

B&W Beryllium Packaging of American Recovery and Reinvestment Act CERCLA Large Equipment for Bulk Disposal at the Y-12 National Security Complex, Oak Ridge, TN – 11218

Joseph W. Birchfield III*, Linda Albrecht**

*Link Technologies

**Alliant Corporation

ABSTRACT

In May 2009 Babcock and Wilcox LLC (B&W) Y-12 was tasked with the removal of approximately 8,500 cubic yards of large equipment and items designated as waste in the Oak Ridge, Tennessee 9201-5 (Alpha-5) building which played a role weapons production. This waste disposal was performed under a time critical removal action memorandum under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The project was funded by the American Recovery and Reinvestment Act (ARRA) from U.S. Department of Energy (DOE) Environmental Management (EM) and administered through the National Nuclear Security Administration (NNSA) using the B&W Prime Contract. While the main contaminant of concern involved uranium, the primary non-radiological contaminant was beryllium which is strictly regulated under 10 CFR 850 regulations [1]. An estimated 80% of the large equipment waste slated for disposal in the Alpha-5 building was contaminated with beryllium.

The desired disposal pathway for the Alpha-5 beryllium waste was the onsite Oak Ridge Reservation (ORR) Environmental Management Waste Management Facility (EMWMF) landfill whose personnel were not routinely required to wear respiratory protection and did not participate in an active beryllium personnel monitoring program. Given the described condition, numerous Alpha-5 large equipment packaging options were evaluated to protect both Alpha-5 operators packaging the waste and EMWMF operators disposing of the waste. A combination of various methods from double wrapping with 6-millimeter (mil) plastic with double-lined supersacks was utilized. In some instances, painting to fix removable beryllium contamination and wrapping in a single 6-mil wrap with double-lined supersacks to double encapsulation was also utilized. These innovative packaging techniques resulted in compliant waste disposal packaging while providing the necessary worker protection against airborne beryllium dust during disposal of large equipment waste from the Alpha-5 legacy removal material project.

PURPOSE

This technical paper addresses the management of beryllium contaminated on legacy waste. The goal of the beryllium management program is to protect human health and the environment by preventing the release of beryllium through controlling surface contamination. Studies have shown that controlling beryllium surface contamination, reduces or eliminates potential airborne contamination. Although there are areas in Building 9201-5 that are contaminated with radioactive materials and mercury, only beryllium contamination is addressed in this management plan. The overall goal of this initiative is the compliant packaging and disposal of beryllium waste from the 9201-5 Legacy Material Removal (LMR) Project to ensure that beryllium surface contamination and any potential airborne release of beryllium are controlled to levels as low as practicable in accordance with 10 CFR 850.25[1].

BACKGROUND

Building 9201-5 (Alpha 5) was completed in May 1944 and served as a production facility for Y-12 functioning as a uranium enrichment facility beginning with the Manhattan Project. The facility has been renovated and altered over the years, converting some shop and laboratory spaces to office and administration services space. The largest Y-12 ARRA project with an estimated budget of \$109.5 million, Alpha 5 consists of 4 floors and a basement which house various pieces of equipment, tools, bagged radioactive waste and out-of-date chemicals that must be removed compliantly and safely. The facility has been characterized for hazardous materials, and the characterization has identified beryllium and radioactive contamination in certain areas. Beryllium contamination in 9201-5 is within approximately sixty percent of the facility.

Concentrations varying from very low (< 0.2 micrograms (μg)/100 cm^2) to areas where concentrations are relatively high, approximately 600 $\mu\text{g}/100 \text{ cm}^2$, in regulated beryllium areas. All work involving beryllium is conducted in accordance with the DOE approved B&W Y-12 Chronic Beryllium Disease Prevention Program Manual, Y73-201 [2].

The primary site related contaminants (SRCs) for the waste in this facility are enriched uranium, depleted uranium, beryllium and mercury. Over 80% of the building is managed as a beryllium area which requires workers to participate in specialized blood testing and monitoring plus participate in a rigorous respiratory protection program. To further complicate matters, a significant amount of mercury (i.e., thousands of pounds) had been spilled from past operations within the facility. Mercury vapors are constantly monitored and personnel are fitted with appropriate respiratory cartridges to minimize mercury vapor inhalation. This facility represents the highest environmental risk for DOE-ORO EM and NNSA at Y-12 and must be quickly addressed to minimize impacts to future Y-12 missions, as well as human health and the environment. There are approximately 8,500 cubic yards of waste that must be removed from the 9201-5 building.

