large component disposal than the United States. The technology and innovation that makes these options viable will soon be available stateside.

INTRODUCTION

The removal and replacement of steam generators is a large and complicated task making volume reduction a vital service for the nuclear power industry. As plants age, the replacement of certain components is required in order to maintain plant efficiency and public safety. Currently in the United States, there are 3 options for the disposal of these items including: on-site storage, direct-disposal at a licensed (low-level radioactive waste) LLWR site, and volume reduction prior to disposal. If today's nuclear plants are to be used by future generations, waste stored on-site will eventually have to be disposed of to make room for newer, more advanced technology. Also, the space at LLWR disposal sites is finite, so all waste sent for disposal should be minimized whenever possible. Reducing the volume of decommissioned steam generators prior to final disposal shows the public that the nuclear industry is doing everything that it can to minimize its waste and conserve the environment. Additionally, many steam generators are massive and are not easily transported to a disposal site. When there is no practical transportation route, the size and weight of the component must be reduced. For various reasons including public safety, cost, and technical expertise, size reduction cannot be practically performed at the site of generation. However, since most facilities have some kind of access to a waterway, the components can be safely transported to another facility with barge access for size reduction.

The size reduction process for steam generators has evolved over the past 5 years. Because of reductions to the amount of final waste, the dose to personnel, and the processing time, it is now an environmentally and economically friendly alternative to on-site storage and direct disposal.

The major operations of this process include:

- removal of the carbon steel steam generator dome
- removal of the channel head and majority of tube sheet to free the tubes from the tube sheet and gain access to all of the tubes for grit blasting

- grit blast decontamination of the steam generator tubes to allow disassembly
- removal of the U-Bend Section of the tubes to allow for tube pulling
- tube pulling operations
- disassembly of the remainder of the steam generator shell and tube support assemblies
- size reduction of the steam generator resultant materials

All of the equipment for the American market is based on previous designs but has been adapted to meet the size requirements for processing of larger steam generators. This inclues a large horizontal band saw, a tube pulling machine, tube blasting equipment, and a diamond wire saw frame.

RESULTS

Dismantling radioactive components can pose a huge risk to personnel, society, and the environment. However, this volume reduction process has been refined over the processing of 10 steam generators in Sweden. This includes 6 large Westinghouse PWR steam generators that were previously installed at the Ringhals Nuclear Power Plant. The most recent evolution has been applied to 3 PWR steam generators from Renghals 2. On average, 72% of the weight was recycled and approximately 92% of the volume was reduced.

It has been replicated at Studsvik's Memphis processing facility and will be applied to 2 PWR steam generators from St. Lucie Nuclear Power Plant.

METHOD

Previous attempts to process steam generators in the United States haven't succeeded largely due to the inability to isolate and/or decontaminate the tube bundle. The tube bundle contains the highest activity levels of any other part of a generator. In addition to higher activity, the unique geometry of the U-bends adds to the complexity of handling the tubes. Several methods have been employed in the past including placing a robot into the channel head to unplug tubes as well using chemical decontamination methods to lower activity.

This process succeeds because of its ability to grit blast the tubes and then separate the tube bundle from its housing inside of the steam generator barrel using remotely controlled equipment. Since the process requires little to no physical interaction with the tube bundle, the steel from other parts of the generator can be isolated and decontaminated.

First, the steam dome (if attached) is removed using a combination a thermal cutting methods and/or diamond wire. The dome is then sectioned into small, manageable pieces. In most cases, the steam dome and its internals are eligible for free release after minimal decontamination effort.

Next, the channel head and a part of tube sheet are cut off to gain access to the tubes and remove any plugs from the tubes. It also frees each tube to allow for grit blast decontamination. Grit blasting techniques pass abrasive media through one leg of the tube bundle and recover it through the other leg until acceptable activity levels are reached. This will allow the tubes to be acceptable for transport for final disposal. After grit blasting, the U-bend section of the tube bundle is detached, sectioned, and packaged for disposal. The remaining tube sections are then drawn out through the tube sheet using the remotely controlled tube puller, which also condenses the tubes for disposal. After this, the shell of the barrel is sectioned, and the tube support plates are separated from the shell material. Finally, the barrel, support plates, and any other internal materials are further cleaned with blasting equipment for free release or Bulk Survey for Release (BSFR).

This method is summarized in Figure 1.

