DECONTAMINATION OF PCB-CONTAMINATED EQUIPMENT FOR RECYCLING AND REUSE

Prepared by:

Stephen J. Mitchell, P.G.,
and
Joshua C. Thomas
Weston Solutions, Inc. (WESTON®)
Austin, Texas

For Presentation at:

The 7th Annual Joint Services Pollution Prevention & Hazardous Waste Management Conference & Exhibition
San Antonio, Texas
19 August 2002
ABSTRACT

Facility decommissioning projects often include an environmental component that involves the identification of hazardous building materials and chemicals present at the site, abatement of those materials, and proper disposal. Polychlorinated biphenyls (PCBs) are one chemical hazard that may need to be addressed during the dismantling of older facilities. The continued use and handling of PCB-containing materials are highly regulated, and their disposal can be very expensive. However, decontamination methods may be performed to allow PCB-contaminated equipment to be reused or scrapped, thereby minimizing waste volumes, reducing disposal costs, and helping facilities meet waste minimization goals. This paper summarizes decontamination approaches for nonporous surfaces that may be used to achieve Toxic Substances Control Act (TSCA) compliance during the decommissioning process. The case studies presented herein show that while TSCA waste volumes have been reduced by up to 90% and disposal costs reduced by 43% on two projects, an economy of scale applies with the decontamination and recycling approach resulting in larger savings on projects with large amounts of equipment with high scrap value, while decontamination for very small amounts of equipment may not be cost effective.

INTRODUCTION

As our military and civilian industrial complex ages, facilities that no longer fulfill a need or operate inefficiently are being removed from service and decommissioned. Decommissioning projects can range from selective dismantling that allows reuse of a structure to total facility demolition. Depending on the facility’s nature, these projects often include an environmental component that involves the identification of hazardous building materials or chemicals used at the site, abatement or remediation of these materials, waste characterization, and disposal.

PCBs are one group of chemical compounds that historically were used in some older industrial systems and may need to be addressed during decommissioning projects. PCBs may be present in building components including oil-filled transformers and capacitors, high-voltage electrical cable and junction boxes, voltage regulators, paints, hydraulic systems, and building insulating...
materials. PCBs also have been found in natural gas systems, specifically at compressor stations. They may be present on building surfaces such as floors and equipment as a result of leaks, spills or other process activities.

The use, handling, and disposal of PCBs are regulated by the U. S. Environmental Protection Agency (USEPA) under the authority of the TSCA. Under regulations promulgated in Title 40, Chapter 761 of the Code of Federal Regulations (40 CFR 761) the manufacture and most uses of PCBs have been banned. PCBs also are regulated for disposal depending on the concentrations in which they are found. Consequently, PCB-containing materials need to be identified and managed during the decommissioning process.

Most nonporous PCB-contaminated equipment, which is the focus on this paper, may be disposed of at a TSCA-permitted landfill or a Resource Conservation and Recovery Act (RCRA)-permitted landfill that accepts PCBs. However, the cost of disposal is often high. For those who seek to minimize wastes and reduce disposal costs, decontamination of the PCB-affected equipment can be implemented under some circumstances to allow its reuse or recycling. This paper was prepared to describe PCB decontamination approaches that have been used to achieve TSCA compliance and minimize PCB-contaminated equipment disposal during two decommissioning projects.

**BACKGROUND**

PCBs are a mixture of chlorine atoms and biphenyl molecules that combine to form complex chlorinated organic compounds. PCBs were manufactured and widely used in the United States from the 1940s through 1978. The chemical characteristics of PCBs made them desirable for use because of their chemical stability, relative inflammability, and excellent heat conducting properties. Prior to 1978, PCBs were widely used in transformer and capacitor oils, paints, oil-impregnated electrical cable, and other insulating materials.

The manufacture and unauthorized use of PCBs were banned by the USEPA in 1978 because of concerns about PCB carcinogenicity and bioaccumulation in humans and the ecosystem. Under the authority granted by TSCA, the USEPA now regulates the manufacture, sale, use, cleanup, and disposal of PCBs under the extensive regulations promulgated in 40 CFR 761. These regulations were substantially revised on 28 June 1998 with the adoption of the PCB Disposal Amendments, which included decontamination procedures for nonporous surfaces.