The current scope of work for the Building 9201-5 (Alpha 5) Legacy Material Disposition Project is to complete removal and disposition of all legacy materials in Alpha 5 to prepare the facility for eventual deactivation and demolition. All work shall be performed in accordance with Applicable Relevant and Appropriate Requirements (ARARs). Legacy materials are defined as easily removable items that involve minimal reconfiguration efforts (e.g., unbolting, unplugging, wire cutting, or cold cutting). The project is being performed in accordance with the requirements of the Federal Facility Agreement for the Oak Ridge Reservation and an approved action memorandum for a time-critical removal action [3] (DOE/OR/01-2404). Legacy waste will be characterized appropriately, prepared and packaged for shipment for disposal at EMWMF.

The Alpha-5 project proposes a comprehensive strategy to manage the beryllium contamination, ensure worker protection, and minimize handling. The strategy is compliant with 10 CFR 850 [1].

REGULATORY CONSIDERATIONS

Section 5(a)(1) of the OSH Act, often referred to as the General Duty Clause, requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees. "Section 5(a) (2) requires employers to "comply with occupational safety and health standards promulgated under this Act."

OSHA also requires beryllium air contamination to be monitored and assessed under the General Industry Regulations (29 CFR 1910 [4]) which includes 1910.1000 [4], specifying limits for air contaminants . Table 1 lists the beryllium limits below.

Table 1. Regulatory Limits for Beryllium Exposure

Substance	8-hour time weighted average (TWA)	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	
			Concentration	Maximum duration
Beryllium and beryllium compounds (Z37.29-1970) [4]	2 $\mu\text{g}/\text{m}^3$ a	5 $\mu\text{g}/\text{m}^3$ a	25 $\mu\text{g}/\text{m}^3$ a	30 minutes.
Key a $\mu\text{g}/\text{m}^3$ – micrograms per cubic meter				

DOE REQUIREMENTS

§ 850.3(a) [1] Definitions. Beryllium Regulatory requirements:

Beryllium means elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate.

§ 850.32 [1] Waste disposal.

(a) The responsible employer must control the generation of beryllium containing waste, and beryllium-contaminated equipment and other items that are disposed of as waste, through the application of waste minimization principles. (b) Beryllium-containing waste, and beryllium-contaminated equipment and other items that are disposed of as waste, must be disposed of in sealed, impermeable bags, containers, or enclosures to prevent the release of beryllium dust during handling and transportation. The bags, containers, and enclosures that are used for disposal of beryllium waste must be labeled according to § 850.38 [1].

§ 850.38 [1] Warning signs and labels.

(a) *Warning signs.* The responsible employer must post warning signs at each access point to a regulated area with the following information: "DANGER BERYLLIUM CAN CAUSE LUNG DAMAGE; CANCER HAZARD; AUTHORIZED PERSONNEL ONLY." (b) *Warning labels.* (1) The responsible employer must affix warning labels to all containers of beryllium, beryllium compounds, or beryllium-contaminated clothing, equipment, waste, scrap, or debris. (2) Warning labels must contain the following information: "DANGER CONTAMINATED WITH BERYLLIUM DO NOT REMOVE DUST BY BLOWING OR SHAKING. CANCER AND LUNG DISEASE HAZARD." (c) Warning signs and labels must be in accordance with 29 CFR 1910.1200 [5], Hazard Communication.

§ 850.23 [1] Action level.

(a) The responsible employer must include in its Chronic Beryllium Disease Prevention Program (CBDPP) an action level that is no greater than 0.2 µg/m³, calculated as an 8-hour time-weighted average (TWA) exposure, as measured in the worker's breathing zone by personal monitoring. (b) If an airborne concentration of beryllium is at or above the action level, the responsible employer must implement §§ 850.24(c) [1] (periodic monitoring), 850.25 [1] (exposure reduction and minimization), 850.26 [1] (regulated areas), 850.27 [1] (hygiene facilities and practices), 850.28 [1] (respiratory protection), 850.29 [1] (protective clothing and equipment), and 850.38 [1] (warning signs) of this part.

REGULATORY REVIEW BY DOE OFFICE OF HEALTH, SAFETY AND SECURITY

Because of the vagueness in the code of federal regulations (CFR), the DOE Office of Health, Safety and Security (HSS) was contacted and requested to provide an interpretation of the CFR for waste disposal was requested. HSS's response is provided below:

The Department of Energy does not have an official definition of beryllium waste as it applies to the 10 CFR 850 [1], "Chronic Beryllium Disease Prevention Program." The following is an informal description of beryllium waste. In general, beryllium-containing material or beryllium-contaminated equipment and other items that are generated by a beryllium activity and are intended to be disposed would be considered beryllium waste. Section 10 CFR 850.3 [1] states that "Beryllium activity means an activity taken for, or by, DOE at a DOE facility that can expose workers to airborne beryllium, including but not limited to design, construction, operation, maintenance, or decommissioning, and which may involve one DOE facility or operation or a combination of facilities and operations." The rule requires that a designated, qualified individual identify beryllium activities and describe them in the site's written CBDPP.