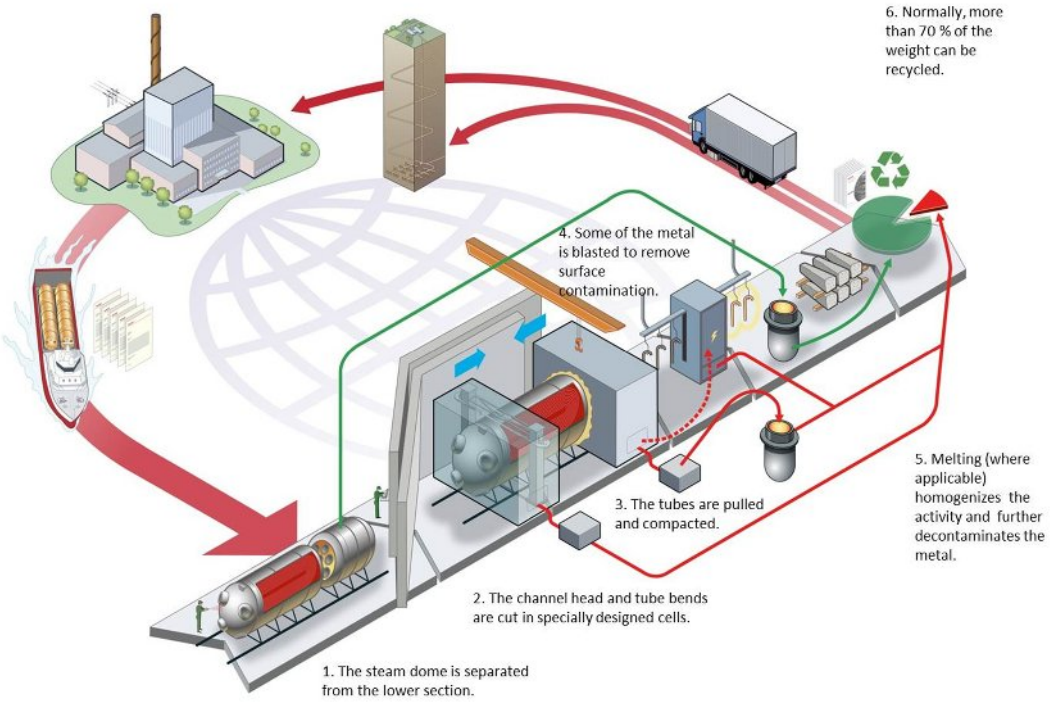

Figure 1. Steam generator process overview

ALARA

Developments in this process have not only decreased the amount of waste produced but also the amount of dose to personnel. Some of the technical solutions that drove the dose reduction include:

- Remotely-controlled band saw, diamond wire saw, tube pulling machine, and tube blasting equipment
- Lead blankets and concrete walls for shielding
- Shielded control room for the operation of the equipment
- Cameras to monitor work on and around the steam generators

The actual collective dose for the treatment of the 3 steam generators from Ringhals 2 is summarized in Table 1.

Ringhals 2 SG	Collective Dose (man-mSV)	Total Activity (Bq)
1	103	5.37E11
2	65	5.37E11
3	53	5.37E11

Table 1. Exposure results from Ringhals 2

TRANSPORTATION

Given the size of most steam generators in the United States, there are a limited number of transportation options available. An over the road heavy haul system is typically used to move the components from containment to the primary shipping point, but rail and barge are usually the most feasible options for the primary transport. The final transport method depends on the size of the components and the location and requirements of the utility. Figures 2 and 3 show the preparation of a steam generator for barge transport.

Figure 2. Barge transport of a steam generator

Figure 3. Transferal of steam generator from barge to over the road transport

DISPOSAL

The volume reduction process will use the following disposal techniques in the United States:

- Monitoring and free release/recycle of non-contaminated materials
- BSFR of those materials that meet the requirements release
- Packaging in approved DOT containers and shipment of materials in accordance with DOT regulations for final radioactive materials disposal at a licensed LLRW disposal site.

Materials that have been decontaminated or are potentially no longer contaminated will be monitored in accordance with company procedures by qualified technicians to ensure the limits specified in the United States Atomic Energy Commission's Regulatory

Guide 1.86 are not exceeded. Various portable monitoring equipment will be used as is determined to be suitable based on the type of materials to be surveyed and the type of contamination to be detected. All surveys of waste materials for free release using this method are documented and records are maintained in accordance with the Tennessee Department of Environment and Conservation's "State Regulations for Protection against Radiation" Rule Chapter 1200-2-10, which outlines the rules for operators of radioactive material licenses.

BSFR will be performed with Browning-Ferris Industries (BFI) North and South Shelby County (Tennessee) Landfills in accordance with the Bulk Survey for Release Technical Basis. All materials released through the BSFR process are subject to the rules of the Division of Solid Waste under the Tennessee Department of Environment and Conservation's "Solid Waste Processing and Disposal" Rule Chapter 1200-1-7. This rule applies to solid waste storage, processing, and/or disposal.

The metal from the steam generators may be decontaminated, disassembled, cut or sized for disposal using various mechanical methods, oxygen / propylene torches, oxygen / magnesium burning bars or other thermal cutting methods as needed. All final waste packages will meet the disposal requirements of the facility to which they are shipped. All LLRW will be shipped to a licensed facility authorized to accept the material by a competent authority.