Materials are defined as being PCB-contaminated if they contain PCB concentrations exceeding the thresholds identified in the 40 CFR 761 regulations. Oil and liquids containing PCB concentrations of greater than or equal to 50 parts per million (ppm), porous materials having PCBs greater than or equal to 50 mg/kg, and nonporous materials having PCB surface concentrations greater than or equal to 10 µg/100 cm² are subject to the TSCA regulations. Prior to June 1998, materials were characterized based on the PCB concentration found in the original source of PCBs, regardless of the concentration in or on the affected media. However, the June 1998 PCB Disposal Amendments clarified that PCB-affected materials may be managed according to the as-found PCB concentration, regardless of the source concentration, if proper characterization sampling is performed.
The decontamination of PCB-contaminated materials to allow their reuse and distribution in commerce should be considered as an alternative to disposal. The regulations in 40 CFR 761.79 specify the general standards and procedures for decontaminating materials affected by PCBs. Self-implementing and performance-based decontamination standards are identified, as well as a process for pursuing USEPA approval of alternative decontamination methods not described in the rules. The selection of an appropriate decontamination approach depends on whether the PCB-affected material is solid or liquid, and whether solid materials are porous materials such as soil, concrete, paint, and wood, or nonporous materials such as metal. Additional regulations apply to some equipment (e.g., transformers) as described in 761.60.

This paper focuses on the procedures described in 40 CFR 761.79 that can be used to decontaminate PCB-affected nonporous surfaces that are not otherwise specifically regulated (e.g., transformers) for decontamination and disposal. For nonporous materials such as metal equipment, the selection of a decontamination method will depend on whether PCBs are present within the equipment interior, on exterior bare metal surfaces, on exterior painted surfaces, or actually manufactured in the paint itself. In the authors' experience, PCBs have been found on nonporous equipment surfaces under each of these circumstances, sometimes on equipment where PCBs would not have been specifically anticipated except for knowledge that PCB-containing transformer oil historically was used for lubrication purposes.

Nonporous materials such as equipment, piping, and containers that have PCB-containing liquids in their interior at concentrations of 50 mg/kg or more, or that are affected by PCB concentrations greater than or equal to 10 µg/100 cm² on exposed surfaces, are regulated for use and disposal by 40 CFR 761.60 and 761.61. Nonporous materials found to contain PCB concentrations at or above these thresholds should be drained of all free-flowing liquids, then either decontaminated, disposed of in a TSCA-approved landfill, or smelted in an industrial furnace that meets the requirements of the regulations. Such materials should be recycled (i.e., scrapped) or reused only if decontaminated as described in 40 CFR 761.79.

Both mechanical and chemical methods can be used to decontaminate PCBs from nonporous surfaces. The regulations state that methods including chopping, distilling, filtering, oil/water separation, spraying, soaking, wiping, stripping of insulation, scraping, scarification, or the use of abrasives or solvents may be used to remove or separate PCBs from nonporous surfaces, as applicable. Again, the most appropriate decontamination method will depend on the location of the PCB-affected surface and whether the affected media is painted or otherwise coated.

Regardless of the methods used, the decontamination process should render the PCB-affected material in a condition that meets the criteria specified in 40 CFR 761.79. For unrestricted reuse or recycling, the decontamination method should reduce the PCB concentrations on uncoated nonporous surfaces to less than 10 µg/100 cm², and on painted or otherwise coated surfaces render the surface in a condition that meets the National Association of Corrosion Engineers (NACE) Visual Standard No. 2 for Near-White Blast Cleaned Surfaces. For smelting, the method should reduce the PCBs on unpainted nonporous surfaces to less than 100 µg/100 cm², and on painted surfaces render it in a condition that meets NACE Visual Standard No. 3 for Commercial Blast Cleaned Surfaces prior to disposal.
DECONTAMINATION OF INTERIOR EQUIPMENT SURFACES

Equipment such as transformers, hydraulic lifts, compressors, and piping may contain PCBs within interior oil-filled reservoirs. In some cases, the interior surfaces of the PCB-affected reservoirs cannot be cleaned easily by mechanical means without time-consuming disassembly or destruction of the equipment. Fortunately, the PCB regulations allow interior reservoirs defined as PCB containers to be decontaminated using chemical flushing procedures.