Beryllium-containing material and beryllium-contaminated equipment and other items generated by an identified beryllium activity and destined for disposal would be presumed to be beryllium waste unless evidence or logic supports a conclusion that it is not. Also (under the 10 CFR 850 [1] provisions), beryllium waste would meet one of the following criteria based on process knowledge, calculation and analysis, and/or sampling:

- Elemental beryllium, insoluble beryllium compounds (e.g., beryllium oxide), and any alloy containing 0.1 percent or greater beryllium by weight that is destined to be disposed of as waste;
- Equipment with removable beryllium contamination (internal or external) exceeding, or potentially exceeding, 0.2 µg/100 cm²;
- Building materials and demolition debris containing beryllium exceeding 0.1 percent (w:w) (1,000 parts per million); or
- Job-associated materials such as gloves, booties, and disposable coveralls coming from a regulated area or from an area where the beryllium can reasonably be expected to exceed 0.2 µg/m³ in air or 0.2 µg/100 cm² removable from surfaces (unless it can be demonstrated that the material could not become contaminated through the use of isolation techniques such as placing a clip-board inside a plastic bag for a walkthrough of the area).

Waste streams that may contain beryllium that meet the above criteria often are highly variable in terms of the matrix and concentration. A qualified individual (e.g., an industrial hygienist) can determine the conditions under which a waste stream, or part of a waste stream, should be designated as beryllium waste. Naturally occurring beryllium in background soil is not considered to be beryllium in 10 CFR 850 [1] and therefore does not contribute to a material being designated as beryllium waste. It also is worth mentioning that certain beryllium-containing materials may be subject to the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations (40 CFR 261 – 268 [6]). Under RCRA, a waste is generally defined as any “discarded material.” For instance, discarded “beryllium powder” has been designated as a RCRA listed hazardous waste (EPA Hazardous Waste No. P015) and must be managed in accordance with the applicable RCRA hazardous waste requirements.

This listing [see 40 CFR 261.33(e) [6]] applies to beryllium powder that is an unused commercial-grade chemical product. In addition, certain beryllium-contaminated materials or equipment to be disposed may also be subject to the RCRA hazardous waste requirements if the waste (that the beryllium is contained in) also exhibits a characteristic of hazardous waste as described in 40 CFR 261.20 – 261.24 [6] (ignitability, corrosivity, reactivity, or toxicity).

The Alpha 5 LMR project has already removed all chemicals that were in the facility and properly disposed of them. Additionally the project has completed a listed waste determination documenting that there are no listed waste issues associated with the LMR project.

EPA AND STATE OF TENNESSEE REQUIREMENTS

The EPA regulated waste disposal through 40 CFR. As discussed in the section above, the EPA only regulates beryllium as a listed waste for RCRA. The Alpha-5 LMR project has no listed RCRA waste. Although the Tennessee Department of Environment and Conservation (TDEC) administers the federal program and has the authority to add additional constraints on it, TDEC has not added any additional requirements on beryllium waste disposal.

ANALYTICAL DATA RESULTS

During the sampling process to characterize LMR material for EMWMF 319 samples were collected. The calculated 95% upper confidence limit (UCL)-95 is 143 mg/kg. The five highest results were 317 mg/kg, 35.8 mg/kg, 33.1 mg/kg, 10 mg/kg, and 5.49 mg/kg. The minimum, mean and maximum are listed below in Table 2.

Table 2. Beryllium Analytical Results for Alpha-5 LMR

# Samples Collected	Min a (mg/kg) b	Mean (mg/kg) b	Max c (mg/kg) b
319	0.056	1.617	317
Key: a min – minimum b mg/kg – milligrams per kilogram c max – maximum			

TEST CASE FOR INDUSTRIAL HYGIENE (IH) CONTROLS OF BERYLLIUM WASTE

Recent lessons learned from the Foundry Decontamination Project, which focused on reducing Personal Protective Equipment (PPE) needed for previous beryllium contamination operating areas, has provided techniques for decontamination and encapsulation useful to the Alpha 5 Project. It is worth noting that Y-12 does comply with the 10 CFR 850 [1] beryllium rule, which requires the DOE action levels to be 10 times less than the OSHA Permissible Exposure Limit (PEL).

