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SEGMENTATION TOOLING FOR USE IN RADIOLOGICALLY CONTAMINATED FACILITIES

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INTRODUCTION

Decommissioning nuclear facilities often requires segmentation of metallic components into manageable-sized pieces. The components may be radiologically clean, contaminated, or activated. Each facility presents unique engineering challenges requiring appropriate segmentation tooling selection. These challenges include oversized components and subassemblies, remote operation requirements, secondary waste minimization and collection, and radiological contamination and/or activation of components.

SEGMENTATION EXPERIENCE

Embracing these challenges, MOTA Corporation developed and successfully deployed specially engineered tools for decommissioning projects within the academic, commercial nuclear and government sectors at Harvard University Cyclotron Laboratory (HCL), Big Rock Point Major Component Removal Project (BRP-MCRP), and Argonne National Laboratory-East (ANL-E) Building 211 60-inch Cyclotron, respectively. The specific tools developed are the Reciprocating Machine Tool (RMT) for large metal components and the Hydraulically Operated Rotating Cutting Equipment (HORCE) for segmentation of highly activated reactor internals.

SEGMENTATION METHOD SELECTION

Accounting for restrictions present in most radiologically contaminated facilities, new segmentation processes were developed after evaluating existing thermal, abrasive and mechanical cutting methods and determining no suitable technology existed. Thermal processes like plasma-arc and electrical discharge machining produce radiologically contaminated secondary wastes such as smoke, molten metal and aerosols that are difficult to control and contain. Diamond wire sawing and abrasive water-jet processes generated large volumes of wet slurries and abrasive grit and have proven unsuccessful on large metal components. Shearing processes have proven effective; however, remote handling and size limitations greatly limit the application of this process for segmentation.

Mechanical segmentation was chosen because of: 1) its ability to effectively cut all types of metals; 2) its ability to control and limit the volume of cutting byproduct (secondary waste); and 3) its associated Health & Safety advantages.

TOOLING DEVELOPMENT

For the ANL-E project, the RMT, an engineered cutting blade, and a delivery system capable of segmenting large items up to 72-inches thick and 103-inches in width was developed. The RMT is hydraulically powered, computer controlled, and capable of cutting in both vertical and horizontal planes. This unique mechanical cutting process has broad D&D applications for the non-thermal segmentation of large mass metallic objects such as cyclotron magnets, steel shielding, rotor shafts, “tube and shell” components, platforms, and other structural members. Using lessons learned from the ANL-E Project, the RMT was reconfigured and the cutting process optimized for deployment on the HCL Project.

Figure 1. RMT (left) and HORCE (right)

HORCE was initially developed for the BRP-MCRP. HORCE is a compact remotely controlled cutting device for segmenting internal reactor components in place. It employs a low RPM, hydraulically operated circular saw that uses commercially available cobalt-tooth cutting wheels. The compact design mounts directly to component using a hydraulically actuated clamping device. The device is fitted with a track system to allow continuous contact with the work piece by the cutting wheel. Cutting chips produced are relatively small yet large enough for easy capture by vacuuming the cutting zone below the engagement point of the blade. A second-generation version of the HORCE has been under development for the segmentation of the upper grid assembly at Millstone Unit 1 (Millstone). The design of this second generation version has incorporated lessons learned from the first field deployment of the HORCE at BRP-MCRP. The primary design improvements are focused on delivery, alignment and attachment of the cutting head to the work piece.

RESULTS

The RMT technology successfully segmented the ANL-E project 250-ton activated steel magnetic yoke and pole assemblies into 33 segments weighing less than 19,000 pounds each. The RMT was reconfigured, optimized, and successfully segmented the 95-inch HCL Cyclotron 642-ton activated steel magnetic yoke and pole assemblies into 16 segments weighing 35-tons or less each. The optimization incorporated lessons learned during the ANL-E project and included implementation of a strict quality assurance inspection relative to blade fabrication as well as improvements to the blade motion mechanics. The improvements resulted in production rates eight times higher at HCL than those experienced at ANL-E.

The HORCE technology successfully segmented the upper grid bars for the BRP-MCRP. The HORCE is currently being modified to segment the top guide assembly at Millstone. Design modifications incorporated for the Millstone application resulting from lessons learned at BRP-MCRP include adjustable independent control of blade speed and feed rate as well as improving the tool’s attachment to the work piece remotely. In addition, improvements to the blade delivery system are being developed to allow easy retrofit for unique applications.

In summary, the RMT and HORCE technologies offer proven alternatives to other established segmentation methods that generate both significant volumes of and difficult to manage secondary wastes. Both tools have demonstrated in the field the ability to limit secondary waste to chips or shavings produced in the cutting process, thereby eliminating the need for elaborate engineering controls for radioactive vapors, slurries, and/or liquids.