As described by 40 CFR 761.79(c), equipment reservoirs generally may be decontaminated by flushing the internal surfaces three times with a solvent, with each rinse volume being equal to approximately 10 percent of the container’s capacity. PCBs must be at least 5 percent soluble in the solvent selected for this process, and the solvent may be reused as long as the concentration of PCBs in the solvent does not exceed 50 ppm. Equipment surfaces in contact with free-flowing mineral oil dielectric fluid containing less than 10,000 ppm PCBs can be drained of all oil and the residual surfaces should be allowed to drain for 15 hours. The surfaces to be decontaminated should then be soaked in a performance-based organic decontamination solvent (such as kerosene, diesel, or terpene hydrocarbons) that contain less than 2 ppm PCBs for at least 15 hours. For equipment with oil having greater than 10,000 ppm PCBs, an additional 15-hour solvent re-soaking should be performed after the initial solvent wash. The drained oil and solvent should be contained and disposed of according to the regulations.

Decontamination requirements other than those in 40 CFR 761.79 may apply to certain types of equipment that commonly have contained PCBs and are regulated specifically by the USEPA. Examples of these types of equipment include PCB transformers, PCB capacitors, PCB hydraulic machines, and natural gas pipeline systems. For example, 40 CFR 761.60(b) requires that PCB-contaminated transformers be drained of free flowing oil; filled with a decontamination solvent such as kerosene, xylenes, or toluene for 18 hours; and then thoroughly drained of all solvents before being disposed of. The 40 CFR 761.60 regulations should be referenced for more specific requirements for these types of equipment.

Verification sampling of the inside of the PCB container generally is not required to confirm the effectiveness of the decontamination method. All that is required is that free-flowing liquids are drained and the specified solvent flushing is performed. As previously noted, the PCB concentrations in the solvent before, during, and after the stipulated number of rinses should not equal or exceed 50 ppm, else the solvent flushing process should be repeated.

DECONTAMINATION OF EXPOSED EQUIPMENT SURFACES

The exterior surfaces of equipment, piping, and other nonporous surfaces can be PCB-contaminated, sometimes even when the internal equipment components did not contain PCB concentrations of 50 ppm or more. In the authors’ experience, exterior equipment surfaces sometimes become PCB-affected as a result of leaks from an interior oil reservoir or by equipment lubrication efforts. Regardless of the cause, exposed nonporous surfaces having PCBs greater than or equal to 10 µg/100 cm² generally represent an unauthorized use of PCBs,
are regulated for disposal, and should be decontaminated prior to being removed for reuse, scrap, or disposal in a landfill not approved for PCB wastes.

Nonporous surfaces that are uncoated can be decontaminated using several chemical solvent washing approaches described by 40 CFR 761.79. The surfaces to be decontaminated could be soaked in a solvent such as kerosene, diesel, or terpene hydrocarbons for at least 15 hours as described in 761.79(c)(3), with an additional 15-hour soaking if the surface had been in contact with mineral oil dielectric fluid with greater than 10,000 ppm PCBs. According to 761.79(c), movable equipment, tools, or sampling equipment also may be decontaminated by either swabbing the affected surfaces with a solvent, or performing the 40 CFR 761 Subpart S double-wash-rinse procedure. The double-wash-rinse procedure involves an initial water/detergent or solvent wash to clean the affected surfaces, a potable water rinse to remove residuals left from the initial wash, a solvent wash to decontaminate PCBs, and a final solvent rinse to clean and rinse the surface.

Solvents such as kerosene, diesel, or terpene hydrocarbons that meet the performance-based organic decontamination fluid requirement of the regulations have been used most commonly in the authors’ experience. Any solvent in which PCBs are 5 percent or more soluble is acceptable. Woodyard, et. al. (1995) tested various solvents on a variety of porous and nonporous surfaces and found terpene hydrocarbons to be among the most effective.

After decontamination has been performed using one of the above-mentioned solvent washing methods, sampling should be performed to verify that PCB concentrations on the nonporous surface have been reduced to acceptable levels. As described in 761.79(b)(3), the surface decontamination standard to be achieved for nonporous materials that will be reused, scrapped, or disposed of in a landfill not approved for TSCA PCB wastes is a PCB concentration of less than 10 µg/100 cm². The decontamination standard to be achieved for nonporous materials that will be smelted is less than 100 µg/100 cm². Sampling should be performed as described in 40 CFR 761 Subpart P of the regulations using a standard wipe test.