The Foundry in Building 9202 had historical beryllium operations conducted during its operating history. B&W changed the mission of the facility and the building needed to be decontaminated for a future, non-beryllium mission. The beryllium levels exceeded the B&W Y-12 contamination criterion of 0.2 µg/100 cm² in the range of detectable to approximately 300 µg/100cm² levels. The Foundry Decontamination Project utilized effective housekeeping, decontamination and encapsulation to remove legacy equipment for waste transport and disposal and to mitigate the remaining Foundry facility conditions (structures and equipment) such that required PPE could be significantly reduced. During the months following the project, IH performed personnel breathing zone and area air samples on all Foundry activities and have demonstrated that routine airborne levels were below the action level of 0.2 µg/m³. Of the hundreds of air samples collected the high was 12 µg/m³, the majority were non-detects (below 0.01 µg/m³) with an average of less than 0.2 µg/m³(the action level). Similarly, surface smear results from established IH survey routines remain <0.02 µg/100cm².

Alpha 5 will utilize the same encapsulation processes (CP240 and Speed Hide) to encapsulate and fix the contamination to the surface. The encapsulant will be applied with garden sprayers to render the contamination inaccessible. Because the LMR project is solely for disposal, there is no intent to decontaminate as a general process.

Alpha-5 has implemented this process on the second and fourth floors on beryllium waste which was shipped to NTS. The industrial hygiene group collected smears and airborne data while this work was on-going. These results document the effectiveness of this process. The results included some smears of surfaces that had been scratched and the fixative removed. The smears documented the fact that the beryllium contamination remained bound within the matrix.

FACILITY CONTROLS

Facility controls implemented for potential beryllium contamination include managing beryllium regulated and buffer areas through administrative posting of areas to control potential sources and to minimize spread of contamination. The beryllium contaminated legacy waste has been characterized as either:

- Beryllium detectable waste based on process knowledge and/or analytical data. Waste may be assumed to meet the definition of beryllium detectable if statistical sampling to verify that it meets free release criteria would add extraordinary or unnecessary cost for disposal
- Beryllium regulated waste based on process knowledge and/or analytical data

Multiple contamination control systems for beryllium contaminated on legacy waste have been implemented using a graded approach under the direction of IH personnel assigned full time to the project:

- Housekeeping – routine wet mopping, spray waxing utilizing garden sprayers, and use of floor scrubbers as a dust control measure
- Methodically controlled egress of personnel (slow and deliberate doffing techniques, incorporation of several controls to limit the potential spread of contamination)
- Use of step off pads, garden sprayers/misters, and HEPA vacuums at doffing stations
- Airless sprayers/garden sprayers in work areas applying water and/or surfactants as a dust control measure

SPECIFIC PRE-PACKAGING ACTIVITIES

Prior to packaging, the following actions will be taken:

- The Y-12 Project IH will review the beryllium work practices and controls and certify in writing that the different or modified controls are adequate to “reduce potential airborne levels of beryllium to below applicable regulatory limits” or “reduce potential airborne levels of beryllium to below the permissible exposure limits (PELs).” This may be documented on the Beryllium Work Plan (BeWP).
- The Y-12 Project IH will recommend areas where spray encapsulant should be used, if needed, for “lockdown” of beryllium to prevent airborne releases during mechanical demolition. These and other controls identified through inspections may be documented in the work package.
- Beryllium waste will be loaded in a beryllium buffer area or in an enclosure. A schematic of a typical enclosure is shown below in Figure 1.