The situation becomes more complicated where the nonporous surface is covered with a porous coating such as paint. Under these circumstances, it is important to understand whether the paint became contaminated as a result of PCB spills onto the surface or whether the paint contains PCBs as a result of its original formulation during manufacture. Some paints have been manufactured with PCBs in their matrix, and as such are defined in 40 CFR 761.3 as a bulk product waste. Bulk product wastes, including paint-coated demolition wastes, can be disposed of in a municipal landfill at any concentration without decontamination, according to 40 CFR 761.62(b). Paint contaminated by PCBs as a result of a spill would be defined as a PCB remediation waste, however, and would be subject to decontamination prior to reuse, recycling, or disposal in a landfill not permitted to accept TSCA PCB wastes.

In situations where PCB-contaminated nonporous surfaces are coated with paint or primer affected by a spill, 761.79(a)(5) regulations require that the coating be removed as part of the PCB decontamination process. In cases where the equipment will be reused, scrapped, or disposed of in a landfill not approved to accept TSCA PCB wastes, the paint coatings should be removed to a bare metal surface meeting NACE Visual Standard 2. Cleaning to this standard
results in a near-white blast-cleaned metal surface. PCB-contaminated equipment that will be destroyed in a smelter can be cleaned to NACE Visual Standard 3, a commercial blast finish not quite as clean as NACE visual standard 2. A certified NACE inspector, or a competent individual using metal comparison coupons that have been treated to this standard, can confirm attainment of the NACE standards.

Paint can be removed from nonporous surfaces to achieve the NACE standards either by mechanical or chemical means. Mechanical paint removal techniques including sandblasting, carbon dioxide (CO₂) blasting, and other manual methods. Sandblasting involves blasting fine-grained, abrasive sand onto the PCB-contaminated surface to strip away paint and any oxidation on the nonporous surface below. CO₂ blasting, where pellets of frozen CO₂ are blasted against the affected surface, is a derivation of the sandblasting process that can reduce waste volumes. Manual methods would involve the use of grinding and scraping tools to remove the paint. Chemical methods, such as the use of chemical paint peeling products, could be used to remove the paint; however, the use of mechanical methods likely would still be required to render the surfaces in a condition meeting the NACE visual standards.

Under some circumstances it may be necessary to consider alternative decontamination methods, such as the thermal or chemical treatment of painted nonporous surfaces. In accordance with 761.79(h), alternative decontamination procedures may be performed to decontaminate nonporous surfaces, but only if they are first approved by the USEPA. Some firms with proprietary decontamination methods may already have a TSCA decontamination permit from USEPA; otherwise, requests for alternative decontamination approval should be submitted in writing to the USEPA in the region where the activity will take place. The application should describe the material to be decontaminated, the decontamination method to be used, and evidence that the proposed decontamination method is capable of cleaning the material to the decontamination standards established in 761.79(b), such as the less than 10 µg/100 cm² standard for unrestricted use.

CASE STUDY #1 - SEAHOLM POWER PLANT, AUSTIN, TEXAS

One location where these decontamination methods have been implemented to reduce PCB concentrations on nonporous equipment surfaces, reduce TSCA waste volumes, allow salvage and reuse of equipment, and save money, is the Seaholm Power Plant, an inactive natural-gas-fired power plant in Austin, Texas. After power generation activities at the power plant were discontinued, the City of Austin began considering options for redeveloping the facility. A decommissioning project was performed to dismantle and remove most of the power-generation-related equipment from the Seaholm Power Plant buildings, leaving some pieces of equipment in place for aesthetic and historical value.

Site investigation results indicated that PCBs exceeding 10 µg/100 cm² were present on some of the equipment in various buildings at Seaholm. PCBs were found most frequently on and around the oil lubrication systems, former station transformer areas, and power-generation equipment. PCBs were present in the turbine generator lubrication oil and were found on other equipment possibly due to the use of the turbine lubrication oil as a lubricant throughout the plant. Specific
equipment where PCBs were found included the turbine generators, lube oil coolers, condensate pumps, boiler feed pumps, lubrication oil reservoirs, and emergency diesel generators.

Considering that PCBs were found on equipment, the City of Austin realized that the decommissioning project would require an environmental management component to ensure that the affected equipment was properly handled, both within regulatory parameters and cost considerations. One goal of this component of the project was to minimize the amount of waste, particularly dismantled equipment, that was to be disposed of at a TSCA-permitted landfill. Transportation and disposal costs for TSCA landfill disposal were expected to be high due to the large size and weight of equipment affected by PCBs. Therefore, decontamination of PCB-affected equipment was encouraged to allow recycling as scrap metal and, as a result, achieving cost savings. In some cases decontamination also was encouraged so that equipment, such as the emergency diesel generators, could be sold or re-used at another facility.

PCB-contaminated equipment that was coated with paint and either had PCB concentrations exceeding 10 μg/100 cm² on its exterior surface or 50 mg/kg or more in the paint (due to apparent spills), and also did not have PCB concentrations of 50 mg/kg in its interior oil, was decontaminated according to 40 CFR 761.79(b). This involved draining the free-flowing oil or other liquids from the equipment; removing packed dirt, oil, or debris (if present) by high pressure washing; and removing porous paint/coatings on the equipment exterior by sand blasting or other abrasive removal methods to achieve the NACE Visual Standard 2 for near-white blasted metal surfaces. Although not required by 40 CFR 761.79(b) for equipment where paint removal to NACE Visual Standard 2 has been performed, solvent washing of the external components using kerosene also was performed as an added measure to help ensure that PCBs were removed.

After this decontamination procedure was completed, the equipment surfaces were inspected by comparing the bare metal surface to a NACE Standard 2 coupon obtained from a certified Sherwin Williams NACE Inspector. If the field inspector determined that the decontamination did not adequately meet NACE Standard 2, additional sandblasting was performed. After the decontamination was confirmed to be adequate based on comparison to the NACE Standard 2 coupon, the equipment was deemed acceptable for re-use, salvage as scrap metal, or disposal at a non-hazardous waste landfill. Photographs and field equipment tracking logs were used to document this process.

Wipe samples also were collected from the bare metal surfaces of approximately 25% of the equipment articles that were decontaminated. Verification sampling was not required by the regulations, but was performed as a quality assurance measure on behalf of the facility owner to verify that the decontamination process was adequate to reduce surface PCB concentrations to less than 10 μg/100 cm². PCBs were not reported in concentrations above 10 μg/100 cm² in any wipe samples collected from decontaminated equipment, proving the method’s effectiveness.

Overall, approximately 827 tons of PCB-affected equipment were removed from the power plant. The approach used to address this equipment included disposal at a TSCA landfill, decontamination for scrap metal recycling, and decontamination for reuse. The table below
summarizes the amount of equipment managed under each approach and the estimated costs associated with each approach.

<table>
<thead>
<tr>
<th>Equipment Management Approach</th>
<th>Equipment Amount (Tons)</th>
<th>Cost of Decon and Transport</th>
<th>Cost of Transport and TSCA Disposal</th>
<th>Value of Equipment (Scrap or Reuse)</th>
<th>Total Cost of Disposal (Net)</th>
<th>Disposal Cost per Ton (Net)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSCA Landfill</td>
<td>85</td>
<td>NA</td>
<td>$26,900</td>
<td>$0.00</td>
<td>$26,900</td>
<td>$316.47</td>
</tr>
<tr>
<td>Decon and Scrap</td>
<td>741</td>
<td>$184,300</td>
<td>NA</td>
<td>$55,500</td>
<td>$128,800</td>
<td>$173.82</td>
</tr>
<tr>
<td>Decon and Re-use</td>
<td>2</td>
<td>$500</td>
<td>NA</td>
<td>$6,500</td>
<td>-$6,000</td>
<td>-$3,000</td>
</tr>
<tr>
<td>Composite of All Approaches</td>
<td>828</td>
<td>$184,800</td>
<td>$26,900</td>
<td>$62,000</td>
<td>$149,700</td>
<td>$181.02</td>
</tr>
</tbody>
</table>

These costs were estimated based on observations of the contractor’s performance, contract unit prices for the project, and other sources. The cost of decontamination per ton was based on the duration of contractor decontamination activities in the field, equipment rental rates, estimated materials costs, City of Austin prevailing wage rates (with a 3.0 multiplier for contractor’s profit and overhead costs), and the cost of disposal of decontamination waste (e.g., disposal of sandblast grit). The estimated cost of scrap metal transportation was estimated at $12.76 per ton based on information provided by the contractor. The estimated cost of TSCA disposal ($316.47 per ton) was based on the contractor’s bid prices. The scrap metal value was estimated at $75.00 per ton in 2001 based on the U.S. Geological Survey, Mineral Commodity Summaries, January 2002 (USGS, 2002). The estimated re-use value of the diesel generators was based on market pricing of similar used units published on the internet.