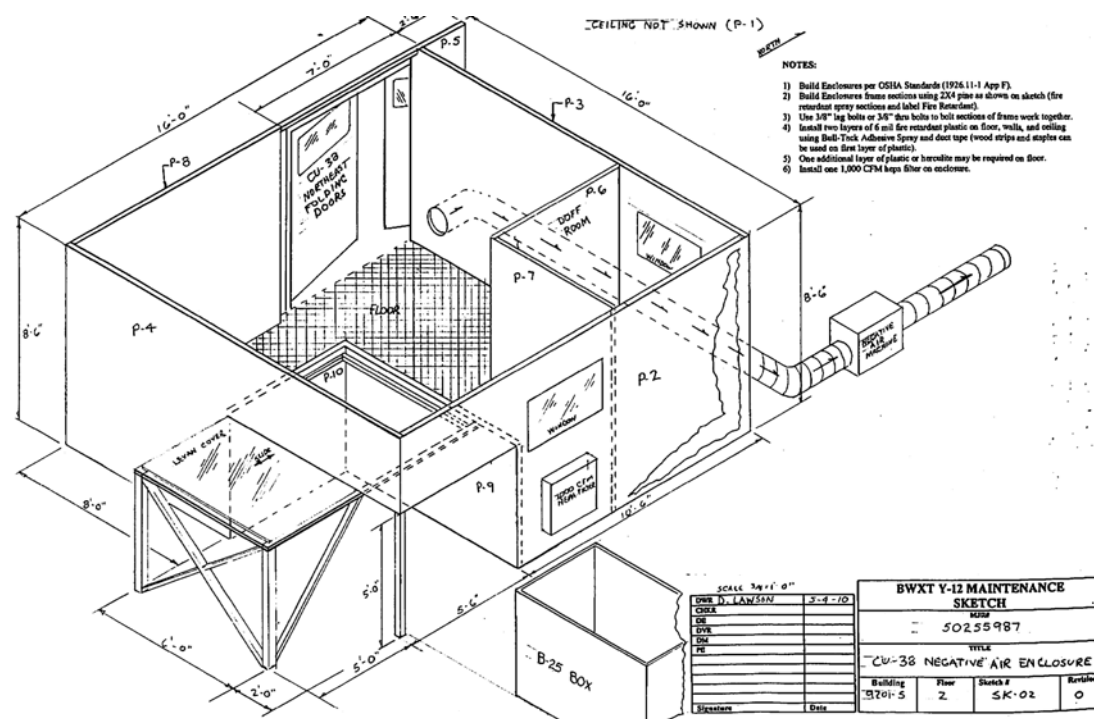


Figure 1. Typical B&W Y-12 Building 9201-5 Beryllium Enclosure

ENCAPSULATION PROCESS

Apply fixative (CP-240 and then if needed Commercial Grade Speed Hide paint, commercial grade fixative such as Fiber-Loc PM) as a control prior to disturbing or moving items. The areas will have been surveyed for beryllium and both swipe and analytical samples will have been collected. All items in the beryllium regulated area will be encapsulated. Within the buffer areas, beryllium waste will be double wrapped or double encapsulated. The project may use encapsulation in the buffer area, if the project IH determines encapsulation should be used.

A Material Safety Data Sheet (MSDS) for the encapsulant material to be utilized is attached. Cp-240 will be used as the primary fixative. If after CP-240 is applied, the airborne levels are not reduced to the level anticipated Speed Hide will be applied. Painting will completely cover exposed surfaces of equipment and material to be encapsulated utilizing high quality paint (e.g. Commercial Grade Speed Hide) or Y-12 IH approved alternative. Painting of encapsulant will be minimized to reduce overspray to buffer areas and legacy waste already characterized. This method was utilized successfully in the 9202 Foundry Decontamination Project.

Additional Specific Work Controls

Additionally, through the work control process:

- Equipment dismantling and material handling practices will be chosen to minimize airborne suspension of beryllium.
- Beryllium material shall not be intentionally subjected to sanding, grinding, or abrading. Although heavy machinery may be used to size reduce the LMR, carry debris, or load debris into containers, debris may not be run over repeatedly with heavy machinery during the demolition and waste packaging process.
- All conveyances shall comply with other applicable transportation requirements for waste packaging as mandated by the Y-12 Waste Management and Transportation Group.
- Y-12 Project Industrial Hygiene monitoring data will be reviewed to confirm that airborne levels of beryllium do not exceed applicable regulatory limits.

Packaging Process

Supersacks

Supersacks will be soft-sided shipping/storage containers that meet the requirements for Department of Transportation (DOT) Industrial Packaging Type 1 (IP-1) or greater (IP-2). The container may be used for solid radioactive material including Low Specific Activity (LSA-1) Objects, Surface-Contaminated Objects (SCO-1), and other material which requires the use of a DOT IP-1 packaging. The soft-sided shipping container will be selected in accordance with the attached B&W packaging specifications. In addition, example vendor specifications have also been included. The following methods will be taken to prevent punctures, rips, and tears of the supersacks:

- Additional padding will be used because the equipment and materials with irregular shape;
- Equipment and waste loaded into supersacks will undergo an evaluation by B&W Waste Engineers to ensure that the internal voids have been filled. Uses of operator aids and void space packages have been developed to assist the waste engineers in making these determinations. These documents provide specific guidance on what items need to be removed from equipment to ensure that the void spaces are filled to the maximum extent practical, which will be a minimum of 90% filled;
- Void space contained in the supersacks will be reduced by utilizing guidance from the manufacturer;
- Weight and fill specifications for each package will be strictly followed as directed by the manufacturer and feedback from EMWMF;
- Package will be labeled in accordance with 10 CFR 850.38(b)(2) [1]; and
- The exterior of all supersacks that enter the beryllium and beryllium regulated areas will be smeared and verified to be below 0.2 ug/100 cm², the beryllium release levels allowed before shipping in accordance with Y73-201 [2].