As shown in the table above, 85 tons of removed equipment were transported to a TSCA-permitted landfill for disposal without decontamination, at an estimated cost of $26,900. Approximately 741 tons of equipment were decontaminated and disposed of as scrap metal, at a net cost of approximately $128,800, which includes an estimated $55,500 return on scrap value. Lastly, two diesel generators (2 tons) were decontaminated for re-use, where the estimated $6,000 value of reusing this equipment offset the cost of decontamination for a net gain of approximately $3,000. In total, the cost of managing the PCB-affected equipment using this approach was approximately $149,700; this includes transportation and disposal, the cost of decontamination (labor and equipment), and accounts for the scrap and re-use value of decontaminated equipment.

Looking at the disposal costs above on a unit (per ton) basis, it is clear that decontaminating equipment so that it could be salvaged or reused reduced disposal costs. The cost per ton for decontamination and scrap metal recycling of PCB-affected equipment was approximately $174, compared to $316 per ton for disposal of equipment at a TSCA landfill. The savings become even more apparent, however, when comparing the costs of the approach taken to other
scenarios. In the table below, Scenario #1 represents the costs if all PCB-affected equipment had been disposed of at a TSCA landfill, Scenario #2 is the actual approach used on the project, and Scenario #3 estimates the cost of equipment disposal if all PCB-affected equipment had been decontaminated for recycling as scrap metal. A decontamination for reuse scenario is not presented because a reasonable estimate of the reuse value for the large quantity and variety of equipment was not feasible.

<table>
<thead>
<tr>
<th>Scenario 1: TSCA Disposal Only (0 Tons Decontaminated)</th>
<th>Scenario 2: Combined Decontamination and TSCA Disposal (Approach Used at Seaholm, 741 Tons Decontaminated)</th>
<th>Scenario 3: Decontamination of All Equipment for Recycling, No TSCA Disposal (827 Tons Decontaminated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Cost Per Ton</td>
<td>Approximate Cost for 827 Tons</td>
<td>Average Cost Per Ton</td>
</tr>
<tr>
<td>$316.47</td>
<td>$261,700</td>
<td>$181.02</td>
</tr>
<tr>
<td>Cost Savings: $0</td>
<td>Estimated Cost Savings Compared to Scenario #1: $112,000</td>
<td>Estimated Cost Savings Compared to Scenario #1: $118,000</td>
</tr>
</tbody>
</table>

As shown in this table, by decontaminating 741 tons of the 827 tons of PCB-affected equipment for recycling and re-use (Scenario #2), the amount of TSCA wastes were reduced by approximately 90%, disposal costs were reduced by 43%, and a cost savings of $112,000 was achieved. Had all of the PCB-affected equipment been decontaminated for recycling (Scenario #3), the project would have reduced disposal costs by an estimated 45%, with a projected savings of $143,000.

**CASE STUDY #2- FORT WINGATE, GALLUP, NEW MEXICO**

The decontamination methods described in this paper also were performed during the decommissioning of Building 11 at Fort Wingate, near Gallup, New Mexico. The work was performed under contract with the U.S. Army Corps of Engineers, Fort Worth District. Fort Wingate is an inactive Army depot that was closed in January 1993. The depot’s mission was to store, ship, and receive material, and to dispose of obsolete or deteriorated explosives and ammunition. Building 11, a former locomotive repair shop, was undergoing environmental restoration prior to property transfer and re-use. Previous environmental investigations indicated that two generators, as well as several oil-filled switches and capacitors, had become PCB-contaminated due to the use of PCB-containing lubricating oils. Since the decommissioning project involved demolition of Building 11, management and proper disposal of this PCB-affected equipment was required.

During the decommissioning project, it was determined that the diesel generators could be decontaminated to reduce TSCA waste volumes, reduce the cost of disposal, and allow recycling (scraping) of the equipment. A PCB decontamination process that complied with the
regulations found in 40 CFR 761.79 was implemented to achieve these goals. As described in 40 CFR 761.79, exterior equipment surfaces with PCB concentrations of 10 \( \mu g/100 \text{ cm}^2 \) or more were decontaminated. The PCB-contaminated equipment was coated with paint, either had PCB concentrations exceeding either 10 \( \mu g/100 \text{ cm}^2 \) on its exterior surface or 50 mg/kg in paint, and did not have PCB concentrations of 50 mg/kg in its interior oil. Therefore, similar to the process described for Seaholm Power Plant, the equipment was decontaminated by draining the free-flowing oil, removing debris by high pressure washing, and removing the porous paint coatings on the equipment exterior by sand blasting to achieve the NACE Visual Standard 2 for near-white blasted metal surfaces.