Boxes

Some waste may be placed into IP-1 containers. These strong tight boxes will be grouted to address void spaces.

- Boxed waste may undergo additional void space fill using gravel or grout prior to direct placement at EMWMF. Due to weight restrictions on packages this activity shall be performed at EMWMF.
- The exterior of all boxes that enter the beryllium and beryllium regulated areas will be smeared and verified to be below $0.2 \mu\text{g}/100 \text{ cm}^2$, the beryllium levels allowed before shipping in accordance with Y73-201 [2].

Double – Wrapped

Some items may be double wrapped in impermeable plastic. These items will either be compliant with the PWAC (less than 40 pounds) or shipped as single debris items requiring placement at EMWMF.

Double- Encapsulated

Some waste may be double encapsulated to ensure all beryllium dust is encapsulated. This will be determined by Industrial Hygiene and used on large items with specific safety issues, such as hoisting and rigging. Transportation will then decide the packaging requirements for these single items to ensure compliance with DOT.

BERYLLIUM CONTROL STRATEGY

A comprehensive approach has been implemented within the Alpha 5 Facility to manage beryllium contamination and to minimize the spread of beryllium in accordance with the DOE approved B&W Y-12 Chronic Beryllium Disease Prevention Program Manual, Y73-201 [3].

PREPARATION OF WASTE FOR SHIPMENT

Beryllium waste shall be packaged in a buffer area or in an enclosure to prevent the contamination of the shipping container. To further monitor and verify that the level of beryllium is minimized, IH will continue utilizing engineering, administrative, and PPE controls. The effectiveness of these controls will be verified by several methods including personal air monitoring, area sampling, and weekly smears of all buffer areas. This will allow IH to monitor the effectiveness of the facility's housekeeping and engineering controls in place in the facility. Beryllium buffer areas will be maintained and verified below $0.2 \mu\text{g}/\text{cm}^2$. Waste items shall be prepared for shipment and disposal by one of the following means (see Figure 2):

- 1) Encapsulated with painting methods approved by Y-12 Industrial Hygiene (IH) and placed in boxes for disposal.
- 2) Encapsulated with painting methods approved by Y-12 Industrial Hygiene (IH) and wrapped using 6-mil polybags and placed into a soft sided shipping/storage container (Supersack). Note: The impermeable wrapping may be a 6-mil bag liner.
- 3) Wrapped and placed in an IP-1 container for disposal. Note: The impermeable wrapping may be a 6-mil box liner.
- 4) Single-encapsulated and single-wrapped with 6-mil poly.
- 5) Double wrapped in 6-mil polybags.
- 6) Double-encapsulated and shipped for direct placement.
- 7) Double-bagged and less than 40 pounds (compliant with the PWAC).

PACKAGING AND CONTAMINATION CONTROL OF THE CONVEYANCE

- Waste material and equipment that are encapsulated will be placed into shipping/storage containers that meet the requirements for Department of Transportation (DOT) Industrial Packaging Type 1 or 2 (IP-1 or 2).
- The waste material will be packaged to ensure the packaging will remain below regulatory beryllium limits.
- Surface smear sampling will be conducted to establish baseline beryllium levels in transport equipment. This will be done for all vehicles prior to their initial shipments in accordance with Y-12 IH and Transportation procedures.
- Each container (e.g., bag or box) will be labeled in accordance with 10 CFR 850.38(b) (2) [1].

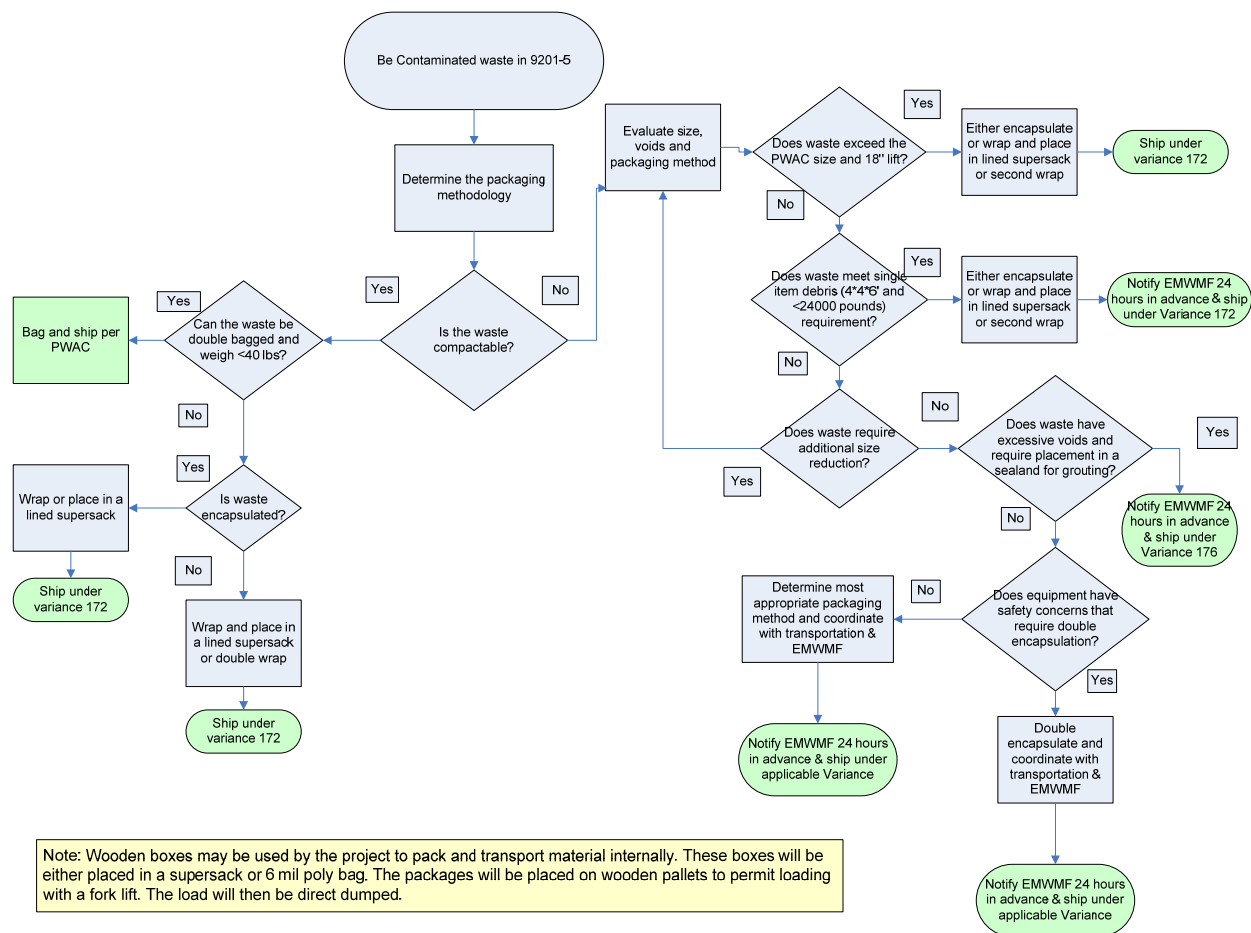


Figure 2. B&W Y-12 Building 9201-5 Beryllium Waste Strategy Flow Diagram

PACKAGING SPECIFICATIONS

Waste will be packaged into Supersacks containers or boxes both of which meet or exceed the IP-1 criteria, double-wrapped or double encapsulated and packaged.

Supersacks

Supersacks utilized by the Alpha-5 Project for disposal will be a soft sided shipping/storage container that meets the requirements for Department of Transportation (DOT) Industrial Packaging Type 1 (IP-1). The container will be used for solid radioactive material including Low Specific Activity (LSA-1) Objects, Surface-Contaminated Objects (SCO-1), and other material which requires the use of a DOT IP-1 packaging.

The soft sided shipping container will either have lifting fixtures that enable the waste to be lifted and directly placed into the designated location within Environmental Management Waste Management Facility (EMWMF) or be direct placed by dumping.

Items that exceed the weight capacity or other limitations of the soft-sided shipping/storage container (e.g., sharp objects that could cut the Supersacks) will be evaluated for segmentation, alternative packaging (wrapped, boxed and void fill or double wrapped with voids filled) and disposal at EMWMF.

Boxes

Boxes will be filled to the maximum extent practical. The lids will be compatible with the grouting equipment to be used at the EMWMF. Boxes will be shipped on a flat-bed truck.