The two generators were decontaminated so that the generators could be evaluated for resale or be scrapped. Decontamination of the relatively small switches and capacitors was not considered cost-effective, so these items were transported directly to a TSCA landfill for disposal. The table below summarizes the estimated costs achieved by decontaminating the generators versus the cost that would have been incurred had the equipment been disposed of at a TSCA landfill.

<table>
<thead>
<tr>
<th>Equipment Description and Weight (Tons)</th>
<th>Scenario #1 Decontamination and Scrap Approach</th>
<th>Scenario #2 Comparison to TSCA Disposal Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated Cost of Decontamination</td>
<td>Approximate Scrap Value of Equipment</td>
</tr>
<tr>
<td>FM Generator (20 tons)</td>
<td>$1,700</td>
<td>$1,500</td>
</tr>
<tr>
<td>CAT Generator (2.5 tons)</td>
<td>$1,550</td>
<td>$200</td>
</tr>
<tr>
<td>Total: 22.5 tons</td>
<td>$3,250</td>
<td>$1,700</td>
</tr>
</tbody>
</table>

Once again, when looking at the complete project, the TSCA waste volume was reduced, equipment was recycled, and disposal costs were reduced by decontaminating the PCB-affected equipment. Approximately one ton of TSCA waste was generated by the decontamination activity (compared to 22.5 tons of PCB-contaminated equipment), meaning that TSCA waste was reduced by 95%. Assuming that transportation and disposal of PCB-contaminated waste at a TSCA landfill costs approximately $300 per ton, the savings achieved by decontaminating and scrapping the two generators is an estimated $5,200. However, this savings is associated with the larger FM generator only, for which the cost of decontamination is nearly offset by the recovered scrap value and the cost of TSCA disposal for the 20-ton unit would have been high.

The cost of decontaminating and scrapping the smaller CAT generator actually was $600 more than the estimated cost of TSCA disposal. This occurred because the cost of decontamination of
the smaller CAT generator was similar to the cost for the larger FM generator because similar equipment rental and labor was necessary for this unit, but the scrap value was much lower. Based on this case study, it is apparent that decontamination and scrapping is more cost-effective in cases where larger amounts of equipment with higher scrap or re-use values are involved.

CONCLUSIONS

This paper described how PCB-contaminated equipment can be decontaminated to meet waste minimization goals. The two case studies presented show that the decontamination of PCB-contaminated equipment can be performed to allow equipment salvage, reduce TSCA waste volumes, and help minimize disposal cost. On the larger Seaholm Power Plant project, it was found that decontamination and scrapping of PCB-contaminated equipment reduced TSCA waste volumes by 90% and disposal costs by 43%. The experience on the smaller Fort Wingate project was somewhat different. While TSCA waste volumes were reduced by 95% and disposal costs were reduced by 70%, the cost of decontaminating lesser quantities and smaller pieces of equipment with low scrap values could be greater than the cost of TSCA disposal.

Therefore, it can be concluded from these case studies that there is an economy of scale, with the decontamination and recycling approach described in this paper being more cost effective and having higher rewards for larger sizes and amounts of equipment with higher scrap values. In situations where large pieces of equipment or large cumulative quantities of equipment are PCB-affected, decontamination and scrapping costs should be significantly less expensive than TSCA disposal. For smaller single pieces of equipment, however, decontamination costs may not be cost effective, although it would still result in a reduction of TSCA waste. Significant cost savings and TSCA waste minimization can be achieved through decontamination and salvage of PCB equipment, but this cost savings may not be realized for small projects where the salvage value of the equipment is low. Facility owners who are faced with decisions on whether PCB-affected equipment should be decontaminated for scrap metal recovery or re-use, or disposed of as TSCA waste, should consider the potential volume of equipment present, estimate the salvage value of the equipment, and assess whether decontamination can be performed cost-effectively.

ABOUT THE AUTHORS

Stephen J. Mitchell (s.mitchell@westonsolutions.com) is a Senior Project Manager and Joshua C. Thomas (josh.thomas@westonsolutions.com) is a Project Scientist for Weston Solutions, Inc., in Austin, Texas. They can be contacted at the Austin office by calling (512) 651-7100.

REFERENCES