Double- Wrapped

Double wrapped items will be shipped in an intermodal or dump truck for direct dumping or on a flat-bed if the items are large and require direct placement.

Double- Encapsulated

Double-encapsulated items will be shipped on a flat-bed. The transportation, weight, and unloading requirements shall be communicated in advance to EMWMF. Additionally any grouting or filling requirements will be coordinated in advance.

COMPLIANCE MONITORING

B&W has been disposing of Alpha-5 fourth floor beryllium waste at the Nevada Test Site (NTS) until EMWMF Waste Lot Profiles could be developed and approved. This waste is similar to the waste on the third and first floors that will be sent to EMWMF, because the waste on all four floors is excess equipment, furniture, and general debris from machining operations. Air samples were collected and analyzed. The air samples were both personal air samples and area samples. All of the air samples were well below the action level of 0.2 $\mu\text{g}/\text{m}^3$.

AIRBORNE BERYLLIUM SAMPLING STRATEGY

Both area and personal air samples for beryllium will be collected during the LMR. According to a hazard analysis/assessment conducted in accordance with 10 CFR 850 [1], the workers performing dismantlement and packaging have the greatest potential to generate airborne levels of beryllium. For this reason, full work shift samples will be collected on these individuals. The results of these samples will be time weighted to reflect a 10-hour work shift.

Area samples will be collected at multiple locations along the work area boundary. These sample locations will be equally spaced, as feasible, to monitor any potential release of material outside of the work area and to verify that established work area boundaries are adequate to protect any personnel outside defined boundaries of the work area.

Outside boundaries of the Alpha-5 facility are periodically monitored for beryllium to ensure acceptable levels are maintained.

ANALYTICAL SAMPLE RESULTS

Air monitoring results will be reported to project supervision and to those employees who have been sampled. The data will be stored electronically in the Y-12 Industrial Hygiene Analytical System. Summaries will be available for project personnel review and will be provided to the EMWMF Project IH Lead upon request for reference. Additionally, any negative exposure assessments developed through the monitoring of initial demonstration of work tasks will be made available to EMWMF management upon request. (Note: Periodic personal breathing zone monitoring and daily perimeter monitoring will continue if negative exposure assessments are achieved.)

DISPOSAL REQUIREMENTS

Waste generated will be packaged and disposed in accordance with the approved waste lot profile and Attainment Plan for Risk/Toxicity-Based Waste Acceptance Criteria at the Oak Ridge Reservation, Oak Ridge, Tennessee (DOE/OR-01-1909&D3) [7].

JUSTIFICATION FOR PROPOSED PURPOSE

Recent lessons learned from the Foundry Decontamination Project, which focused on reducing Personal Protective Equipment (PPE) needed for previous beryllium contamination operating areas, has provided techniques for maintaining safe work areas, decontamination and encapsulation of equipment/material, and waste, all of which are useful to the Alpha 5 Project. The Foundry in Building 9202 exceeded the B&W Y-12 contamination criterion of 0.2 $\mu\text{g}/100\text{ cm}^2$ in the range of detectable to approximately 300 $\mu\text{g}/100\text{cm}^2$ levels. The Foundry Decontamination Project utilized effective housekeeping, decontamination and encapsulation to remove legacy equipment for waste transport and disposal and to mitigate the remaining Foundry facility conditions (structures and equipment) such that required PPE could be significantly reduced. During the months following the project, IH performed personnel breathing zone and area air samples on all Foundry activities and have demonstrated that routine airborne levels are acceptable. Similarly, surface smear results from established IH survey routines remain $<0.02\ \mu\text{g}/100\text{cm}^2$.

CONCLUSION

By controlling the potential surface contamination for beryllium through implementation of comprehensive controls at the source by the Alpha 5 Facility and the Alpha 5 Legacy Material Disposition Project, beryllium contaminated materials can be managed, packaged and transported for disposal at EMWMF utilizing methods that control potential releases of airborne beryllium contamination and surface contamination to levels that are as low as practicable in accordance with 10 CFR 850.25 [1]. Previous use of the materials and techniques included in this paper have been effectively implemented to control the potential surface contamination of beryllium. Source controls described within this technical document, an additional final layer of protection offered by soft-sided or boxed packaging and direct placement into EMWMF at predesignated locations within EMWMF ensure beryllium waste disposal from the Alpha-5 LMR Project can be accomplished safely and compliantly.

REFERENCES

1. U.S. Department of Energy, *Chronic Beryllium Disease Prevention Program*, 10 Code of Federal Regulations 850, December 1999.
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